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Abstract

Total marine fisheries catches for French Guiana from 1950-2010 were estimated using a method called 'catch reconstruction'. Our reconstruction of marine fisheries catches included estimates of all domestic fisheries catches. These included the local commercial sector, small-scale fisheries for subsistence, the shrimp fishery (French vessels only) and discarded by-catch from French shrimp trawlers. Foreign fisheries catches in French Guiana's waters that target shrimp and snapper are also included. Total catches by domestic fisheries in French Guiana were estimated to be approximately 767,000 t over the period 1950-2010, which is 4 times the officially reported landings presented by the FAO on behalf of French Guiana (177,719 t). This large difference is mainly due to discards associated with the domestic shrimp trawl fishery that totaled 555,000 t over the study period. This study illustrates the need for better reporting of fisheries catches in French Guiana as there are currently large amounts of fish being caught and/or discarded that are unaccounted for in the catch statistics.

Introduction

French Guiana is a French overseas department located on the northeast coast of South America, between Suriname and Brazil, and has a land area of about 86,500 km² and an Exclusive Economic Zone (EEZ) of nearly 126,000 km² (Figure 1). The territory is one of the four overseas departments of France, and is a part of the Republic of France and a member of the European Union since 1957. The territory is divided into two urban districts: Saint-Laurent du Maroni and Cayenne (prefecture of French Guiana); 96% of the land is covered by rainforest.

In French Guiana, there are several commercial fisheries that take place on the continental shelf. These include a shrimp fishery, which targets mainly brown shrimp (*Farfantepenaeus subtilis*) and pink shrimp (*Farfantepenaeus brasiliensis*), a snapper fishery which targets red snapper (*Lutjanus purpureus),* lane snapper (*Lutjanus synagris),* and vermilion snapper (*Rhomboplites aurorubens*; Charuau 1997), and a small-scale fishery which supplies the local market. In addition to the commercial fisheries for shrimp, snapper and the local market, there is an informal sector which operates near-shore, harvesting for subsistence purposes.

The shrimp and snapper fisheries of French Guiana are, in part, foreign access fisheries. Shrimp fisheries were predominantly exploited by the United States from the 1950s to the mid-1980s, and since the 1990s, shrimp stocks have been almost entirely exploited by France. Although French shrimp trawlers send their catch to Europe, here it is considered a domestic fishery as French Guiana is an overseas department of France. Snapper is mainly exploited by Venezuela, although some snapper is also caught by local commercial vessels. Local commercial fisheries have traditionally used canoes to fish in mangrove swamps and estuaries. The main species caught in this sector are gillbacker (*Sciades herzbergii*), sea catfish (*Bagre bagre*), croaker (*Micropogonias furnieri*, *Stellifer stellifer*), mullet (*Mugil curema*, *Mugil incilis*), and grouper (*Ephinephelus itajara*, *Ephinephelus striatus*).

