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Abstract

We reconstruct marine fisheries catches for Cambodia from 1950-2010. Annual national landings statistics only account for the catches of taxable vessels, resulting in a substantial underestimation of total catches. Sources of unreported catches are i) small-scale fishing sector (artisanal and subsistence); ii) marine catches sold at sea; and iii) fish discards. We quantify catches from these three sources and add them to annual landings statistics that are reported to the FAO. Total reconstructed catch in Cambodia was 4.1 million t from 1950-2010, suggesting that reported landings (1.4 million t) underestimated total catches on average by a factor of 3. This reconstruction did not account for the catch of foreign fishing vessels in the waters of Cambodia, which represent another source of significant fishing pressure. Our result emphasizes the imperative for improved fisheries monitoring and enforcement in Cambodia to facilitate a move to sustainable and comprehensive fisheries management.

Introduction

Marine fisheries in Cambodia make a relatively small contribution to society compared to the inland fisheries of Tonle Sap (Great Lake) and the Mekong, which supply more than 80% of the country's total fisheries production (Gillett 2004). Cambodia's marine fisheries were slow to develop compared to its neighbours, fishing in the Gulf of Thailand, i.e., Thailand and Vietnam. Commercial expansion in the region started in the 1960s and fisheries in the Gulf of Thailand were already showing signs of overexploitation in the 1970s (FAO 1997; Gillett 2004), traditional fishing largely dominated along Cambodia's inshore areas until the mid 1980s (Sherman *et al.* 2007; Doma 2011). Decline in Cambodia's inshore fisheries is believed to have started in the 1980s, coinciding with a period of expansion in the number of trawlers operating in both shallow inshore as well as offshore waters. Fisheries management in Cambodia has been greatly constrained by past political instability, and the lack of institutional capacity, technical expertise, and financial resources continues to hinder efforts to attain sustainable fisheries management (Gillett 2004; UNEP 2007; Doma 2011).

Open access in Cambodia's marine fisheries is a major factor underlying the current degraded state of coastal fisheries, in which fishers have experienced rapidly declining fish catches (Gillett 2004; UNEP 2007) and escalating conflict between different groups of users (Chansothea *et al.* 2007; Gillett 2008). A lax licensing system and poor enforcement of licensing requirements allows large numbers of people to enter the fisheries freely. As such, the existing level of fishing is much higher than that accounted for by fisheries regulatory institutions.

Our objective is thus to reconstruct the marine fish catches of Cambodia from 1950-2010 by accounting for sources of unreported fisheries catches that are missing from official statistics. This will present a more realistic picture of past and present fisheries exploitation levels and human reliance on fishing. The information can be applied to assess the status of Cambodia's marine fisheries resources as well as to facilitate a move towards more sustainable and comprehensive fisheries management.

Figure 1. Map of Cambodia, showing the countries' EEZ (solid line) within FAO statistical area 71.

Background

Cambodia's coastline faces the Gulf of Thailand and stretches several hundred kilometres from the Thai border in the northwest to the Vietnamese border in the southeast (Figure 1). The Exclusive Economic Zone (EEZ) covers an area of about 48,000 km² www.seaaroundus.org and is shallow, having an average depth of around 50 m (Gillett 2004). The coastal area includes the four provinces of Koh Kong, Kampot, Sihanoukville and Kep. It also includes a large estuary in the northern part of Koh Kong province and the great Bay of Kompong Som (Sokhan 2002). In 2008, the coastal population numbered around 960,400 and was mostly rural (National Institute of Statistics 2010).

Cambodia's marine fisheries are multi-species and multi-gear. About 80-90% of all marine fishing is inshore (UNEP 2007), usually up to 10 km from the coast (Sokhan 2002). Fishing takes place over coral reefs, seagrass beds, mangrove and estuarine habitat, as well as soft bottom and rocky habitats (UNEP 2007). Marine capture fisheries are categorised as coastal or commercial: Coastal fisheries encompass small-scale fishing using traditional gears and non-motorised or motorised boats with engines 50 hp, operating from the coast to the 20-m isobath. Boats with engines 30 hp are required to pay a licensing fee. Commercial fisheries use motorised boats with engines 50 hp, hence are subject to a licensing fee. Commercial vessels operate drift nets, purse seines, and trawl nets in waters from the 20-m isobath to the limits of the EEZ (Puthy 2011). In 2009, 58% of Cambodia's fishing fleet consisted of non-motorised boats, while another 35% was made up of motorised boats with engines 10hp, and 7% of boats with 10-30 hp engines. The remaining 2% of the fleet was evenly split between boats with engines 31-50 hp, and boats 50 hp in power (FAO 2011).

The inshore fishery is dominated by small-scale fishers who typically make single day fishing trips with boats 8-15 m in length. Common gears used include fish, shrimp, and crab gillnets, mackerel and anchovy seine nets, push nets, crab and squid traps, and hook and lines. Gillnets and longlines are used throughout the year, while seine nets are used during the southwest monsoon (Gillett 2004). Inshore fishing remained largely subsistence based until the mid 1980s (Doma 2011), when small trawl vessels (30 hp engine) became increasingly widespread due to their relatively low cost and ability to operate in Cambodia's productive inshore fishing grounds (Gillett 2008). It is estimated that about 25% of all motorised marine fishing vessels in Cambodia are trawlers (Gillett 2008), although we were not able to distinguish trawlers by engine size. The concentration of trawlers in shallow waters has led to sometimes violent confrontations with traditional fishers (Sherman *et al.* 2007; Doma 2011).

Cambodia's fisheries have a large pelagic component. Of the 33 species of commonly exploited finfish, the five most abundant species in landings are *Megalaspis cordyla* (torpedo scad), *Scomberomorus commerson* (narrowbarred Spanish mackerel), *Rastrelliger brachysoma* (short mackerel), *Rastrelliger kanagurta* (Indian mackerel) and *Atule mate* (yellowtail scad) (Try 2003; Gillett 2004). Shrimp fishing is significant in Cambodia not only for domestic consumption, but also as a valuable export product (Gillett 2008). The majority of shrimps are caught by trawlers, followed by gillnets, push nets, and stow nets. It is estimated that about 3000 to 4000 t of shrimp are caught each year; yet, shrimp catches have not been reported to the FAO since 1993 (Gillett 2008).

