Fisheries Centre

The University of British Columbia

Working Paper Series

Working Paper #2014 - 15

Reconstruction of Total Marine Fisheries Catches for Bangladesh: 1950-2010

Hadayet Ullah, Darah Gibson, Danielle Knip,
Kyrstn Zylich and Dirk Zeller

Year: 2014

Email: hadayet127@gmail.com; d.gibson@fisheries.ubc.ca

Reconstruction of total marine fisheries catches for Bangladesh: 1950-2010

Hadayet Ullah[a], Darah Gibson[b], Danielle Knip[b], Kyrstn Zylich[b], and Dirk Zeller[b]

[a] *WorldFish – Bangladesh Office, House 22B, Road 7, Block F, Banani, Dhaka 1213, Bangladesh*
[b] *Sea Around Us, Fisheries Centre, University of British Columbia*
2202 Main Mall, Vancouver, BC V6T 1Z4, Canada
hadayet127@gmail.com; d.gibson@fisheries.ubc.ca; d.knip@fisheries.ubc.ca; k.zylich@fisheries.ubc.ca; d.zeller@fisheries.ubc.ca

Abstract

We reconstructed the marine fisheries catches for Bangladesh in the Exclusive Economic Zone (EEZ) from 1950-2010. FAO catch statistics are used as the reported landings baseline and adjusted using information from national reports, independent studies, local experts and grey literature. Adjustments are estimates of illegal, unregulated and unreported (IUU) catch in the form of under-reported commercial catch, discarded by-catch and subsistence catches. The reconstructed total catch of Bangladesh, including estimates of discards, unreported commercial catch and subsistence catch, increased from just under 225,000 t·year^{-1} in the 1950s to 867,000 t·year^{-1} in the 2000s. In contrast, the catch reported by FAO on behalf of Bangladesh increases from 34,000 t·year^{-1} in the 1950s to almost 470,000 t·year^{-1} in the 2000s. Overall, the reconstruction is 157% higher than the landings reported by FAO on behalf of Bangladesh. Unreported subsistence catches contribute 45% of the total reconstructed catch. Bombay duck (*Harpadon nehereus*) is the most important species in the subsistence reconstruction, representing over 12% of the total subsistence catch. Hilsa shad (*Tenualosa ilisha*) represents 18 % of the total reconstruction and is the greatest single species contribution. The discrepancies between the reported baseline and the reconstructed catch are mostly due to subsistence catches that are unreported to the FAO. Our results demonstrate the importance of monitoring IUU catches for all sectors of national fisheries.

Introduction

Bangladesh is a low-lying South Asian Country of 147,570 km^2, situated between India and Myanmar and bordered by the Bay of Bengal in the south (Figure 1). Bangladesh has a population of 156 million, of which 23% (35.1 million) live in the coastal zone (Islam 2004). In 1947, when British India was partitioned, Bangladesh (labeled east Pakistan) became part of the newly independent Pakistan. However, Pakistan's history from 1947 to 1971 was marked by political instability, economic difficulties and a continuous increase in friction between East and West Pakistan. This resulted in a new independent country named Bangladesh in 1971.

Bangladesh is endowed with substantial marine resources in the Bay of Bengal (BOB), with great potential for fisheries. In 1974, after the declaration of the 200 nautical miles (nm) Exclusive Economic Zone (EEZ), the country gained an area of 166,000 km^2 under its economic jurisdiction for exploration, exploitation, conservation and management.

According to recent studies, at least 444,000 people are involved in coastal and marine fisheries (DANIDA-DFID 2003). The marine capture fisheries represented 22 percent of the total reported fishery landings by volume in 2001-2002. The marine capture fisheries of Bangladesh exploit a complex, multi-species resource, and can be subdivided into subsistence (small-scale, non-commercial), artisanal (small-scale, commercial) and industrial (large-scale, commercial) fisheries sectors. Among the commercial catch, more than 90% is landed by artisanal fishing vessels, while industrial fisheries contribute around 6% to the total landed catch (Ahmad 2004). Little is known about the fisheries of Bangladesh during the 1950s. It is reported that approximately one-third of the total landings (40,000 t) of marine fish in Pakistan were caught in East Pakistan (Rahimullah 1950). Set bag-nets (SBN) were the most popular gear and extensively used in the waters of East Pakistan. Hilsa shad (*Tenualosa ilisha*) was caught in large quantities and represents the largest portion of commercial landings for that time.

Figure 1. Bangladeshi EEZ and shelf waters (<200 m depth) in the Bay of Bengal.

Unfortunately, there are no statistics of fisheries catch in Bangladesh readily available until the early 1980s, nor was there any statistical system for collection of fisheries data. Thus, estimates were of a conjectural nature rather than based on actual field surveys (Mohiuddin *et al.* 1980). However, the Bangladesh Fisheries Development Corporation (BFDC) was established in 1964 to promote the fishing industry, particularly in the marine sector. According to a survey conducted by the BFDC, the estimated marine fish catch (excluding the estuarine catch) was approximately 99,000 t in 1967-68. The eastern coast of Bangladesh, namely Chittagong, accounted for 70% of the total marine catch, followed by the central coast (Noakhali), Barisal, Patuakhali and Khulna districts (south coast). Around 95% of the total marine catch is reported as being caught in near-shore waters by artisanal fishers using mostly gill nets and SBN. The BFDC, in collaboration with the Food and Agriculture Organization (FAO) and the United Nations Development Programme (UNDP), estimated about 9,500 sail boats and 41 mechanized vessels operated in Bangladeshi waters in 1967-68. The major target taxa were Hilsa shad, sea catfishes (Ariidae), Indian threadfin (*Eleutheronema tetradactylum*), Indo-Pacific king mackerel (*Scomberomorus guttatus*), herrings (Clupeidae), Bombay duck (*Harpadon nehereus*) and sharks and rays.

Commercial trawling in offshore waters of Bangladesh commenced in 1972 with the introduction of 10 trawlers (Rahman 1999). Some commercial shrimp grounds were also identified in 1976 and 1977. Consequently, Bangladeshi entrepreneurs and foreign firms became interested in shrimp trawling. After independence, between 1972 and 1980, the Government issued permission for a total of 140 trawlers. Thus, during the 1970s, traditional small-scale boats (non-mechanized and mechanized) as well as large-scale commercial trawlers exploited coastal and off-shore waters. Yet, during the 1970s, surveys were the major source of annual catch estimation, while quantitative marine catch reporting by specific taxa was not available. A survey conducted in 1972 estimated the total marine fish catch (excluding the estuarine catch) to be 100,000 t (Mohiuddin *et al.* 1980), 95 % of which came from artisanal fisheries. Set bag-nets was found to be the most important fishing gear yielding more than 42% of the total marine catch followed by set and drift gillnets which account for 33%, while seine nets, longlines, and cast nets account for 7%, 6% and 6%, respectively. In the 1970s, the landed taxa proportions do not seem to vary significantly except for an increase in shrimp landed. However, after the introduction of commercial trawl fisheries, it became more important to have a comprehensive catch monitoring system and better management of the fishery resources of Bangladesh.