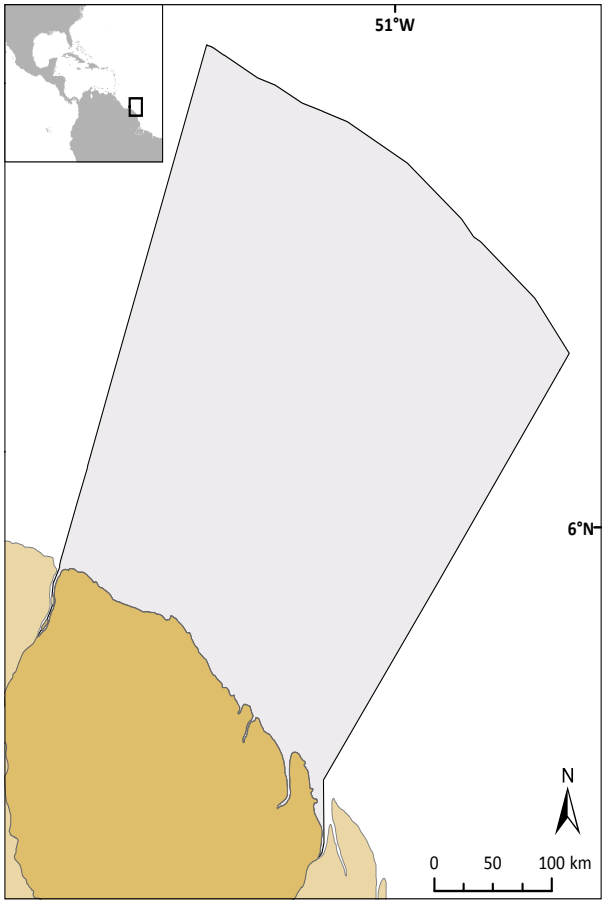

Figure 1. Map of French Guiana including EEZ

Time series data on marine fisheries landings since the 1950s is publically available from the United Nations Food and Agriculture Organization's FishStat database (www.fao.org/fishery/statistics/en). The FAO data are based on national statistical data supplied by its member countries and therefore, the quality of the data depends on the capacity for statistical collection within these countries. Data obtained from the FAO have been the basis of many global fisheries studies (e.g., Pauly *et al.* 1998) but they are, in fact, incomplete (Zeller *et al.* 2006; Zeller *et al.* 2007). FAO statistics often report only commercial landings and rarely account for other fisheries catch components such as subsistence fisheries, Illegal, Unreported and Unregulated (IUU) catches, and discarded by-catch, which can often be quite substantial.

The objective of the present study is to provide an estimate of total marine fisheries catches taken by French Guiana's domestic fisheries as well as an estimate of the catches taken in the waters of French Guiana by foreign fleets. These estimates will provide a more comprehensive estimate of marine fisheries removals in French Guiana and will serve as a scientific baseline in the face of continued exploitation and climate change.

Methods

Total marine fisheries catches for French Guiana were estimated from 1950-2010 by estimating catches from the commercial and subsistence sectors. Specifically, we estimated catches in French Guiana's waters that were considered domestic fisheries. These included domestic catches destined for the local market and those caught for subsistence, as well as catches by the French trawl fishery for shrimp and the associated discarded by-catch. The total of all domestic fisheries components from 1950-2010 was then compared to total FAO landings for the same time period. Total catches by foreign fisheries were also estimated but were not included in our comparison. Foreign catches included the US and Japanese shrimp fisheries in earlier decades, discards from the US and Japanese shrimp fisheries and catch from the Venezuelan snapper fishery.

Population

To estimate per capita rates for subsistence catches in French Guiana, we obtained population data from a population statistics historical demography website (www.populstat.info), which provides census data every few years. In years when no census data were available, a linear interpolation between neighboring years was done to estimate population values for the missing years (Figure 2). We assumed that marine fisheries concern only coastal residents in terms of seafood consumption, as the inland population would rely more on freshwater fish resources. Due to the vast amount of rainforest coverage inland, the majority of people in French Guiana live near the coast (Artigas *et al.* 2003). Using historical demographic data on municipalities of French Guiana, we estimated that 92% of the population live along the coast and 8% live inland (www.populstat.info). To determine the urban versus rural population breakdown, we used information obtained from the UN Population Division. In 1950, the urban to rural population split was almost half and half. The population as a whole increased from 1950 with the urban population increasing at a higher rate than the rural population. By the late 1970s, almost 70% of the population was living in urban areas. In 1950 the coastal population of French Guiana was almost 25,000 and by 2010 the coastal population was approximately 200,000 (Figure 2). In the mid-1980s the population started increasing at a faster rate than in the previous time period (1950-1980; Figure 2).