Historical development

Cambodia gained independence from France in 1953. During this era, coastal fishing was primarily carried out for subsistence, alongside rice and other crop production. In 1960, Thai fishers introduced trawling in the Gulf of Thailand, and in the mid 1960s this new technology spread to Cambodia (Sokhan 2002). Political turmoil in the 1970s greatly disrupted coastal fishing. From 1975 to 1979, fishing activities were banned under the Khmer Rouge regime, and the population was decimated by genocide. After the end of the Khmer Rouge rule, fishing in the early 1980s was still largely subsistence and fishery resources were reportedly abundant (Sherman *et al.* 2007; Doma 2011).

The 1990s saw the return to peace and acceleration of economic development. In 1993, the opening of a fertilizer factory created market value for low value fish, which included small-sized fish, non-edible species, and juveniles of commercially important fish (Puthy 2011). Trawlers began targeting low value fish to supply the fertilizer factory. This resulted in the low value fish component of catches rising to 60-65%, from 1980s level of about 30-40% of total catches. Road construction throughout the 1990s enabled fishers in formerly isolated villages to better engage in the market economy, and consumer demand for marine fish and shrimp increased (Doma 2011). At the same time, fishing by small trawlers in inshore areas intensified, despite a fisheries decree under the Fiat Law (1987) that prohibited trawling between shore and the 20-m isobath (Gillett 2008). By the mid 1990s, small-scale catches had declined, in some places by as much as 60% (Doma 2011). In 2007, shrimp stocks showed signs of exhaustion, and coastal fisheries were considered to be overexploited (UNEP 2007); (Doma 2011). Offshore fishing shows potential for expansion, as Cambodian participation remains limited due to lack of vessel capacity (Gillett, 2004). Currently, offshore areas are mostly fished by legally licensed and illegal (non-licensed) vessels from Thailand and Vietnam (Gillett, 2004).

Recreational fishing

There are no data on Cambodia's marine recreational fishing sector. Informal sources (e.g., personal webpages, fishing forums[1]) suggest that there is some deep sea sport fishing off the coast of Sihanoukville, but the major focus of recreational fishing tourism is centred on the freshwater fisheries of Tonle Sap Lake (FAO, 2011) and the Mekong River. As such, we assumed negligible catch from marine recreational fishing and this sector is not addressed in the reconstruction.

[1] Examples: http://yourphnompenhpal.blogspot.ca/2009/02/deep-sea-fishing-in-sihanoukville.html; http://www.tripadvisor.ca/ShowTopic-g325573-i9821-k4868834-Deep_sea_fishing-Sihanoukville.html; http://www.canbypublications.com/sihanoukville-cambodia/sihanoukville-tours.htm

Fisheries management

Cambodia's marine fisheries are administered by the Department of Fisheries (DoF) and governed under the Fisheries Law of 2006, which replaced the Fiat Law on Fisheries Management and Administration of 1987 (Puthy 2011). The principle objective of the Fisheries Law is sustainable management of marine fishery resources, which is achieved through gear, area, and temporal restrictions (Puthy 2011). For example, the period from January 15th to March 31st is declared as closed season for mackerel species (Puthy 2011). Nonetheless, it is widely acknowledged that lack of enforcement greatly compromises management effectiveness (Sherman 2007; Gillett 2008), and illegal fishing by foreign and Cambodian vessels is common.

Fisheries data collection

Cambodia's marine fisheries are poorly documented due to the absence of a structured data collection system and limited human resources (Gillett 2004; FAO 2007). Most financial and technical resources are devoted to the more important inland fisheries, where steps to improve data collection were put in place in the late 1990s (Gillett 2004). Marine fisheries statistics should be viewed cautiously; for example, in some years, catch trends were based on expert opinions or traditional knowledge (FAO 2010), and the catch volume of major taxonomic groups such as low value fish was derived from their economic value (FAO 2010).

Marine fisheries statistics are deficient in a number of ways. Catch statistics only reflect the landings of vessels that pay a fishing tax (in the form of license fees) to the government. Only boats with engines 30 hp are required to be licensed, thus the vast majority of the small-scale fisheries dominating inshore areas is not accounted for. It should be noted that records kept by provincial fisheries departments on the number of marine fishing vessels exclude those that operate prohibited fishing gears such as small trawlers (ADB 1996 in Sokhan 2002). In fact, it is estimated that less than 10% of vessels that should be licensed, actually are (Gillett 2004). On the other hand, foreign access fishing licenses are also issued to foreign vessels, mainly Thai, to fish in Cambodia's EEZ. Thus, Cambodian marine fisheries statistics report landings by non-Cambodian flag vessels.

Marine catches are also underestimated due to the omission of Cambodian catches that are landed outside of the country (Gillett 2004), i.e., sold and trans-shipped at sea. In addition, shrimp catches have apparently not been reported to FAO since 1993 (FAO 2011). Conversely, Doma (2011) states that the DoF estimates that about one quarter of recorded production is made up of fish caught outside of Cambodian waters, which implies a source of over-estimating marine fish caught in Cambodia. However, we were unable to find further evidence supporting this point. It is not possible to distinguish whose catches are represented in current marine fisheries statistics because total quantity of fish is not allocated by gear or fleet. Nonetheless, the amount of over-estimating that may exist is overshadowed by the magnitude of under-reporting in marine fisheries statistics. Cambodia's official marine landings data are under reported due to:

i) Small-scale fishers, including subsistence and artisanal fishers who operate non-motorised or motorised fishing vessels with engines 30 hp, or trawl in inshore areas;

ii) Catch sold and trans-shipped at sea to foreign vessels;

iii) Discards.

This reconstruction only accounts for catches caught by Cambodian vessels in Cambodian waters. Thus, there are two potential sources of over-reporting:

i) Catch from licensed Thai vessels that are erroneously reported by Cambodia as Cambodian catch;

ii) Inclusion of fish caught by Cambodian flagged vessels outside of Cambodian waters

Methods and Materials

Reported landings

Annual reported marine fisheries landings from 1950 to 2010 were extracted from FishStat (FAO 2012). National statistics on total landings, number of trawlers, and number of fishing vessels were compiled in fragmented time series from various sources (e.g., Gillett 2004; Puthy 2011).

Over-reported catch

We subtracted the catch from licensed Thai vessels and the quantity of fish caught outside Cambodian waters to minimize double-counting any internal adjustments that DoF may have made to annual reported marine fisheries landings. Thai licensed catch was reflagged to Thailand. We started accounting for over-reporting in 1990, the year when catches by foreign fishers licensed to fish in Cambodia's EEZ started being included in marine fisheries statistics (Puthy 2011). This was also the year when a sudden increase of 53% was observed in reported catches from 1989.