The Fisheries Resources Survey system (FRSS) was initiated with the financial and technical assistance of FAO/UNDP in order to achieve some management objectives. Finally, in 1984, a system was developed for collection of catch statistics as well as a manual for survey methodology (Hoq and Haroon 2012). The objective of the catch assessment survey was to publish a Fisheries Statistical Yearbook of Bangladesh with particular emphasis on the hilsa fishery. In 1980 and 1981, there were 412,000 fishers, while for 1983/1984 the number of fishers is estimated at 515,000, indicating an annual increase of 8% (Rahman *et al.* 2003). In 1984 and 1985, a frame survey of traditional and mechanized boats carried out by FRSS of the Department of Fisheries (DOF) estimated a total of 17,331 boats operating in the marine artisanal fishery, of which 3,317 were mechanized. The major gear employed was SBN (12,615) and gillnets (6,889), followed by trammel-nets, longlines and beach seines (Anon. 1985).

Though the catch assessment survey provides very valuable fishery data, there are limitations in the survey and data collecting methodology. These limitations relate to sample size and sampling procedure in the complex and changing coastal fisheries system of Bangladesh, and they require more attention. Bangladesh has a centralized fisheries management system, under the Department of Fisheries, where three principal directors and principal scientific officers implement management measures through district and sub-district offices (De Young 2006). Their focus is to ensure food security (De Young 2006). The marine wing of the Department of Fisheries was established in the 1980s, however, a rigorous effort to survey, monitor and manage marine fisheries is only recently observed. An initiative to strengthen the Marine Fisheries Resources Survey Unit (FRSU) with regards to sampling procedures and assessment of fisheries resources has been launched in the last decade. Therefore, the data collection procedure is much improved and data are available for specific taxa during the last few years. At present, BFDC operates six major fish landing centers in the coastal districts at Chittagong, Cox's Bazar, Khulna, Barisal, Patherghata and Khepupara, and the FRSU has about 14 landings/sampling points along the coast. FRSU collects landing data from these units as well as performs lab analysis on catch composition to ensure data quality.

Presently, marine catch contributes around 19.4% to the total fish catch of Bangladesh, and of this approximately 90% is landed by artisanal fishers. The commercial sector has an estimated 22,500 non-mechanized and 21,400 mechanized fishing boats. Due to the adverse impact of trawling, trawler fleets were reduced to around 100 vessels and joint ventures between Thailand and Bangladesh were stopped. The major shrimp and fish species that are currently exploited by trawl nets are giant tiger prawn (*Penaeus monodon*), banana prawn (*Fenneropenaeus merguiensis)*, Indian white prawn (*Fenneropenaeus indicus*), speckled shrimp (*Metapenaeus monoceros*), yellow shrimp (*Metapeneaues brevicornis*), hairtail (Trichiuridae), silver pomfret (*Pampus argentus*), goatfish (Mullidae), catfishes, croakers (*Sciaenidae*), Bombay duck (*Harpadon nehereus*) and other lizard fish (Synodontidae). It is noteworthy that a large quantity of by-catch caught by the shrimp trawler is generally thrown overboard. Thus, discards may be up to 80% of the actual catch, which is equivalent to 30,000–35,000 t annually (Rahman *et al.* 2003).

A shift in commercial fin fish species has been observed and catch per unit effort (CPUE) in the shrimp fishery is steadily decreasing and is approximately 50% of CPUE from the early 1990s (Hussain and Hoq 2010). This is assumed to be due to the combined impact of trawling and destructive SBN fisheries (Nabi and Ullah 2012). These methods of fishing have been destroying the coastal resource base over the last 20 years. SBN fishery is still the dominant gear type in artisanal fisheries. The pressure of small-scale subsistence fisheries on the marine resources cannot be ignored, yet, there are no data pertaining to this sector. It would be useful to know the exact status of fisheries and to formulate proper management measures based on that knowledge. Therefore, the present study aims to more accurately quantify total marine fisheries catch from the EEZ waters of Bangladesh, by taking into account all fisheries sub-sectors and illegal, unregulated and unreported (IUU) fisheries; including subsistence catch and discarded by catch.

Materials and methods

FAO reports annual landings statistics (Fishstat) on behalf of Bangladesh for marine fisheries since 1950, and these data are considered as the reported landings baseline for this reconstruction. FAO data on behalf of Bangladesh were compared to national landings data. In general, catch data from 1984 to 2010 represent a better picture of the fisheries, yet, there are considerable gaps in catch data throughout the time series. Therefore, the total marine fisheries catches were estimated using information obtained from national reports, independent studies, local experts and grey literature.

Population

The Center for International Earth Science Information Network (CIESIN 2012) provides coastal rural and coastal urban population data for Bangladesh for 1990, 2000 and 2010. Therefore, Populstat[1] data were used to calculate the proportions of coastal rural and coastal urban populations in relation to the total population, with the 1990 fraction carried back to 1950. Population numbers are interpolated between 1990 and 2000, as well as 2000 and 2010.

Commercial fisheries

Artisanal fisheries

Artisanal (i.e., small-scale commercial) fisheries catches are estimated using anchor points. In the absence of reliable data for a particular taxonomic group, anchor points are created using the ratio of catch composition of different gears for a particular year which are most similar to the surrounding years. Bombay-duck, one of the major target species in artisanal fisheries, represents data only for the years 2005 to 2010. More than 80% of the catch of this species comes from SBN and gill net fisheries. The number of nets deployed (i.e., effort), both for SBN and gill nets, are available for 2008, however, for the earlier years, only SBN data are available. Therefore, we use the SBN fishery as an effort proxy and estimate an annual landing of 3,211 t in 1982 which also includes catch from the gill net fishery (10% of SBN landing). Similarly, a total of 1,286 t is estimated for 1966, and we assume 90% of the 1966 catch as the anchor point for 1950. The establishment of the 1950 anchor point is based on the assumption that Bombay-duck always had a significant contribution in the landings of East Pakistan marine fisheries. In fact, Bombay-duck was reported to be abundant in the waters of East Pakistan during this time (Bapat 1970). Finally, linear interpolations are applied between anchor points for years without data to derive a complete time series.