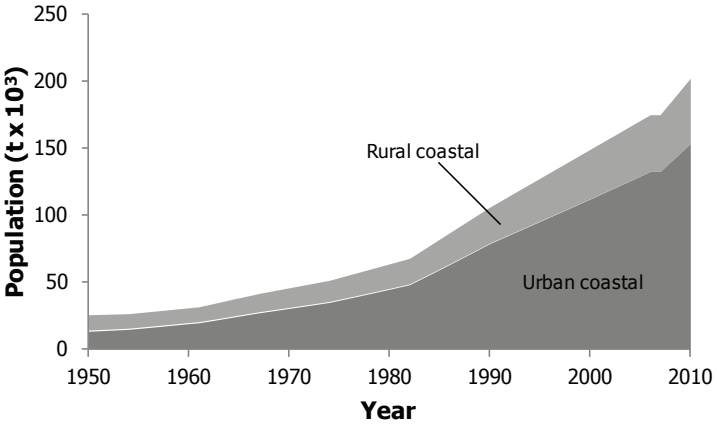

Figure 2. Coastal population of French Guiana, divided into rural and urban sub-sectors, 1950-2010.

Domestic fisheries

Data on the main domestic fisheries in French Guiana— small-scale commercial catches for the local market (artisanal) and for subsistence, and the shrimp fishery by French vessels—were extracted from FAO fisheries statistics database and from reports published by independent researchers. For fisheries that were lacking a complete time series of catch data, we estimated the missing catch data by linear interpolation between zero catches the year before the fishery started to the first year of available data. This approach assumes that exploitation increased only by a small amount each year, when in fact it is likely to have increased quickly at the beginning and then stabilized, which would have resulted in a higher overall value. However, to remain conservative in our approach, we assumed a linear increase.

Local commercial (artisanal)

Local commercial catch data for the period 1970-1979 were obtained from a report by the Western Central Atlantic Fishery Commission (Anon. 1983). Catch numbers from the report (Anon. 1983) were comparable to the FAO data (minus the shrimp landings) for this same period. Thus the FAO data, obtained from the FishStat database were considered to be the best described estimate of catches by the local commercial fleet. As the FAO data present shrimp catches, which are deemed to be caught by French vessels (see below), we used the FAO data, excluding the 'Penaeus shrimps nei' category, as the best estimate of local commercial catches for the years 1950-2010. The FAO data aggregates the commercial fish landings into one category ('marine fishes nei') prior to 2005. We used the species composition for the local commercial fishery described in Anon. (1983) to disaggregate the landings by species or group from 1950-2005 (Table 1) and retained the FAO species breakdown for the 2005-2010 period. The main species caught by the local commercial sector and sold in the local market are Sciaenids, catfish, sharks, tripletail, mullets, snook and tarpon (Anon. 1983).

Table 1. Species composition (%) of the annual artisanal (small-scale commercial) landings by French Guiana for the local market (Anon. 1983).

Family or group	Proportion of catch
Sharks	40.4
Sciaenidae	21.3
Ariidae	14.6
Mugilidae	12.9
Misc. marine fish	10.0

Subsistence

In the absence of subsistence fisheries data, the subsistence catch was estimated based on a report on total catches of 812 t presented in Hardy (1947). We assumed that at this time most fisheries were artisanal with some catches being sold at the local market and a portion retained for personal consumption. We also assumed that the catch total presented in Hardy (1947) included shrimp catches, which were considered exports. We subtracted commercial catch (FAO data) destined for the local market and shrimp catches (FAO data) from Hardy's estimate of 812 t for 1950 and the remaining catch was considered to enter the non-market economy (i.e., fish retained by fishers for personal consumption; may be traded or bartered but not sold). We assumed that this remaining catch was mainly for the rural coastal population, as the urban population likely had greater access to commercially caught fish, available at the local market. We assumed that the per capita subsistence catch rate in 2007 was half that of 1950, reflecting the improved infrastructure (i.e. processing facilities, roads, etc.) and enhanced distribution systems that occurred over the study period. This increase in access to commercial products by rural people would cause a decrease in subsistence catch rates over time. To derive a complete time series, we interpolated linearly from the 1950 per capita subsistence rate based on Hardy (1947) to our assumption-based rate for 2010. The subsistence rates were then applied to the rural coastal population through the entire time series to get annual estimates of subsistence catches from 1950-2010.