Thai catches

There was only one data point on which to estimate the proportion of Thai vessels. In 2002, an estimated 167 to 226 Thai boats were licensed to fish in Cambodia (Gillett 2004). We did not have data on the number of marine fishing vessels in 2002, therefore used data from 2001, the closest year for which we had data. In 2001, there were 1393 boats with engines 30 hp. We divided the average number of licensed Thai boats in 2002 (i.e., 197) by the total number of boats 30 hp (i.e., 1393) which yielded a proportion of 0.14. Due to lack of further data, we assumed that this proportion of Thai vessels in the total number of licensed marine vessels remained constant at 14% from 1990 to 2010.

Catch outside Cambodian waters

About one quarter of recorded production is made up of fish caught outside of Cambodian waters (Doma 2011). Therefore, starting from 1992 onwards, we reassigned 25% of annual reported catch to waters outside the Cambodian EEZ. We assume most of these catches would be taken in Vietnamese waters[2], although Cambodian flagged vessels have been detained for illegal fishing as far away as Russia's Far East (Annonymous 2007, 2010).

Unreported catch

Unreported catches originate from three sources: 1) small-scale fishers; 2) catch sold at sea; 3) discarded fish. We estimated the catch contribution from these three sources from 1950-2010 and added them to annual reported FAO marine landings adjusted for the above over-reporting.

Small-scale fishers

We estimated the contribution of small-scale fishers using two approaches for two distinct time periods. For the period 1950-1980 we estimate small-scale fish catches based on fish consumption rates. Thereafter, catches are calculated based on the fishing effort of small-scale fishers from 1980-2010.

1950-1980

We assumed that small-scale fishing from 1950-1980 was subsistence based. It is reasonable to conclude that marine fish catch was entirely consumed by the coastal population, due to preference for freshwater fish in the interior provinces (Lamberts 2001) and poor land transport infrastructure during this period. Thus, marine fish catches from 1950-1980 were estimated based on the fish protein consumption rate of the coastal population:

$$MC_i = P_i * C_i$$

where *MC* is marine catch, *P* is coastal population, and *C* is fish consumption rate in year *i*.

Cambodia's population ranged from 4.3 million in 1950 (UN 2002) to roughly 14 million in 2010. Years with data gaps were filled using linear interpolation. Coastal population was obtained by totalling the number of people in the four coastal districts of Kep, Kampot, Koh Kong, and Sihanoukville. Coastal population breakdown was only available for the years 1962 (Munson 1963), 1998, and 2008 (National Institute of Statistics 2010). We divided coastal population by national population for years with data, then linearly interpolated the proportion of coastal population for data-less years from 1962-2008. We maintained the 1962 coastal proportion for years stretching back to 1950, and kept the 2008 coastal proportion constant until 2010. Annual population data were then multiplied by coastal proportion to obtain coastal population in Cambodia from 1950-2010.

A baseline survey reported annual per capita fish consumption in coastal regions of Cambodia to be 38 kg·person^{-1}·year in 1995 (APHEDA 1997). In 1960, 10,000 t of marine fish were produced in Cambodia (Munson 1963). We divided this by coastal population in 1960 to obtain a *per capita* fish consumption rate of approximately 27 kg·person^{-1}·year. We applied the 1960 consumption rate for all years prior to 1960, linearly increased fish consumption rate from 1960-1995, then maintained the 1995 rate (i.e., 38 kg·person^{-1}·year) until 2010. To reflect the lack of fishing during the Khmer Rouge rule (1975-1979), we arbitrarily assumed that small-scale catches dropped to 10% of their usual level.

1980-2010

In this period, marine fish catches were estimated based on fishing effort of small-scale fishers as follows:

$$MC_i = F_i * CR_i * E_i$$

where *MC* is marine catch, *F* is the number of fishers, *CR* is catch per unit effort, and *E* is fishing effort in year *i*.

The number of fishers was estimated based on the proportion of coastal households that fish. This was obtained by dividing the number of people employed under the 'Fishing and aquaculture' industrial category (National Institute of Statistics 2010) in the 1998 and 2008 census by the coastal population. We assumed that in coastal provinces 'fishing' referred to marine fishing and not inland fishing. We also assumed that the number of people employed in aquaculture

[2] http://www.illegal-fishing.info/item_single.php?item=news&item_id=3077&approach_id=19, Accessed 28 January 2013.

in coastal provinces is negligible, because Cambodian aquaculture is based mainly on inland cage culture and some pond-based production systems (Joffre *et al.* 2010). We arbitrarily assigned 85% of fishing employment to direct fishing and 15% to indirect fishing, based on the understanding that small-scale fisheries tend to have a heavy harvest base due to the low fishing technology in use. The final computed proportion of coastal fishing households in 1998 and 2008 was almost identical at 9.1% and 8.9% respectively.

In the early 1980s, about 30-50% of people in one fishing community in Koh Kong province were fishers (Sherman *et al.* 2007). Given that civil society, including fishing, was severely disrupted by the violent Khmer Rouge regime, we assumed that repatriation of people to a fishing livelihood was not complete until 1985. As such, we started with 10% fishing proportion in 1980, then raised it to 30% as the proportion of coastal fishing households in 1985. We then linearly interpolated missing values from 1986-1998 and 1999-2008, and maintained the 2008 proportion until 2010. We conservatively assumed one fisher per household from 1980-2010.

Data on number of households in coastal provinces were available for 1998 and 2008. For years prior to 1998, we estimated number of households by dividing coastal population by average household size. In 1998 and 2008 the average household sizes were 5.4 and 4.6 respectively (National Institute of Statistics 2010). We linearly interpolated household size between the 1998 and 2008, and maintained the 2008 value until 2010. For years prior to 1998, we assumed that change in household size mirrored the annual change in coastal population size from 1980-1997. This resulted in an average household size of 6.03 in 1980. We then obtained the number of coastal households from 1980-2010 by dividing coastal population by average household size.

Table 1. Annual small-scale catch rate estimates in anchor years.

Year	CPUE (kg·trip^{-1}·fisher^{-1})	Effort (trips·fisher^{-1}·season^{-1})	Catch rate (t·fisher^{-1}·season^{-1})
1980	51	36	1.9
1999	36	70	2.5
2004	-	-	2.1
2009	-	-	1.1

We derived catch rates (Table 1) from the following case studies:

i) 1980: Using traditional gear and non-motorised boats, fishers could catch between 50-80 kg of fish and shrimp per night (Sherman *et al.* 2007). In another community, fishers caught between 20-40 kg of fish and 5-10 kg of shrimp per day (Sherman *et al.* 2007). We took the average of the total catch at each community (67.5 kg and 37.5 kg), which resulted in a catch rate of 51 kg·fisher^{-1}·day^{-1};

ii) 1999: A study of small-scale fishing in 8 villages in Koh Kong province describes gear type, catch, and catch composition (Chu *et al.* 1999 in Gillett 2008). The average catch from single trawls operating in near-shore waters less than 10 m depth was 36 kg·trip^{-1};

iii) 2004, 2009: An in-depth study of fishing in Sre Ambel lagoon in Koh Kong province reported a drop in fish catches from approximately 2.1 t·fisher^{-1}·season^{-1} in 2004 to 1.1 t·fisher^{-1}·season^{-1} in 2009[3] (Doma 2011).