Hilsa shad is by far the overall most important fishery in Bangladesh. This species has the best representation in the FAO data for Bangladesh marine fisheries, particularly after 1984. Ahsanullah (1964) reported a catch of approximately 7,000 t of Hilsa from the marine waters of Bangladesh for 1957. An assumption-based anchor point of 5,000 t in 1950 is chosen, considering that Hilsa was the major contributor in the landings of East Pakistan fisheries (Rahimullah 1950). A linear interpolation connects the anchor points in 1984, 1957 and 1950. Indian threadfin, mainly targeted by large mesh drift gill nets (LMD), is considered an important fishery of East Pakistan (Shomura 1971) as well as Bangladesh after independence. Catch data of this fishery are not reported separately until the last decade of the time series. Some catch composition statistics for mechanized boats, collected by the BFDC, reveal that Indian threadfin accounts for 8.1%, 5.8%, 1.8%, 4.9%, and 1.1% of the total catch for 1967, 1973, 1976, 1979 and 1980, respectively (Zobairi 1970; Mohiuddin *et al.* 1980). These ratios are used to calculate the anchor points for corresponding years. Thus, a total of 5,832 t catch is calculated for 1967, and two-thirds of this is assumed to represent the 1950 catch.

During the 1980s, the bulk of shrimp catch in artisanal fisheries came from SBN fishery, although the proportion of shrimps in the catch is not known (Van der Knaap 1989). The offshore SBN catches consist of 21% shrimp (Akerman 1986). Nevertheless, Van der Knaap (1989) estimates a total of 6,000 t of shrimp by applying a conservative proportion of 10% of the total SBN production for 1984. A catch of 4,000 t is assumed for 1950 and linear interpolation connects the anchor points for intervening years. Mostly penaeid shrimps are targeted, however, a significant amount of Jawla paste shrimp (*Acetes indicus*) is present in artisanal crustacean landings. Since jawla paste shrimp is a comparatively low value species, less attention is paid to this fishery. However, Ullah (2007) notes the significant contribution of this species, in terms of weight, and calculates a ratio of 40.5%, 50.3%, 35.1% and 10.0% of the total crustacean landings for 2007, 2004, 1987 and 1980, respectively. Thus, jawla paste shrimp yields a total catch of 576 t for 1980 and a conservative assumption of 10% of the 1980 catch (i.e., 57 t) is assigned for 1950, assuming that the species had a lower contribution during the 1950s (Nabi and Ullah 2012).

FAO landing statistics for the uninformative pooled category ‘marine fishes nei’ refer to a group of miscellaneous species that are not considered with the same importance as Hilsha fisheries. Nevertheless, considering the importance of these fishes, we disaggregate this group into five major groups/species (silver pomfret, ‘jewfish’ [croakers], gobies, silver croaker, and anchovies). Silver pomfret (*Pampus argenteus*) is usually caught by gillnets and partly by SBN in Bangladesh. A survey conducted by DOF (Anon. 1985) counts a total of 19,504 nets (gillnet and

[1] http://www.populstat.info/

SBN) in 1985 which is used to calculate a CPUE of 0.26 t·net^{-1}. Using this CPUE, a total catch of 2,072 t is assigned for 1968. Landings data show that the total marine catch increases by 3.25 times between 1950 and 1968. Thus, using this ratio, a catch of 637 t is calculated for silver pomfret in 1950. Finally, linear interpolations are applied between anchor points for years without data to complete the time series. 'Jewfish', mostly members of the family Sciaenidae (croakers), are another common and commercially important group (Zafar *et al.* 2000). A report in regards to species-wise catch composition of mechanized boats at Cox's Bazar (Mohiuddin *et al.* 1980) mentions that jewfish account for 1.3%, 1.4% and 3.2% of the total catch for 1968, 1970 and 1972, respectively. These ratios are used to calculate the landings for these years and a total of 338 t catch is assigned in 1950 following the same principle as for pomfret.

Gobies (Gobiidae) are also extensively caught in the estuarine set bag-net (ESBN) fishery in the inshore water of Bangladesh, but are not specifically reported given the family's low commercial value. It is noted that this group accounts for 15.3% and 5.2% of the total SBN catch in 1987 and 2005, respectively (Huntington *et al.* 2007). A total of 5,221 t is assigned for 2008 (Ullah 2007), while 1,220 t is calculated for 1950 following the same principle as for pomfret. Silver croaker (mainly *Pterotolithus maculates*) is reported to contribute 5,180 t of total landings in 2008 (national statistics) while a total of 2,850 t is accounted for in 1991 (Huq *et al.* 1993). Of this quantity, 93% is from the longline fishery and the rest is from the SBN and trammel net fisheries. The longline fishery was introduced in 1970 and considering that only SBN and trammel net contribute catch back to 1950, we assume 2,280 t catch (80% of 2,850 t in 1991) for 1970 and 200 t (7% of 2,850 t in 1991) for 1950. Anchovies, mostly consisting of *Setipinna taty, Setipinna phassas, Coilia dussumier,* and *Thryssa* spp., are considered in the breakdown of 'marine fishes nei'. This group is reported to contribute 2.8% (Huntington *et al.* 2007) and 4.4% (Nabi and Ullah 2012) in 1985 and 2008, respectively. In 1991, anchovy is reported to contribute 9.5% of total SBN catches and thus a total catch of 4,921 t is calculated from total SBN landings (51,805 t in 1991), and 184 t is assigned for 1950.

Catfishes (Ariidae) are reported to contribute 2.5% to the landings of ESBN on the coast of Chittagong in 1987 (Huntington *et al.* 2007). To remain conservative, this ratio is used to calculate landings (from total SBN catch) of this group in 1987, while 605 t is assigned to 1950. For Seerfish (*Scomberomorus* spp. and *Rastrelliger* spp.), a total catch of 1,800 t in 1965 is noted by West (1973), and 600 t is assigned for 1950. This group mostly includes Indo-Pacific king mackerel (*Scomberomorus guttatus*) and Indian mackerel (*Rastrelliger kanagurta*). The landing data for seerfish that are supplied to FAO between 1985 and 2001 are deemed not reliable. Therefore, we decided to include these years in the reconstruction process. In this group, Indo-pacific king mackerel are reported to be abundant in the marine catch (Mohiuddin *et al.* 1980).

According to the Fisheries Resource Survey System (FRSS), shark landings are 6,234 t and 2,000 t in 2001 and 1986, respectively. Available evidence (Haldar 2010) suggests that almost 80% of shark catches comes from artisanal fisheries, mostly from gill nets, SBN and hook and line fisheries. However, some improved shark nets were introduced in recent decades. Therefore, we assign 4,987 t and 1,600 t for 2001 and 1986, respectively. For 1970, we calculate an average ratio of 2.0% for shark catches in the total marine landings, which accounts for 1,774 t. Artisanal fishing operations in the estuaries and coastal waters of Bangladesh used to be carried out by traditional craft until the mechanization of fishing boats. These vessels were introduced by the Bangladesh Fisheries Development Corporation (BFDC) and the Bangladesh Jatio Matshyajibi Samabay Samity (BJMSS) in the mid 1960s. Therefore, a calculated landing of 966 t in 1960 and a very conservative estimate of 50 t for 1950 are assigned for this fishery. Finally, linear interpolation is performed among the anchor points for all the groups/species for a complete time series.