Table 2. Relative abundance (%) of species found in the 0-20m isobaths region of the continental shelf of French Guiana used to determine species composition of the subsistence fishery (Source: Guéguen 2000).

Family or group	Proportion of catch
Rays	45.1
Ariidae (catfish)	31.8
Sciaenidae (weakfish, croaker)	10.1
Seabob (local shrimp)	2.7
Misc. marine organisms	10.3

The species composition for subsistence catches in French Guiana were based on relative abundance estimates of near-shore species (0-20 m isobaths) taken from Guéguen (2000). Artisanal fisheries take place within the 10 m isobaths region of the continental shelf, with fishers using gill-nets to target fish mainly for subsistence purposes (Charuau 1997). We assumed that the subsistence catch composition would be similar to that given by Guéguen (2000; Table 2).

Industrial shrimp (France)

In the early time period the shrimp fishery was dominated by French vessels, which were considered domestic catch as French Guiana is an overseas department of France. US vessels also trawled French Guiana's waters but were considered foreign catch (See Foreign Fisheries section below). Since 1992, France has held all of the shrimp trawler licenses for the waters of French Guiana (Charuau and Die 1997). The two main areas being trawled for shrimp are the continental shelf, which yields southern brown shrimp (*Farfantepenaeus subtilis)* and pink spotted shrimp (*Farfantepenaeus brasiliensis*), and a smaller deep water fishery on the shelf slope, which yields mainly the deep-water shrimp (*Solenocera acuminate*) and the scarlet shrimp (*Parapenaeus edwarsianus*; Charuau 1997). FAO shrimp landings data were comparable to data obtained from several reliable, independent sources for shrimp catches by France, which were estimated from the number of French vessels and the catch per vessel given in Charuau and Die (1997) for the period 1977-1996. The number of vessels reported in Charuau and Die (1997) were almost identical to the number of vessels given by Dintheer and Le Gall (1988). Therefore, we accepted the FAO shrimp landings over the entire 1950-2010 time period. Charuau and Die (1997) estimated that in the mid to late 1990s, shrimp catches in French Guiana were 86-92% brown shrimp (*P. subtilis*) and 7-13% pink spotted shrimp (*P. brasiliensis*). These percentages were applied throughout the time period to derive catch by species.

Discarded by-catch from the shrimp trawl fishery were calculated using a discard rate of 84.2% given in Keller (2005) for French Guiana's shrimp trawl fisheries. This translates into a discard to shrimp ratio of 5.3 to 1, which is similar to rates presented in other studies. A study by Charlier (2000) gave a by-catch to shrimp ratio of 5:1 and a report by Charuau and Medley (2000a) stated that 30,000 t of fish were discarded annually (an approximate ratio of 7.7 to 1). The species composition of discarded by-catch was based on a study on discards from the shrimp trawl fishery in Venezuela (Marcano *et al.* 2001). The species composition of discards from the shrimp trawl fishery was given for three areas and we used the Atlantic coast region, which is nearest to French Guiana. All species listed were cross-referenced in FishBase (www.fishbase.org) to verify that these species were also found in French Guiana's waters. Separate data for 15 species were listed in the Venezuelan study and the remaining 28 were grouped and described as miscellaneous marine fishes (which represented 18.4% of the composition). In order to reduce the amount of discards labelled as "others", the composition of the 15 species only was calculated at the family level and applied to 13.4% of the "others" category, leaving 5% of the discards as miscellaneous marine fish (Table 3).