All years with missing data were linearly interpolated between the anchor points, and the catch rate was held constant from 2009-2010.

Fishing effort data were based on small-scale fishing practices in Sre Ambel, Koh Kong province (Doma 2011). We derived a weighted average effort of 72 trips·season^{-1} in 2000, and 64 trips·fisher^{-1}·season^{-1} in 2005. We had no information on fishing effort in the 1980s. We assumed that fishing effort would be lower in 1980 because i) people were just returning to fishing after the fall of the Khmer Rouge regime in 1979, during which fishing was banned; and ii) fishing was still largely a subsistence based activity, done alongside rice cultivation (Sherman *et al.* 2007). As such, we conservatively applied a fishing effort rate that was half that of the 2000 level, i.e., 36 trips per season in 1980. All years with missing data were linearly interpolated between these anchor points.

Catch sold at sea

We started accounting for unreported catch sold at sea by Cambodian vessels in 1965, the year that commercial trawling commenced. It is estimated that about 25% of marine fisheries catch by Cambodian vessels is landed outside of the country and not included in official statistics (Flewwelling and Hosch 2004 in Gillett 2008). Some sources suggest that up to 80% of marine fisheries production is sold at sea and not landed in Cambodia (Chansothea *et al.* 2007; FAO 2011), i.e. reported catches are only 20% of total marine fisheries production. We assumed that the higher estimate prevailed from 1965 until 1990, a period when fisheries management was minimal due to political instability. We started to linearly decrease the unreported portion in 1991 from 80% to 25% in 2000, based on the assumption that fisheries officials began to accommodate for unreported catches sold as sea as they became more aware of the situation. The year 1990 was selected because reported catch increased by 53% from 1989 to 1990, which is suggestive of a change in accounting system. Unreported catches sold at sea were then maintained at 25% of marine production from 2000 until 2010.

Estimated catches sold and trans-shipped at sea from 1965-1969 and 1970-2000 were summed and distributed across those periods to avoid creating sharp increases in the early 1970s and 1990s. Total catches from 1965-1969 were distributed in incremental increases, while total catches from 1970-2000 were evenly distributed. We halved the weighted average quantity of catches sold at sea from 1975-1979 to account for decreased fishing activity during the Khmer Rouge regime. Catches at sea were linearly interpolated from 2001 to 2004, the year in which we reverted to using unadjusted quantities of catch sold at sea. We did this to recognise possible improvements in Cambodia's fisheries statistics accounting system.

[3] The catch rates reported by Doma (2011) were 5 t and 2.7 t per family fishing unit in 2004 and 2009, respectively. We converted these to per fisher unit based on 2.4 fishers per family (Puthy, 2007).

Discards

Fish discarding in Cambodia is low, as there is demand for low value fish for use as crab bait (Gillett 2008), conversion to fertilizer and fishmeal. It was thus reasonable to apply a minimal 1% discard rate to Cambodia (Kelleher 2005) starting in 1993, the year a fertilizer plant was built in Sihanoukville, until 2010. Before the fertilizer plant was built, low value fish had no market value and were discarded (Puthy 2011). These discards were likely not included in marine fisheries statistics.

To account for discards prior to 1993, we added back the amount of low value fish that would have been caught. We assumed that the amount of low value fish that was discarded was similar to the amount of low value fish that was being landed after it became a market commodity. To do this, we calculated the average proportion of low value fish in marine catches from 1993-2010. Then, for every year from 1965 to 1992, the difference between that year's low value fish proportion and the average proportion of low value fish from 1993-2010 was assumed to be discarded at sea. Hence, annual discards (d) from 1965-1992 were estimated as:

$d = (t_a - t_i)^* l_i$

where t_a = average low value fish proportion from 1993-2010; t_i = low value fish proportion in year i (reported low value fish/total landings); and l_i = reported landings and catch sold at sea in year i.

Finally, annual reconstructed catch was computed as

Total catch = Reported landings – Over-reported catch + Unrecorded catch.

Species composition

Reported landings

Species composition of unreported commercial catches was assumed to resemble that of reported landings, which include the catches of motorised vessels with engines 30 hp. FAO data on total marine catch quantity from 1950-2010 were categorised into 8 major groups[4], but conveyed limited information. For example, 'tuna-like fishes nei' had only one non-zero entry, while 'marine fishes nei' was used as an all-inclusive category for finfish and low value fish. As such, cumulative taxonomic groups are uninformative for any type of analysis, therefore, we disaggregated 'marine fishes nei' as follows:

Low value fish – In the 1980s, low value fish made up 30-40% of total catch of fish from trawling (Puthy 2011). This proportion increased to 60-65% of trawl catches by the mid 2000s (Puthy 2011). We linearly increased the proportion of low value fish in trawl catches (T_t) from 30% in 1980 to 65% in 2005. We applied 30% from 1965-1979, and maintained 65% from 2006-2010. From 2000-2006, we obtained statistics where 'marine fishes nei' was broken down to 'finfish' and low value fish (Puthy 2011). Due to the absence of information, we assumed that the proportion of low value fish in reported catches (T_r) mirrored the temporal trend of T_t, although we acknowledge that the proportion of low value fish caught differs by gear. To determine T_r from 1965-2010, we first calculated the ratio of T_r to T_t for each year from 2000-20006. We then took the average of the ratios from 2000-2006, and kept this ratio constant stretching back to 1965.

R = average [$(T_r/T_t)_j$ ... $(T_r/T_t)_j$]

Where R = average ratio of low value fish in reported catch to low value fish from trawling; T_{rj} = Percentage of low value fish in reported catches in year j, where j= 2000 to 2006 ; and T_{tj} = Percentage of low value fish from trawling in year j, where j= 2000 to 2006.

To determine T_r for all years prior to 2000, we applied formula below. We maintained the 2006 T_r value from 2007 until 2010.

$T_{ri} = Tt_i * R$

where i = year 1965 to 2005 .