Industrial fisheries

Industrial trawling, mainly for demersal finfish, in offshore waters of Bangladesh began in 1972 with the introduction of 10 trawlers (Rahman 1999). Therefore, no catches are assigned for industrial trawling for the period 1950 to 1971. The CPUE of Bombay-duck is estimated as 12 t·trawler^{-1} based on the total landings and corresponding trawler numbers in 2010. Considering this CPUE, a total catch of 49 t and 1,236 t are calculated for 1978 and 1985, respectively. The category 'marine crustaceans nei' (for industrial) mostly refers to shrimp catch that became a focal point of interest just after the discovery of commercial shrimp grounds in Bangladesh in 1976/1977. As a result, many Bangladeshi entrepreneurs and foreign firms became interested in shrimp trawl fishing. The estimated catch of shrimp for 1985/1986 is 4,031 t (Van Zalinge 1986). Shahidullah (1986) reports an estimated shrimp catch of 700 t in 1980/1981 from the trawler fleet, which sharply increases to 4,500 t in 1983/1984. A conservative estimate of 250 t is assigned to 1972, the initial year of shrimp trawling. A report on catch composition of BFDC trawlers, presented in Mohiuddin *et al.* (1980), notes 1.2% (1973) and 1.6% (1979) of silver pomfret in total landings and these are used to estimate a total of 72 t and 126 t for the respective years. We use the estimate of 72 t for 1973 as an anchor point for 1972. For 'jewfish' (croaker), a total of 903 t (15% of total industrial landing, Mohiuddin *et al.* 1980) is calculated for 1973, which we also use as an anchor point for 1972. Mohiuddin *et al.* (1980) also notes 2.4% (1973) and 25.7% (1979) catfishes in total landings that are used to estimate a total of 144 t and 2,040 t for the respective years. Since 80% of the shark catch comes from artisanal fisheries, we assumed the remaining 20% comes from industrial fisheries. Using the same shark landings anchor points of 6,234 t for 2001 and 2,000 t for 1986, we assigned 1246.8 t and 400.2 t to the industrial sector in 2001 and 1986, respectively. Finally, linear interpolations are performed among the anchor points for all the groups/species to have a complete time series.

Artisanal and Industrial IUU

There is illegal, unreported and unregulated (IUU) catch in the form of under reporting in the Bangladeshi commercial fisheries. Approximately 50% of industrial trawlers under-report or do not report their catch at all (Ullah, H. WorldFish Center. pers. obs.). In order to account for this under reporting, we take 50% of the reported industrial landings for each year as unreported industrial catches. For artisanal catches, at least 15-20% of the catch is under-reported (Ullah, H. WorldFish Center. pers. obs.). We use the average of these values, i.e., 17.5% and estimate artisanal unreported catch.

Discards

The estimates of discarded catches in Bangladeshi fisheries, particularly in the industrial sector, varies significantly between years due to the large quantities of so-called low-value fish that are caught by both shrimp and fish trawlers. Reports note a discard amount of 20,000 t in 1980 (White and Khan 1985), 35,000 t in 1985 (Khan and Latif 1995), and 50,000 t in 1995 (Islam 2003). White and Khan (1985) also report 1,300 t discarded in 1979 from 9 industrial trawlers. Since offshore commercial trawling, mainly for demersal finfish, began in 1972 with the introduction of 10 trawlers, we assign discards of 1,300 t as an anchor point in 1972. The taxonomic breakdown applied to the shrimp trawl discards was based on weighted catch compositions of the bottom trawl fishery (Chowdhury *et al.* 1993). For artisanal fisheries, it is reported that there is very little discarding since virtually all the catch is sold and consumed by local people or fishers (Khan 2010). However, shrimp (*P. monodon*) post larvae (PL) collection (mostly by push net and fixed bag-nets) has been regarded as a very critical issue. This is because of its devastating nature that kills billions of other species at the larval stage (Khan and Latif 1995; Hoq and Haroon 2012). In 1970, shrimp seed collection began and the use of push nets increased considerably. Before that, only fixed bag-nets were used to catch shrimp PL. Discards in 2002 are assumed to be the same as those in 1999. Since the Government of Bangladesh imposed a ban on wild fry collection in 2002, we assume that there are no discards in this sector after 2002. However, a conservative estimate of 50 billion individuals is considered for 1970. We assume an average weight of 20 mg·individual^{-1}, which yields a total catch of 1,102 t, 2,646 t and 4,409 t for 1970, 1989 and 2002, respectively. For 1969, a conservative estimate (10% of the 1970 value) results in 110 t, and 34 t is assigned for 1950. Then, linear interpolation is performed among the anchor points and a more comprehensive time series for discard component is constructed.

Kelleher (2005) concludes that Bangladesh finfish trawl fisheries are characterized by a very high discard rate and proposes a 4:1 ratio of discards to target catch. This ratio is used here to construct the discard component of finfish trawling. According to national statistics on fish landings, finfish trawl catch comprises 42.7% (i.e., 5,794 t) of total industrial trawl landings. This ratio is used to estimate a total discard of 5,313 t from the finfish trawl landings in 1984. The number of finfish trawlers operating in Bangladesh in 1984 was 10, and 7 vessels in 1972. Thus, we estimate 3,719 t of fish for 1972 and set this as an anchor point. Subsequently, a time series is obtained for the discard component of finfish trawl using linear interpolation. The taxonomic breakdown of the industrial landings was applied to the finfish trawl discards.

Subsistence (non-commercial) fisheries

Subsistence data for Bangladesh is incomplete and not readily available. Therefore, we used the per capita rate for subsistence estimated for India (Hornby *et al.* this volume) to estimate a complete time series for 1950-2010. The per capita subsistence rates for India are comparable to recent per capita subsistence rates published for Bangladesh (Ahmed *et al.* 2013), suggesting that the per capita rates we used are representative. To determine total subsistence, we multiply the coastal population of Bangladesh by the per capita subsistence catch rate of India for each corresponding year of the time series. The taxonomic breakdown applied to subsistence catches were based on datasets of set bag-net fishers, which was thought to provide the best representation of subsistence fisheries in Bangladesh (H. Ullah, pers. obs.).

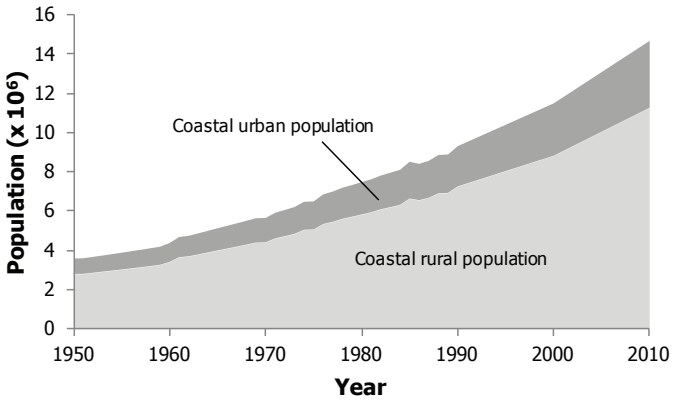

Figure 2. Total coastal population of Bangladesh 1950-2010.