Table 3. Species composition (%) of by-catch from the shrimp trawl fishery in French Guiana derived from an FAO study (Marcano *et al.* 2001) on discards from the Venezuelan shrimp trawl fishery.

Family	Taxonomic group	Proportion of discards (%)
Ariidae	Ariidae	5.4
Batrachoididae	*Porichthys* sp.	5.5
	Batrachoididae	0.9
Bothidae	*Trichopsetta caribbaea*	4.3
	Bothidae	0.7
Clupeidae	*Harengula clupeola*	2.3
	Clupeidae	0.4
Gerreidae	*Diapterus rhombeus*	3.7
	Gerreidae	0.6
Haemulidae	*Genyatremus luteus*	12.8
	Haemulon boschmae	4.3
	Haemulon steindachneri	2.8
	Haemulidae	3.3
Rhinobatidae	*Rhinobatos percellens*	2.4
	Rhinobatidae	0.4
Rhizostomatidae	*Stomolophus* sp.	6.7
	Rhizostomatidae	1.1
Sciaenidae	*Larimus breviceps*	2.5
	Macrodon ancylodon	13.1
	Nebris microps	6.5
	Sciaenidae	3.6
Serranidae	*Diplectrum formosum*	3.5
	Serranidae	0.6
Tetraodontidae	*Lagocephalus laevigatus*	3.6
	Tetraodontidae	0.6
Trichiuridae	*Trichiurus lepturus*	3.0
	Trichiuridae	0.5
Misc. marine fish	Approximately 28 species	5.0

Foreign Fisheries

Foreign fisheries in French Guiana considered here were the Venezuelan snapper fishery, the US shrimp fishery and the Japanese shrimp fishery. It is likely that other foreign vessels were fishing in French Guiana's waters, especially prior to the establishment of their EEZ in 1977 (Booth *et al.* 2000). However, we were only able to account for the Venezuelan snapper fishery and the US and Japanese shrimp fisheries as these are both well documented. For foreign fleets fishing in French Guiana, we assumed that the catch was reported by the respective flag country. With the establishment of an EEZ in 1977, French Guiana initiated licensing systems that may have restricted the activity of foreign vessels (Jones and Villegas 1980).

Shrimp (US)

The United States started exploratory fisheries for shrimp in the waters of French Guiana in 1944, started to trawl shrimp commercially in 1959 and continued trawling until 1990, which was the last year of catches (Jones and Villegas 1980). To estimate US shrimp catches from 1950 onward, we assumed that catches were zero in 1943 (the year before exploratory fishing began) and a linear interpolation was done to the first available data point in 1968. Catch by US shrimp trawlers were estimated from vessel numbers and yield (catch/vessel) presented in Charuau and Die (1997) for the period 1968-1990. Discards associated with this fishery were estimated based on the rate given by Keller (2005) for French Guiana's shrimp trawlers. Shrimp trawling in the early years likely had even higher discard rates as gear was less selective and benthic biomass even greater (Charlier 2000; Schratzberger *et al.* 2002; Gillett 2008). However, to remain conservative we used the rate of 84.2% given by Keller (2005). To derive a species breakdown for discards by US shrimp trawlers we used the composition given by Marcano *et al.* (2001; Table 2).

Shrimp (Japan)

A small Japanese shrimp trawl fleet operated in French Guiana from 1979-1986. Catches were estimated using the average number of vessels (Dintheer and Le Gall 1988) and the annual yield in tonnes per vessel (Charuau and Die 1997).

Snapper

The commercial snapper fishery exploited by Venezuelan longline vessels began in the 1940s, although reliable data have only been available for years when a licensing system was in place, 1985-1999 (Charuau and Medley 2000b). The three main species landed were red snapper, lane snapper, and vermilion snapper (Charuau 1997). As part of their fishing license agreement, Venezuelan boats are required to land and sell 75% of their catch in French Guiana; the other 25% is stored on board and landed in Isla Margarita, Venezuela (Charuau and Die 1999). Another

requirement of the license was for the boat operator to have a contract with a local processing plant in French Guiana (Charuau 1997). The majority of the catch, while landed and processed in French Guiana is exported, mainly to the French Antilles (Anon. 2006). We therefore consider that these catches are not part of the local commercial catch nor contribute to the local seafood supply.