We assumed that the species composition of low value fish in Cambodian fisheries was similar to that of others in the Gulf of Thailand (Khongchai *et al.* 2003), where trawl fisheries contributed the largest proportion of low value fish (FAO 2007). Species breakdown of low value fish is presented in Table 2.

Table 2. Composition of low value fish.

Species	Proportion (%)
Leiognathidae	47
Small crabs	11
Saurida spp.	10
Apoginidae	6
Balistidae	6
Gobiidae	6
Others	14

Finfish – The quantity of finfish in reported catches was calculated as 'marine fishes nei' minus the portion that was low value fish. We allocated finfish as either demersal or pelagic fishes. As there was no data on species composition of reported landings, we assumed that finfish composition was similar to fisheries in the vicinity of the Gulf of Thailand. This is consistent with the approach taken by Csavas *et al.* (1994), who stated that Cambodian marine fish landings could be inferred from Thailand's landings in the Gulf of Thailand. There were four anchor points for determining the

Table 3. Percentage (%) of finfish belonging to demersal and pelagic groups.

	1973[1]	1992[2]	1993[2]	1994[2]
Demersal	37	28	24	19
Pelagic	63	72	76	81

[1] Vibunpant *et al.,* (2003)
[2] Gambang *et al., (*1999 in Gillett 2008)

[4] FAO fish categories were marine crabs nei, sea cucumbers nei, natantian decapods nei, marine fishes nei, marine molluscs nei, cephalopods nei, Argentine shortfin squid, and tuna-like fishes nei.

demersal and pelagic split (Table 3). The 1973 values were applied starting in 1965. Linear interpolation was used to fill in gaps in data from 1974 to 1991, then 1994 values were held constant until 2010. Species breakdown of demersal and pelagic fishes is presented in Table 4.

Annual reported catches were thus broken down to the following major groups:

Demersals – e.g., *Nemipterus* spp., *Priacanthus* spp., Lutjanidae;

1) Pelagics – e.g., Scombridae; Carangidae, Clupeidae;
2) Crustaceans – Shrimps (*Metapenaeus* spp., *Penaeus* spp.), Crabs (*Portunus* spp.);
3) Molluscs and miscellaneous invertebrates – squids and cuttlefish, shellfish;
5) Miscellaneous small marine fishes – low value fish (juveniles of commercial species) and mixed fish (species that are naturally too small to be of commercial value).

Table 4. Composition of demersal and pelagic fish groups.

Demersal	Proportion (%)	Pelagic	Proportion(%)
Nemipterus spp.	34.0	Scombridae	60
Priacanthus spp.	20.0	Atule mate	10
Rays	10.0	Megalaspis cordyla	10
Mullidae	10.0	Clupeidae	10
Sciaenidae	8.4	Stolephorus indicus	10
Lutjanidae	4.2	-	-
Tachysuridae	3.5	-	-
Ariidae	3.2	-	-
Others	6.7	-	-

Table 5. Percentage (%) composition of small-scale catches in Cambodia.

	1950	1973[1]	1999[2]
Demersals	32	8	7
Pelagics	48	36	18
Crustaceans	10	24	36
Molluscs & misc. invertebrates	10	7	9
Misc. small marine fishes	0	25	30

[1] Vibunpant *et al.,* 2003
[2] Chu *et al.,* 1999

Small-scale sector

Catch composition of the small-scale sector is presented for the years 1950, 1973, and 1999 (Table 5), of which the latter two were based on published data. The rationale for the 1950 anchor points is as follows: The majority of poor coastal households in Cambodia consume low-value marine fisheries products including fish, oysters, and other aquatic animals on a daily basis (Sopanha *et al.* 2012). A study showed that besides fish, roughly 20% of inland Cambodians' total fish diet is from other aquatic animals, such as shrimps, crabs, snails, frogs, and shellfish/ molluscs (Hortle 2007). We assumed that the diet of poor coastal households was representative of subsistence diets in the 1950s, and that the proportion of other aquatic animals in coastal inhabitants' fish diet was similar to that of inland inhabitants', i.e., 20%. Thus, in 1950 we assigned 80% of catch to finfish and 20% to non-fish groups. The non-fish proportion was evenly divided between crustaceans and molluscs and invertebrates. The finfish proportion was allocated to demersal and pelagic fish groups only; we assumed zero low value fish in 1950 as there were no trawlers at that time. The 1973 data set provided species composition of catches using traditional gears (fish gillnets, shrimp gillnets, crab traps) and pushnets from the eastern Thai portion of the Gulf of Thailand (Vibunpant *et al.* 2003). The second data set was based on a 1999 study of small-scale trawlers (30 hp boats) in Koh Kong province, Cambodia (Chu *et al.* 1999 in Gillett 2008). Composition details are provided in Table 5. We linearly interpolated values between anchor point years, and maintained the 1999 composition values to 2010.

Sectoral breakdown

We treated all catches from 1950-1964 as coming from the small-scale sector, and assumed that the commercial sector emerged in 1965 with the introduction of trawling. Prior to 1965, all FAO reported catches were allocated to the small-scale sector. From 1965-2010, we allocated FAO reported catches to the commercial sector under the assumption that there were motorized vessels in use, and due to the fact that marine fisheries statistics only accounted for catches from taxable marine vessels (30 hp), and the majority of small-scale fishers use motorised boats that are 30 hp.

The small-scale sector consists of the subsistence and artisanal sub-sectors. We defined subsistence fishing as fishing to meet family consumption and/or social obligations only, and not primarily intended for sale. In contrast, artisanal fishing is conducted for both food and financial purposes. We treated all small-scale fishing prior to 1980 as

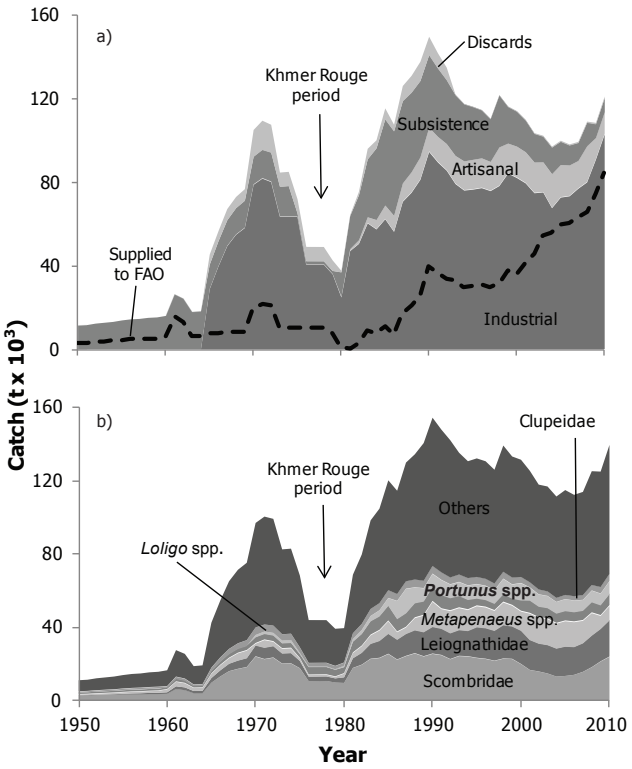

Figure 2. Cambodia reconstructed catches for 1950-2010 a) by sector. The solid line represents reported landings; b) by major taxonomic groups. "Others" represents 67 additional families.