Results

Population

The coastal population of Bangladesh has been increasing steadily since 1950 (Figure 2).

Commercial catches

Industrial sector

Bangladesh's industrial sector did not begin until 1972 with the introduction of motorized vessels (Rahman 1999). Total reconstructed industrial catches increased steadily from almost 27,000 t in 1972 to just over 90,000 t in 1985. Catches remained fairly stable for the next 20 years (until the mid 2000s) and averaged approximately 99,000 t·year^{-1}. From 2006-2009 catches averaged 117,000 t·year^{-1} and then dropped slightly in 2010 with just under 97,000 t. Reported landings for the industrial sector represented just over 8% of the total industrial catch in the 1970s but increased to an average of 32% in the late 2000s. Unreported landings ranged from 4% in the 1970s to 16% in the late 2000s. Discards were the largest contributor decreasing from 87% in the 1970s to 52% in the late 2000s. The major taxa caught in the industrial sector are members of the family Ariidae (sea catfishes), which represent approximately 15% of the total industrial catch.

Artisanal sector

Reconstructed total artisanal catches in Bangladesh increased from 28,000 t in 1950 to over almost 673,000 t in 2010. Landings represent the majority of the catch average a consistent 84-85% over the entire time period. Unreported landings have also made up a consistent portion of the catch over the time period at just under 15% of the catch. Discarding is not a problem like it is in the industrial fishery and artisanal discards averaged less than 1%. There are no discards after 2002 due to the ban on wild fry collection. Hilsa shad dominates the catch, representing 41%. Bombay-duck and silver croaker each represent just under 7% of the total artisanal catch.

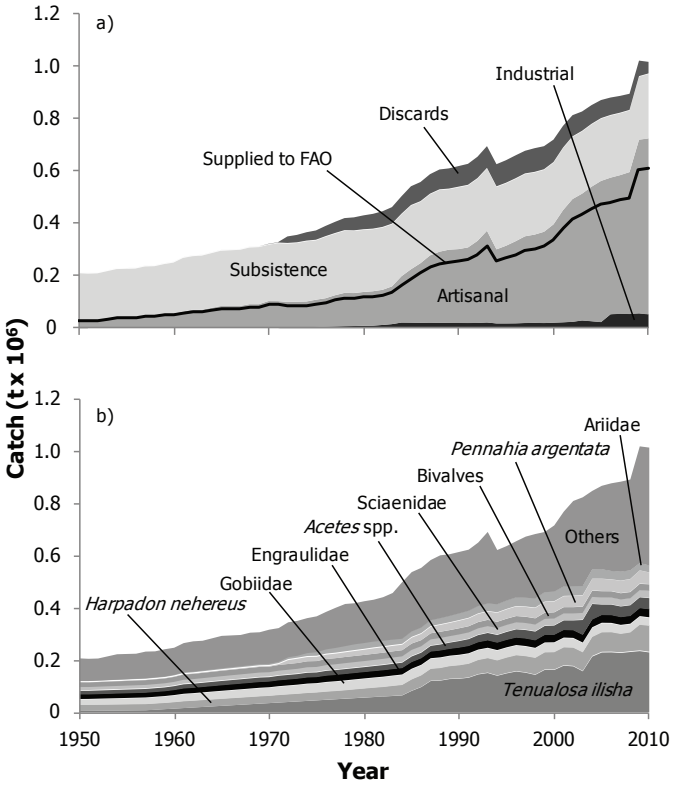

Figure 3. Reconstructed total catch for Bangladesh from 1950-2010, by a) fishing sectors and discards, with the official FAO data overlaid as a black line; and b) major taxa. 'Others' includes 60 additional taxonomic categories.

Discards

Total discards in the Bangladesh commercial fisheries, from both artisanal and industrial sectors, amount to over 2 million t (Figure 3a). The industrial sector contributes approximately 96% and the artisanal sector 4% of the total discards. Until 1972, when industrial fisheries began, discards were 100% artisanal, and then after the wild fry ban in 2002, discards were 100% industrial. Discards represent just under 16% of the reconstructed total commercial catch.

Subsistence catches

Subsistence fisheries are of great importance in Bangladesh. Many people feed their families in this manner. Subsistence catches have remained fairly stable, increasing slightly from almost 182,000 t in 1950, to just over 246,000 t in 2010 (Figure 3a). It is thought that the species of greater commercial value are not fished for subsistence purposes. Bombay-duck is the most popular subsistence species, representing over 12% of the catch. Other popular taxa that are targeted by subsistence fishers are Gobiidae (gobies; 10.8%), Engraulidae (anchovies; 10.8%), bivalves (10.0%), Sciaenidae (drums and croakers; 8.4%), *Acetes* spp. (paste shrimp; 7.7%) and Palaemonidae (shrimps; 3.9%).

Reconstructed total catch

The total reconstructed catch of Bangladesh from 1950-2010, including estimates of discards, unreported commercial catch and subsistence catch increased from just under 210,000 t in 1950, to almost 1,016,000 t in 2010 (Figure 3a). The reconstructed tonnage is 157% higher than the landings of just over 11.7 million t reported by FAO on behalf of Bangladesh (Figure 3a). The unreported subsistence catch has the most influence on the reconstruction, contributing nearly 45% overall. There is an overall increasing trend through the time series which is likely a reflection of the rapidly growing population in Bangladesh.

Taxonomically, Hilsa shad and Bombay-duck represent about 18% and 9% of the reconstruction, respectively (Figure 9b). Hilsa shad is the most import species in the artisanal fishery and Bombay-duck is the most import subsistence species. Other important taxa include Gobiidae (6.6%), Engraulidae (5.3%), *Acetes* spp. (4.9%), Sciaenidae (4.6%), bivalves (4.5%), *Pennahia argentata* (4.1%), and Ariidae (4.0%; Figure 3b).

Discussion

The reconstructed total catch for Bangladesh from 1950-2010 is 157% greater than the official landings reported to FAO. Unreported subsistence catches are the largest contributor to the reconstruction in terms of tonnage.

The reconstructed subsistence catch contributes 46% to the total. This is an issue, considering the growing coastal population of Bangladesh which shows no sign of slowing. It is clear that this coastal population, both rural and urban, heavily depend on marine based protein for subsistence. The demand for fish and marine invertebrates will only increase with the population size in the future. Our reconstruction of Bangladesh's subsistence catch is merely an estimate, due to the fishery's unregulated nature and this value may be a slight misrepresentation. However, it is evident that Bangladesh's growth and increasing demands are not and will not be sustainable, especially if the government is managing marine populations based solely on reported landings. It would be useful for the Department of Fisheries in Bangladesh to begin regulating and monitoring these coastal subsistence fisheries and utilize this information in their management schemes.