Although the snapper fishery began in 1940, independent data on the snapper fishery were only available for 1985–1999 (Charuau and Die 1999; Charuau *et al.* 2000). We assumed that the catch prior to 1940 was zero and a linear interpolation was done from zero in 1939 to the first available data point in 1985. After 1999, the catch was held constant and carried forward in time. There were no reported catches in 1981, as the fleet was grounded due to "high operational costs" (Anon. 1983).

Results

Domestic fisheries

Local commercial (artisanal)

The total landings reported by the FAO for the period 1950-2010, excluding shrimp landings, were over 93,000 t (Figure 3). We assumed that these numbers represented the local small-scale commercial fisheries sector (i.e., artisanal). In 1950, the local commercial catch was estimated at 200 t, increasing to an average of approximately 1,000 t·year^{-1} in the 1970s and then substantially increased to an average of almost 3,500 t·year^{-1} in the early to mid-1990s (Figure 3). Catches decreased after that and catches averaged 2,300 t·year^{-1} for the remainder of the study period.

Subsistence

Subsistence catches were estimated at 412 t in 1950, increasing to 600 t by 1987 and 880 t by 2010 (Figure 3). Total catches by the subsistence sector over the period 1950-2010 were estimated to be 33,960 t, which translates to an additional 30% over the FAO reported catch.

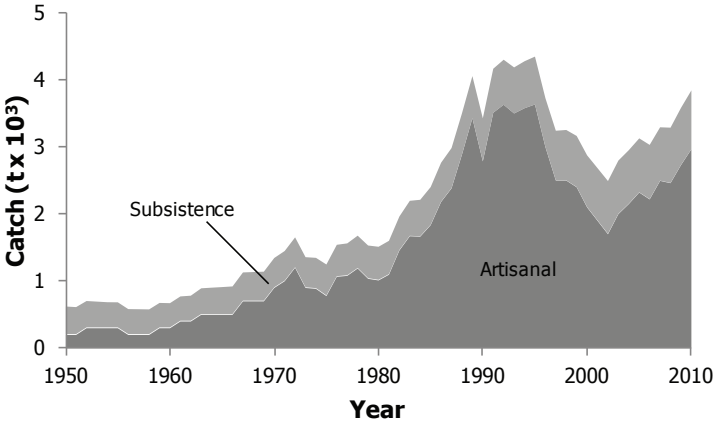

Figure 3. French Guiana's small-scale fisheries catches (1950-2010), from the artisanal and subsistence sectors. Artisanal catch is taken as the non-shrimp component of FAO landings and subsistence catch is derived from Hardy (1947).

Industrial shrimp

Over the study period shrimp catches by French vessels were estimated to be approximately 84,000 t. Shrimp catches by French vessels were less than 1,000 t·year^{-1} until 1985, after which catches increased to an average of 3,500 t·year^{-1} (whole weight) from the late 1980s to the 2000s (Figure 4). Estimated discards from the shrimp trawl fishery were substantial, with French vessels discarding over 555,150 t of by-catch from 1950-2010 (Figure 4).

Foreign fleets

Shrimp (US)

Shrimp landed by US shrimp trawlers fishing in French Guiana's waters totalled almost 73,000 t over the US fishing period (1950-1990). Shrimp landings by US vessels were less than 500 t in the early 1950s while exploratory fishing was taking place. As commercial fishing began in the late 1950s, catches increased to 2,800 t·year^{-1} by 1968 and then reached a peak of 3,974 t in 1981 (Figure 5). Catches declined after that to 550 t by 1990. US fishing in French Guiana's waters then ceased as vessel licenses were all transferred to French vessels. Estimated discards by US shrimp trawlers totalled over 390,000 t during the time that the US fleet operated in French Guiana (1950-1990; Figure 5).