being subsistence based, as most families also simultaneously engaged in agriculture (Doma 2011). Economic and infrastructure development accelerated in Cambodia throughout the 1990s, allowing coastal inhabitants to engage in alternative employment opportunities such as tourism. By the end of 2006, 60% of fishers were economically dependent on fishing, whereas 40% of local fishers were part-time fishers (Doma 2011). We applied this information to form anchor points of 60% artisanal and 40% subsistence fishing. We linearly interpolated the subsistence and artisanal components from 1980-2006, then maintained the 2006 values until 2010.

Foreign fishing fleets

Fishing by foreign fleets, mainly Thai, both legal and illegal, takes place extensively in Cambodian waters. Thai vessels fish heavily in the offshore area, where the Cambodian fleet has limited capacity to exploit. It is believed that Thais have been fishing in Cambodia for many years under unofficial agreements (Butcher 1999; Gillett 2004), and continue to do so regularly due to limited offshore monitoring and surveillance. An estimated 167 to 226 Thai fishing vessels were licensed to fish in Cambodia in 2002 (Gillett 2004), and annual catches from licensed Thai vessels are estimated to range between 26,500 and 37,500 t (Gillett 2004). Additionally, illegal fishing by non-licensed vessels originating from Thailand and Vietnam is also prevalent (Gillett 2004), but there are no estimates on the volume of catches taken by these vessels. Other than the catches taken by Thai vessels licensed to fish in Cambodia whose catches are incorrectly labeled as being Cambodian, we do not include other non-Cambodian catches in this reconstruction.

Results

Cambodia's reconstructed catch totalled 3.2 million t from 1950-2010 (Figure 2a). This estimate was 2.3 times the total marine landings of 1.4 million t that were reported to FAO for the same period. Fifty-eight percent of total reconstructed catch was attributed to the commercial sector, while the small-scale sector comprised 42% of reconstructed catch. Out of 3 million t of unreported catch, 1.3 million t (43%) was contributed by the small-scale sector. Of this, 980,000 t (74%) were considered to be for subsistence, with the remainder belonging to the artisanal sector (Figure 2a). Unreported catches that were sold at sea amounted to 1.6 million t (53%) from 1965-2010, while discards made up the smallest proportion at 190,000 t, about 4.6% of total unreported catches. The difference between reconstructed and reported catches was highest in the period 1950 to 1975, then again in the 1980s. During these time intervals, reconstructed catches were on average 4.4 and 21 times that of reported catches, respectively. The latter trend occurred immediately following the end of the Khmer Rouge regime in 1979. From 1990 onwards, the average discrepancy dropped to unreported catches being about 2.3 times that of reported catches.

Catch composition showed overall increasing proportions of miscellaneous small fish and demersal and pelagic fishes through time. In contrast, within the small-scale sector, both demersal and pelagic groups declined in proportion, as did molluscs and invertebrates, while crustaceans increased. Demersal composition was made up mainly of low value fish such as threadfin breams (*Nemipterus* spp.), bigeyes (*Priacanthus* spp.), and drums (Sciaenidae), and only small amounts of higher value fish such as snappers (Lutjanidae). The fish groups that contributed most to total catches from 1950-2010 included mackerels, ponyfishes, prawns, squids, jacks, and swimming crabs (Figure 2b).

Discussion

This reconstruction is the first attempt, to our knowledge, at addressing the incompleteness of Cambodia's marine fisheries statistics in a comprehensive manner, which has been highlighted by many in the past (Gillett 2004, 2008; Doma 2011). We showed that reconstructed catches were on average 229% higher than reported catches from 1950-2010. This can be considered a conservative estimate – the number of reported vessels with engines 30 hp constituted only 2% of total fishing vessels in 2009. Given that only the landings of taxable vessels (those with engines 30 hp) are reported, the magnitude of under-reporting becomes clear. Under-reporting is a consistent problem that has not been resolved due to the presence of a large small-scale fishing sector and poor enforcement of illegal foreign fishing in Cambodian waters. Overall, marine fisheries are not afforded the same financial and technical resources as the more important inland fisheries.

The bulk of unreported catches came from the small-scale sector (subsistence and artisanal fishers), which, at 1.3 million t in the period 1950-2010, was roughly equivalent to the amount of total reported catch and accounted for about one-third of total reconstructed catch. Small-scale fishing plays a crucial role in supporting food security in Cambodia's coastal villages. This point was emphasized by the reconstruction, which showed at least 17,100 fishers, or about 1.5% of the coastal population in 2010, participated in small-scale fishing. Ignoring the fisheries exploitation pressure from this sector can lead to eroded food security and give rise to other socio-economic issues in the future. Our reconstruction revealed that annual catch rates had decreased from a conservatively estimated 1.9 $t \cdot fisher^{-1} \cdot year^{-1}$ in 1980 to 1.1 $t \cdot fisher^{-1} \cdot year^{-1}$ in 2010, a drop of almost 40%. It appears that this drop has been a relatively recent phenomenon, with 2005 seemingly the turn-point (Doma 2011; Sopanha *et al.* 2012). Despite this, the number of people migrating to coastal areas is projected to grow (Gillett 2004; UNEP 2007). The open access nature of fisheries and low capital investment cost attracts many poor people to start fishing (Sherman *et al.* 2007; UNEP 2007), thereby threatening the resource base even further (Sherman *et al.* 2007). Of concern also is the trend in increasing numbers of small motorised boats (30 hp), which enables fishers to increase fishing effort (UNEP 2007). Ironically, the government has been reluctant to regulate small-scale fishing because it may 'create hardship for the poor' (Gillett 2004). Yet, it is this inaction that will likely contribute to further decline and hardship in Cambodia's small-scale fisheries.