Overall, unreported commercial landings and commercial discards from 1950-2010 represent 7.4%, and 8.6% respectively, in the reconstructed total catch. Their contribution to the reconstruction is much smaller than subsistence catches, yet, still significant. Artisanal unreported landings contribute almost 88% of the total unreported landings from commercial fisheries. The industrial sector is a smaller contributor; however, 33% of the large-scale commercial landings go unreported. It is evident that better regulation and enforcement in these fisheries would allow for a more accurate reporting of the actual annual catch. This in turn will be useful to the government when making management decisions.

As for discards, the industrial sector contributes over 96% to the overall discarded tonnage from 1950-2010, and 75% of the reconstructed total industrial catch is discarded. For a country that is heavily dependent on marine based protein and subsistence fisheries, discarding practices should be monitored more carefully, and curtailed as soon as possible. Discarding is a large and unnecessary waste of Bangladesh's precious marine resources.

Bangladesh desperately needs to monitor their various fisheries more closely to have a more complete picture of the annual total catch. Management decisions can only be improved with a more comprehensive knowledge and accounting of all catches. This will in turn benefit food security for the growing nation in the future.

Acknowledgements

This is a contribution of *Sea Around Us*, a scientific collaboration between the University of British Columbia and The Pew Charitable Trusts. The first author would like to thank some of his colleagues and friends who helped significantly to complete this work: notably SM Hasan (Scientific Officer, Marine Fisheries Survey Management Unit), Suman Barua (Statistical Officer, Marine Fisheries Office Chittagong, Bangladesh) and MA Mazid (former Director General at the Bangladesh Fisheries Research Institute).

References

Ahmad M (2004) Living in the Coast: People and Livlihoods. Water Resources Planning Organization (WARPO), Ministry of Water Resources, Dhaka, Bangladesh. 49 p.

Ahmed A, Ahmad K, Chou V, Hernandez R, Menon P, Naeem F, Naher F, Quabili W, Sraboni E and Yu B (2013) The status of food security in the Feed the Future Zone and other regions of Bangladesh: Results from the 2011-2012 Bangladesh Integrated Household Survey. Report prepared by the International Food Policy Research Institute, Policy Research and Strategy Support Program for Food Security and Agricultural Development in Bangladesh, for the United States Agency for International Development, Grant Number: EEM-G-00-04-00013-00, Dhaka. 272 p.

Ahsanullah M (1964) Population dynamics of hilsa in East Pakistan. Agriculture Pakistan 15(3): 351-365.

Akerman SE (1986) The coastal set bagnet fishery of bangladesh–fishing trials and investigations. FAO, Madras, India. 29 p.

Anon. (1985) Report on the Frame Survey of the Marine Artisanal Fisheries in Bangladesh, 1984-95. Department of Fisheries, Dhaka, Bangladesh.

Bapat SV (1970) The Bombay duck, *Harpodon nehereus* (Ham.). Central Marine Fisheries Research Institute, India. 87 p.

Chowdhury Z, Khan M and Quayum S (1993) The beach seine fishery of Teknaf. pp. 51-64 *In* Chowdhury Z, Huq M, Islam M, Khan M, Mustafa G, Paul S, Quayum S, Sada M and Sarker M (eds.), Studies of Interactive Marine Fisheries of Bangladesh. Bay of Bengal Programme, Madras, India.

CIESIN (2012) National Aggregates of Geospatial Data Collection: Population, Landscape, And Climate Estimates, Version 3 (PLACE III). Center for International Earth Science Information Network (CIESIN)/Columbia

University, Palisades, NY. Available at: http://sedac.ciesin.columbia.edu/data/set/nagdc-population-landscape-climate-estimates-v3. [Accessed: Nov 21, 2012].

DANIDA-DFID (2003) The Future for Fisheries. Findings and recommendations from the Fisheries Sector Review and Future Development Study, FAO Representation–Bangladesh. The Local Consultative Group–Bangladesh (available from http://www.lcgbangladesh.org/), Dhaka. 65 p.

De Young CE (2006) Review of the state of world marine capture fisheries management: Indian ocean. FAO fisheries Technical Paper No. 488 Rome. 458 p.

Haldar GC (2010) National plan of action for shark fisheries in Bangladesh. pp. 75-89 *In* Hussain MG and Hoq ME (eds.), Sustainable Management of Fisheries Resources of the Bay of Bengal. Bangladesh Fisheries Research Institute, Bangladesh.

Hoq ME and Haroon AKY (2012) Support to Sustainable Management of the Bay of Bengal Large Marine Ecosystem (BOBLME) Project. Bangladesh Fisheries Research Institute, Bangladesh. 198 p.

Huntington T, Khan G, Islam S, Brakel MV and Miller A (2007) Towards sustainable coastal and marine fisheries in Bangladesh: initiating a precautionary approach. WorldFish Center, Dhaka, Bangladesh.

Huq MQM, Khan MG, Chowdhury ZA and Sarker MN (1993) The bottom longline fishery for croaker (Sciaenidae). In Chowdhury ZA, Huq MQM, Islam MS, Khan MG, Mustafa G, Paul SC, Quayum SA, Sada MNU and Sarker MN (eds.), Studies of Interactive Marine Fisheries of Bangladesh. Bay of Bengal Program, Madras, India.

Hussain MG and Hoq MEe (2010) Sustainable Management of Fisheries Resources of the Bay of Bengal–Compilation of national and regional workshop reports. The Bay of Bengal Large Marine Ecosystem Project, Dhaka, Bangladesh. 123 p.

Islam MR, (ed.) (2004) Where land meets the sea: a profile of the coastal zone of Bangladesh. University Press, Dhaka, Bangladesh.

Islam MS (2003) Perspectives of the coastal and marine fisheries of the Bay of Bengal, Bangladesh. Ocean & Coastal Management 46: 763-796.

Kelleher K (2005) Discards in the world's marine fisheries: an update. FAO technical papers: 1-131.

Khan MG (2010) Bangladesh coastal and marine fisheries, and environment. pp. 1-35 *In* Hussain MG and Hoq ME (eds.), Sustainable Management of Fisheries Resources of the Bay of Bengal. Bangladesh Fisheries Research Institute, Bangladesh.

Khan MG and Latif MA (1995) Potentials, constraints and strategies for conservation and management of open brackishwater and marine fishery resources. *In* Report of the national workshop on fisheries resources development and management in Bangladesh 29 October–1 November 1995. Bay of Bengal Programme, Madras, India.

Mohiuddin MS, Kibria G, Hossain MM and Ali Le (1980) Bangaldesh–Status Paper on Coastal Fishery Resources. *In* FAO (ed.), Report of the Consultation on Stock Assessment for Small-Scale Fisheries in the Bay of Bengal2. FAO, Chittagong, Bangladesh.