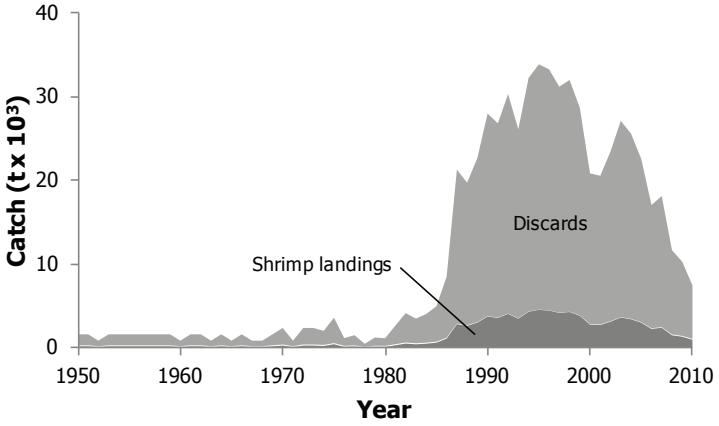

Figure 4. Domestic shrimp catches and associated discarded bycatch, 1950-2010, for French Guiana.

Shrimp (Japan)

The Japanese shrimp trawl fleet caught a total of approximately 8,350 t over the period of Japanese fishing (1979-1986; Figure 6). Discarded by-catch associated with this fishery was estimated to be 44,500 t.

Snapper (Venezuela)

Catches by the Venezuelan snapper fishery were estimated to be almost 46,000 t over the period 1950-2010 (Figure 7). Catches for this fishery peaked in 1996 at 2,257 t·year^{-1}.

Reconstructed total catch

The reconstructed total domestic catch for French Guiana, excluding the US, Japanese and Venezuelan fisheries, was estimated to be approximately 766,800 t for the period 1950-2010 (Figure 8a). This total is over 4 times the officially reported catch as presented in the FAO landings statistics (Figure 8a). Our reconstruction presents a more comprehensive account of total marine fisheries extractions in French Guiana than that presented by the FAO on behalf of French Guiana, by the inclusion of subsistence catch estimates and better accounting for catches by the domestic shrimp fishery and their discards. Our reconstruction incorporated all domestic fisheries which included commercial catches for the local market (artisanal), subsistence fisheries catches, the domestic shrimp fishery (industrial) and discarded by-catch from the domestic shrimp fishery. The total domestic reconstructed catch was composed of 12.2% artisanal landings, 4.4% subsistence catches, 11.0% industrial landings and 72.4% industrial discards (Figure 8a).

The overall species composition of the domestic catch was dominated by the major species of shrimp caught, *Farfantepenaeus subtilis*, with 9.9% of the total reconstructed catch (Figure 8b). Other important taxonomic groups included *Macrodon ancylodon* (9.5%), *Genyatremus luteus* (9.3%), Ariidae (7.1%), Sciaenidae (5.2%), *Stomolophus* sp. (4.9%), *Nebris microps* (4.7%), sharks (4.1%), and *Porichthys* sp. (4.0%; Figure 8b). The majority of these species and families are discards in the shrimp fishery which constitutes 72% of the catch.

Although not included in the catch reconstruction results for French Guiana, foreign fisheries operating in French Guiana's waters (Venezuelan snapper fishery and US and Japanese shrimp fisheries) were also estimated. Catches and discards by foreign vessels fishing in French Guiana's waters were estimated at approximately 561,800 t over the period 1950-2010, the majority of which were catches and discards from the US shrimp fleet (Figure 5).