Discards were estimated to total around 190,000 t from 1965-2010. Discarding was more common before the opening of a fertilizer factory in the early 1990s (Puthy 2011) and fishmeal factory in the 2000s (UNEP 2007). Even then, third grade marine fish, presumably the type that would be discarded, likely had a use as input for low grade fish sauce, the commercial production of which had started in Cambodia in 1940 (Sophat 2004). This is reflected in our reconstruction, whereby annual discards averaged 6,400 t from the mid 1960s to 1990, compared to 1,100 t from 1991 until 2010. The latter period was when new markets emerged for low value fish, and influenced trawlers to target and land low value fish (Puthy 2011).

Our catch composition breakdown provides an approximate idea of how marine fisheries species have changed over time in Cambodia. To our knowledge, species data are not recorded nationally, so this is the first temporal presentation of Cambodia's likely catch composition. Given the absence of detailed Cambodian catch composition data, we used surveys and/or studies conducted in Peninsular Malaysia and the Thai portion of the Gulf of Thailand. Csavas *et al.* (1994) similarly inferred Cambodian catches from Thailand fisheries, thus it was the best approximation we could make under such poor data conditions. We acknowledge that the fisheries in Thailand and east coast of Peninsular Malaysia were more advanced than those in Cambodia, therefore may reflect trends that are not in synch with Cambodia's slower development, or may not fully capture characteristics that are unique to Cambodia's fisheries.

There was uncertainty over whether catches of non-Cambodian vessels, or catches taken by Cambodian vessels outside of Cambodia, were included in marine statistics. The continuous upward trend in catches since 2000 may reflect increased overall fishing effort. Alternatively, the seemingly linear trend in catch increases since 2000 may be suggestive of systemic over-reporting (as per Watson and Pauly 2001). This situation may arise if fisheries officials' have personal gains, such as a job promotion, tied to achieving increased fisheries productions from their area of management (Watson and Pauly 2001). Notwithstanding, it is another reason to treat reported landings with caution. We did not include extra catches for shrimp that apparently have not been reported to FAO since 1992 (Gillett 2008). The rationale for this is that crustaceans make up about 1/3 of small-scale catches, and we had already accounted for this sector elsewhere in the reconstruction. In fact, an independent FAO source estimated that 12,600 t of shrimp were captured from Cambodian coastal waters in 2004 (Gillett 2008), a figure that is in the same magnitude as this reconstruction's estimated shrimp catch in 2004 (18,006 t). Nonetheless, due to the very limited availability and quality of data, we were not able to address these issues to the full extent we would have liked.

The inshore zone from shore to the 20-m isobath is considered heavily exploited, and is threatened by population growth, land based development, unregulated fishing effort, and destructive fishing methods (Gillett 2004; UNEP 2007). Degradation of marine resources is likely to continue if fisheries administrators continue to be complacent on enforcing existing regulations. A first step would be to overhaul existing methods for collecting and managing marine fisheries data, so that information (such as better taxonomic composition data) that is required for at least preliminary assessments of stock status (Froese *et al.* 2012; Kleisner *et al.* 2012) is collected or sampled and raised to annual totals. Offshore fisheries remain under-used by Cambodian fishers, and strategies to encourage a more even spatial distribution of existing fishing effort, while curtailing further capacity growth (Watson *et al.* 2012), may relieve pressure on inshore fish stocks. Controlling illegal fishing by foreign vessels can prevent at least 26,500 t of fish from being taken out of Cambodian waters annually that do not contribute to Cambodia's food security or its economy. In fact, Cambodia was recently warned of facing possible European Union sanctions if it did not take steps quickly to fight illegal and unregulated fishing (Bloomberg 2012).

Although reconstructed catches are over 200% higher than reported catches, our estimate is likely conservative. We based the number of fishers on census data, which likely underestimated the number of real fishers, since subsistence fishers may not always identify themselves as such. Fishing effort data were sourced from only one case study (Doma 2011) – the annual catch rate of 1.1 t·fisher^{-1} in the late 2000s is low compared to regional fisheries, where small-scale fishers can catch up to 3 t·fisher^{-1}·year^{-1} (Louise Teh and Lydia Teh, unpublished data). However, it is also true that the fishing power of Cambodia's small-scale fleet is low compared to others in the region. One source estimated that only 10% of fishers are licensed (Gillett 2004), hence up to 90% of fishing effort may not be accounted for in national marine fisheries statistics. This suggests that total landings may be up to a magnitude higher than current reported landings, which is a level far higher than the level estimated by this reconstruction.

Marine fisheries management in Cambodia has tended to exist in the shadow of the country's inland fisheries, resulting in large gaps in knowledge about the state of the resource and the people who depend on it. This study provides a first attempt at establishing a time series of marine catches in Cambodia, and should be a wake up call to pay attention to how much is being extracted from the marine environment before it is too late.