Nabi MRU and Ullah MH (2012) Effects of set bagnet fisheries on the shallow coastal ecosystem of the Bay of Bengal. Ocean & Coastal Management 67: 75-86.

Rahimullah M (1950) Marine Fisheries of Pakistan with a Review on Trawling. Asia-Pacific Fishery Commission, Pakistan.

Rahman MM (1999) National Report on the Impact of Shrimp Trawl Fisheries on Living Marine Resources of Bangladesh. *In* FAO (ed.), Tropical Shrimp Fisheries and their impact on Living ResourcesNo. 974 FIIT/C974. FAO, Rome.

Rahman MM, Z.A. C and Sada MNU (2003) Coastal Resources Management, Policy and Planning in Bangladesh. pp. 689-756 *In* Silvestre G, Gerces L, Stobutzki I, Ahmed M, Valmonte-Santos RA, Luna C, Lachica-Aliño L, Munro P, Christensen V and Pauly D (eds.), Assessment, Management and Future Directions for Coastal Fisheries in Asian Countries. WorldFish Center, Philippines.

Shahidullah M (1986) Marine fisheries resources management in Bangladesh and current status of exploitation. Marine Fisheries Bulletin 3: 26.

Shomura RS (1971) Indian Ocean. pp. 97-108 *In* Gulland JA (ed.), The Fish Resources of the Ocean. Fishing News (Books) Ltd., England.

Ullah MH (2007) Trophic model of the coastal ecosystem of the bay of bengal and simulation of fishery yields for its set bag net fisheries. M.Sc. thesis, University of Chittagong, Institute of Marine Sciences and Fisheries, Bangladesh.

Van der Knaap M (1989) Shrimp fisheries in the Bay of Bengal. Bay of Bengal Programme, Working Papers-BOBP/WP/58, Bangladesh. 33 p.

Van Zalinge NP (1986) The Bangladesh shrimp resources: Management issues and data requirements. FAO/UNDP, Bangladesh. 17 p.

West WQB (1973) Fishery Resources of the Upper Bay of Bengal. Indian Ocean Programme, Indian Ocean Fisheries Commission, FAO, IFOC/DEV/73/28, Rome.

White TF and Khan MG (1985) The marine fisheries resources of Bangladesh and their potential for commercial development. Ministry of Agriculture–Fisheries and Livestock Division, Bangladesh.

Zafar M, Mustafa G, Amin SMN and Haque MA (2000) Population dynamics of *Johnius argentatus* (Houttuyn) from the Northeastern part of the Bay of Bengal, Bangladesh. Asian Fisheries Science 13: 243-249.

Zobairi ARK (1970) Survey of the Bay of Bengal. East Pakistan Fisheries Development Corporation, East Pakistan.

Appendix Table A1. FAO landings vs. reconstructed total catch (in tonnes), and catch by sector with discards shown separately, for Bangladesh, 1950-2010.

Year	FAO landings	Reconstructed total catch	Industrial	Artisanal	Subsistence	Discards
1950	24,000	210,000	-	28,200	182,000	34
1951	24,000	208,000	-	28,200	180,000	38
1952	24,000	209,000	-	28,200	181,000	42
1953	30,000	218,000	-	35,200	182,000	46
1954	36,000	226,000	-	42,300	183,000	50
1955	36,000	227,000	-	42,300	184,000	54
1956	36,000	228,000	-	42,300	185,000	58
1957	42,000	236,000	-	49,300	186,000	62
1958	42,000	237,000	-	49,300	187,000	66
1959	48,000	245,000	-	56,400	188,000	70
1960	48,000	250,000	-	56,400	194,000	74
1961	54,000	268,000	-	63,500	205,000	78
1962	60,000	275,000	-	70,500	204,000	82
1963	60,000	277,000	-	70,500	207,000	86
1964	66,000	287,000	-	77,600	209,000	90
1965	72,000	296,000	-	84,600	211,000	94
1966	72,000	298,000	-	84,600	213,000	98
1967	72,000	299,000	-	84,600	215,000	102
1968	78,000	308,000	-	91,600	216,000	106
1969	78,000	310,000	-	91,600	218,000	110
1970	88,150	320,000	-	103,600	215,000	1,102
1971	87,920	326,000	-	103,300	221,000	1,183
1972	84,660	348,000	3,220	97,000	223,000	24,882
1973	85,360	354,000	3,280	97,700	224,000	28,431
1974	86,030	364,000	3,850	98,100	230,000	31,981
1975	91,660	371,000	4,730	104,000	226,000	35,531
1976	96,240	388,000	5,580	108,700	234,000	39,080
1977	105,770	403,000	6,590	119,100	235,000	42,630
1978	113,240	418,000	7,580	127,100	237,000	46,180
1979	112,640	421,000	8,210	125,900	237,000	49,729
1980	115,970	428,000	9,140	129,100	237,000	53,108
1981	118,220	434,000	9,610	131,400	237,000	56,486
1982	122,370	444,000	12,220	134,200	238,000	59,864
1983	133,000	460,000	15,350	144,200	237,000	63,242
1984	164,882	501,000	21,330	177,000	236,000	66,621
1985	187,658	540,000	21,020	204,000	243,000	71,772
1986	207,468	556,000	20,370	227,800	234,000	73,155
1987	232,858	586,000	19,860	258,100	233,000	74,538
1988	244,853	604,000	20,400	271,700	236,000	75,922
1989	251,563	608,000	20,050	279,900	231,000	77,305
1990	253,453	617,000	19,810	282,300	236,000	78,783
1991	258,884	625,000	19,610	288,800	237,000	80,261
1992	280,127	653,000	19,950	313,500	237,000	81,739
1993	312,715	693,000	21,590	350,500	238,000	83,218
1994	253,044	624,000	17,980	283,200	238,000	84,696
1995	264,650	639,000	18,000	296,900	238,000	86,174
1996	279,170	658,000	18,340	313,700	238,000	87,652
1997	295,141	675,000	19,540	331,500	238,000	86,517
1998	300,452	685,000	20,270	337,200	237,000	90,517
1999	309,797	693,000	19,450	348,800	237,000	88,237
2000	333,799	718,000	20,820	375,900	236,000	85,781
2001	379,497	771,000	22,240	428,500	237,000	83,324
2002	415,420	812,000	24,080	469,300	237,000	80,867
2003	431,908	826,000	29,200	484,600	238,000	74,001
2004	455,207	850,000	26,320	514,200	238,000	71,545
2005	474,597	870,000	23,060	539,600	238,000	69,088
2006	479,810	879,000	52,610	522,600	237,000	66,632
2007	487,438	885,000	54,880	529,700	237,000	64,175
2008	497,573	894,000	53,960	542,400	236,000	61,718
2009	602,642	1,020,000	56,040	664,200	241,000	59,262
2010	607,492	1,016,000	52,480	672,700	246,000	44,270

Appendix Table A2. Reconstructed total catch (in tonnes) by major taxonomic group for Bangladesh, 1950-2010. 'Others' contain 60 additional taxonomic categories.

Year	*Tenualosa ilisha*	*Harpadon nehereus*	Gobiidae	Engraulidae	*Acetes* spp.	Sciaenidae	Bivalvia	*Pennahia argentata*	Ariidae	Others
1950	6,250	24,300	21,000	19,700	14,100	15,400	18,200	480	3,720	86,800
1951	6,580	24,100	21,200	19,600	14,000	15,300	18,000	560	3,860	85,100
1952	6,920	24,200	21,600	19,700	14,100	15,500	18,100	650	4,040	84,400
1953	7,260	24,400	22,100	19,900	14,200	15,700	18,200	730	4,230	90,800
1954	7,600	24,500	22,500	20,000	14,300	15,900	18,300	810	4,410	97,200
1955	7,940	24,700	23,000	20,100	14,400	16,000	18,400	900	4,600	96,600
1956	8,270	24,800	23,400	20,300	14,500	16,200	18,500	980	4,780	95,900
1957	8,610	24,900	23,900	20,400	14,600	16,400	18,600	1,070	4,960	102,200
1958	10,750	25,100	24,300	20,600	14,700	16,500	18,700	1,150	5,150	99,700
1959	12,880	25,200	24,800	20,700	14,800	16,700	18,800	1,240	5,330	104,300
1960	15,020	25,900	25,700	21,300	15,300	17,200	19,400	1,320	5,590	103,600
1961	17,180	27,300	27,200	22,500	16,100	18,200	20,500	1,410	5,940	111,800
1962	19,310	27,300	27,500	22,500	16,100	18,300	20,400	1,490	6,100	115,900
1963	21,450	27,600	28,100	22,800	16,300	18,600	20,700	1,580	6,300	113,900
1964	23,590	27,900	28,700	23,100	16,500	18,800	20,900	1,660	6,510	119,000
1965	25,720	28,200	29,300	23,300	16,700	19,100	21,100	1,750	6,710	124,000
1966	27,860	28,400	29,800	23,600	16,800	19,300	21,300	1,830	6,910	121,800
1967	29,990	28,600	30,300	23,800	17,000	19,500	21,500	1,920	7,100	119,600
1968	32,130	28,800	30,800	24,000	17,100	19,800	21,600	2,000	7,300	124,400
1969	34,270	29,200	31,300	24,200	17,300	20,000	21,800	2,170	7,490	122,000
1970	36,390	29,000	31,300	23,900	17,100	19,800	21,500	2,340	7,610	130,600
1971	38,540	29,900	32,400	24,600	17,600	20,400	22,100	3,200	7,880	129,100
1972	40,670	30,300	32,900	24,800	17,700	20,600	22,300	14,790	9,910	133,800
1973	42,810	30,600	33,400	25,000	17,800	21,000	22,400	16,460	10,360	133,700
1974	44,950	31,500	34,300	25,600	18,300	21,800	23,000	16,340	14,100	133,800
1975	47,080	31,200	34,300	25,300	18,100	21,800	22,600	16,430	16,720	137,100
1976	49,230	32,400	35,500	26,200	18,700	22,700	23,400	16,860	19,130	143,600
1977	51,360	32,600	35,900	26,300	18,800	23,000	23,500	17,300	20,960	153,600
1978	53,500	33,400	36,400	26,500	18,900	23,500	23,700	17,920	22,700	161,300
1979	55,630	34,600	36,700	26,500	18,900	23,700	23,700	18,930	24,730	157,100
1980	57,760	35,800	37,100	26,600	19,000	24,000	23,700	19,720	24,670	160,000
1981	59,890	36,900	37,400	26,600	19,400	24,200	23,700	20,880	25,180	159,900
1982	62,030	37,600	37,800	26,700	20,000	24,600	23,800	20,820	23,970	166,600
1983	64,160	39,600	38,100	26,700	20,400	24,800	23,700	20,960	23,100	178,300
1984	66,290	41,200	38,400	26,600	20,800	25,000	23,600	20,820	21,890	216,600
1985	83,990	44,700	39,400	27,400	21,800	25,800	24,300	22,330	23,110	226,800
1986	98,780	45,400	38,900	27,000	21,700	25,200	23,400	23,620	23,660	228,200
1987	122,470	46,900	39,100	27,400	22,100	25,300	23,300	24,890	24,300	230,100
1988	123,810	48,700	39,100	28,200	23,300	25,700	23,600	25,910	25,240	240,400
1989	130,090	49,800	38,300	28,100	24,000	25,400	23,100	27,150	26,340	235,900
1990	131,080	52,100	38,600	29,200	25,400	26,000	23,600	28,360	27,570	235,000
1991	135,240	53,800	38,400	29,800	26,500	26,200	23,700	29,570	28,730	233,600
1992	148,040	55,500	38,200	30,000	27,600	26,500	23,700	30,670	29,690	242,800
1993	153,590	56,900	38,000	30,100	28,700	26,800	23,800	31,410	30,220	273,700
1994	142,860	59,000	37,800	30,200	29,700	27,000	23,800	33,720	32,640	207,300
1995	152,200	60,600	37,600	30,300	30,800	27,300	23,800	34,920	33,710	208,100
1996	159,540	62,200	37,300	30,400	31,800	27,500	23,800	36,000	34,630	214,700
1997	154,660	63,600	37,000	30,500	32,800	27,500	23,800	36,760	34,960	233,900
1998	146,320	65,300	36,700	30,500	33,800	27,400	23,700	38,720	36,670	246,100
1999	165,820	66,900	36,300	30,500	34,800	27,300	23,700	40,020	37,610	230,100
2000	165,420	68,200	36,000	30,500	35,800	27,200	23,600	40,470	37,570	253,400
2001	182,210	69,800	35,800	30,700	36,900	27,300	23,700	40,950	37,630	285,700
2002	179,500	71,400	35,700	30,900	38,000	27,400	23,700	41,790	37,620	325,700
2003	160,400	72,900	35,500	31,000	57,400	27,400	23,800	42,050	36,080	339,200
2004	217,680	74,600	35,200	31,100	59,900	27,400	23,800	43,940	36,360	300,100
2005	233,570	76,300	34,900	31,200	40,400	27,400	23,800	46,050	36,860	319,100
2006	234,140	76,300	33,800	31,300	40,700	27,300	23,700	43,910	32,700	335,200
2007	231,670	72,300	32,700	31,300	41,000	27,200	23,700	46,430	34,880	344,300
2008	235,610	74,000	31,500	31,300	41,200	27,100	23,600	48,210	33,720	347,400
2009	238,970	100,300	31,100	31,900	41,900	27,600	24,100	49,910	28,340	446,300
2010	233,840	101,400	30,600	32,600	42,700	28,300	24,600	43,840	27,200	450,700