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

Year	FAO landings	Reconstructed total catch	Industrial	Artisanal	Subsistence	Discard
1950	3,400	11,300	-	-	11,300	-
1951	3,400	11,500	-	-	11,500	-
1952	3,900	12,200	-	-	12,200	-
1953	4,100	12,600	-	-	12,600	-
1954	4,300	13,000	-	-	13,000	-
1955	4,800	13,700	-	-	13,700	-
1956	5,100	14,300	-	-	14,300	-
1957	5,100	14,500	-	-	14,500	-
1958	5,400	15,000	-	-	15,000	-
1959	5,400	15,200	-	-	15,200	-
1960	5,900	15,900	-	-	15,900	-
1961	15,900	26,200	-	-	26,200	-
1962	13,500	24,200	-	-	24,200	-
1963	6,800	17,800	-	-	17,800	-
1964	6,800	18,100	-	-	18,100	-
1965	7,600	40,500	24,000	-	11,600	4,870
1966	7,600	51,700	34,900	-	11,900	4,870
1967	8,500	61,700	44,000	-	12,200	5,440
1968	8,500	67,500	49,500	-	12,600	5,440
1969	8,800	71,100	52,500	-	12,900	5,640
1970	20,200	92,200	66,000	-	13,200	12,940
1971	22,000	95,400	67,800	-	13,600	14,090
1972	21,000	94,100	66,800	-	13,900	13,450
1973	10,800	77,700	56,600	-	14,200	6,920
1974	10,800	78,100	56,600	-	14,600	6,920
1975	10,800	65,000	56,600	-	1,500	6,920
1976	10,800	42,100	33,700	-	1,500	6,920
1977	10,800	42,100	33,700	-	1,500	6,920
1978	10,800	42,100	33,700	-	1,500	6,920
1979	8,000	37,500	30,900	-	1,400	5,120
1980	1,200	36,800	24,100	300	11,600	770
1981	814	63,800	46,600	700	15,900	500
1982	3,015	73,700	48,800	1,500	21,600	1,740
1983	9,444	90,900	55,200	2,700	27,800	5,160
1984	7,721	96,200	53,500	4,300	34,400	3,980
1985	11,178	110,000	57,000	6,400	41,300	5,410
1986	7,247	104,300	53,000	7,500	40,500	3,280
1987	17,567	118,800	63,400	8,500	39,500	7,390
1988	21,096	122,800	66,900	9,500	38,200	8,220
1989	26,146	128,400	71,900	10,500	36,600	9,360
1990	39,927	140,800	85,700	11,300	34,900	8,960
1991	36,454	134,500	82,200	12,000	32,900	7,400
1992	33,778	128,900	79,600	12,500	30,700	6,130
1993	33,169	121,700	79,000	13,200	29,200	330
1994	30,054	117,300	75,800	13,700	27,400	300
1995	30,500	116,000	76,300	14,000	25,400	310
1996	31,200	114,400	77,000	14,000	23,100	310
1997	29,800	110,100	75,600	13,700	20,500	300
1998	32,200	121,500	78,000	18,200	25,000	320
1999	38,100	116,000	83,900	14,100	17,600	380
2000	36,000	113,800	81,800	14,700	16,900	390
2001	42,000	109,500	79,200	14,600	15,300	430
2002	45,850	103,100	74,400	14,400	13,800	460
2003	54,750	101,800	74,700	14,200	12,400	560
2004	55,800	96,600	67,100	16,000	12,800	560
2005	60,000	99,300	72,200	15,300	11,200	600
2006	60,500	97,600	72,800	14,500	9,700	610
2007	63,500	98,800	76,400	13,000	8,700	640
2008	66,000	108,400	79,400	17,000	11,400	660
2009	75,000	107,800	90,200	10,100	6,700	750
2010	85,000	120,300	102,300	10,300	6,900	850

Appendix Table A2. Reconstructed total catch (in tonnes) by major taxa for Cambodia, 1950-2010. 'Others' contain 73 additional taxonomic categories.

Year	Scombridae	Leiognathidae	*Metapenaeus* spp.	*Loligo* spp.	*Portunus* spp.	Clupeidae	Others
1950	3,250	-	480	790	240	540	6,000
1951	3,280	60	520	790	260	550	6,100
1952	3,440	130	590	830	290	570	6,500
1953	3,520	200	640	850	320	590	6,700
1954	3,590	270	700	860	350	600	6,900
1955	3,740	360	770	900	380	620	7,300
1956	3,840	450	840	920	420	640	7,600
1957	3,850	530	890	920	440	640	7,700
1958	3,940	630	960	940	480	660	8,000
1959	3,950	720	1,010	940	510	660	8,100
1960	4,080	840	1,540	970	-	680	8,600
1961	6,650	1,520	2,440	1,570	-	1,110	14,500
1962	6,060	1,530	2,230	1,430	-	1,010	13,500
1963	4,400	1,220	1,620	1,030	-	730	10,000
1964	4,420	1,330	1,620	1,040	-	740	10,300
1965	10,100	2,570	2,290	1,540	-	1,680	24,600
1966	13,470	3,360	2,800	1,910	-	2,240	31,000
1967	16,390	4,050	3,060	2,230	-	2,730	37,000
1968	17,660	4,500	4,040	2,370	-	2,940	40,200
1969	18,660	4,800	4,190	2,490	-	3,110	42,300
1970	24,460	5,930	1,080	3,260	1,350	4,080	57,200
1971	22,990	6,170	4,250	3,130	1,420	3,830	59,000
1972	23,830	6,200	2,460	3,210	1,530	3,970	58,400
1973	20,510	5,520	2,640	2,720	1,650	3,420	46,400
1974	20,650	5,580	2,700	2,720	1,690	3,440	46,500
1975	18,000	3,980	1,410	2,050	880	3,000	39,300
1976	10,910	2,500	900	4,110	560	1,820	23,400
1977	10,980	2,500	900	4,060	560	1,830	23,400
1978	11,040	2,500	900	4,000	560	1,840	23,300
1979	10,200	2,280	850	3,600	530	1,700	20,300
1980	9,980	3,080	2,030	3,270	1,000	1,660	18,800
1981	18,140	5,290	2,930	5,900	1,710	3,020	32,000
1982	19,920	6,470	3,700	6,400	2,310	3,320	38,000
1983	23,150	8,130	4,760	7,430	2,960	3,860	48,500
1984	23,630	9,240	5,750	7,510	3,380	3,940	51,700
1985	25,840	10,920	6,950	8,220	4,320	4,310	60,100
1986	22,740	10,810	4,190	6,940	9,970	3,790	56,500
1987	24,700	11,990	3,610	7,550	13,460	4,120	64,900
1988	26,180	12,510	6,730	7,940	8,670	4,360	68,500
1989	24,500	13,160	9,180	7,480	7,300	4,080	75,300
1990	25,940	14,580	13,830	7,790	7,340	4,320	81,100
1991	25,210	14,330	10,800	7,510	8,260	4,200	78,100
1992	22,970	14,090	12,230	6,860	7,560	3,830	75,100
1993	24,720	14,070	12,080	6,430	7,720	4,120	66,600
1994	24,500	13,840	11,480	5,390	7,890	4,080	63,900
1995	23,660	16,690	11,570	4,020	7,920	3,940	64,800
1996	23,140	16,700	11,400	3,890	7,790	3,860	64,300
1997	22,090	16,310	10,970	3,690	7,470	3,680	62,200
1998	23,290	18,190	12,480	4,300	8,500	3,880	69,000
1999	23,090	17,710	11,420	3,690	7,750	3,840	66,200
2000	20,310	18,150	10,560	5,910	9,480	3,380	64,100
2001	17,050	16,340	14,500	6,930	7,210	2,840	61,000
2002	16,230	15,200	14,200	5,860	6,750	2,700	57,300
2003	15,130	15,500	14,240	5,830	6,660	2,520	57,400
2004	13,450	15,280	13,680	5,300	6,380	2,240	55,500
2005	13,770	16,010	13,950	5,340	6,590	2,300	57,400
2006	14,380	15,170	13,660	5,260	6,400	2,400	55,400
2007	16,010	15,590	12,370	5,260	5,990	2,670	56,400
2008	18,550	17,230	12,350	5,780	6,400	3,090	62,200
2009	21,720	17,690	7,240	5,590	6,430	3,620	63,100
2010	24,310	19,780	7,960	6,280	7,090	4,050	70,500