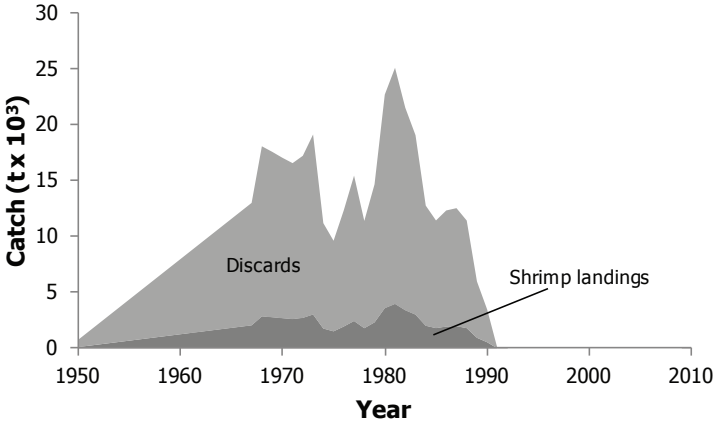

Figure 5. Shrimp catches by US trawlers in French Guiana, 1950-1990.

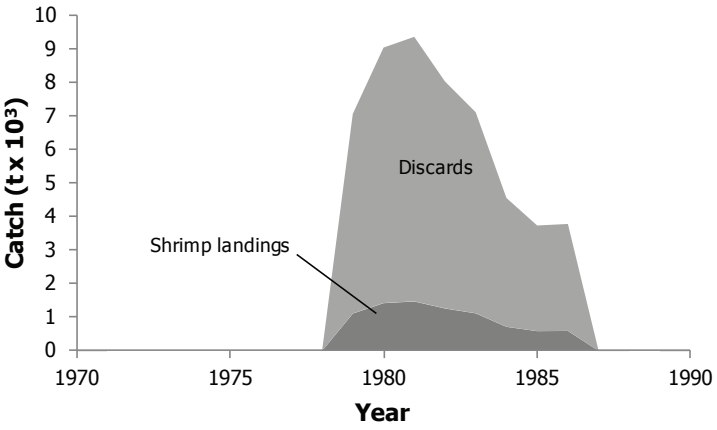

Figure 6. Shrimp catches and associated discards by Japanese trawlers in French Guiana. Note that the time period shown is 1970-1990, whereas all other graphs are displayed from 1950-2010.

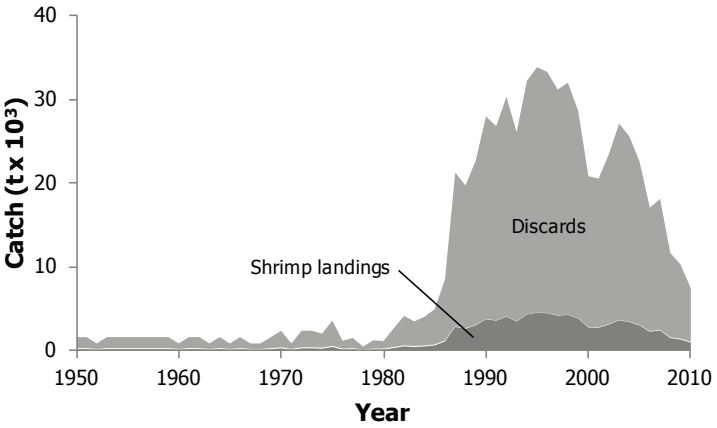

Figure 7. Snapper catches by Venezuelan fleet in French Guiana, 1950-2010.

Discussion

Total marine fisheries catches in French Guiana's waters from 1950-2010 were estimated to be approximately 766,800 t. This reconstructed catch total is over 4 times the amount reported by the FAO on behalf of French Guiana. This large discrepancy is due mainly to the substantial quantity of discards from France's shrimp trawl fishery operating in French Guiana's waters that were included in our reconstruction, but that are not accounted for in FAO statistics.

FAO data for French Guiana present landings from the local commercial fishery plus shrimp landings by French vessels. Shrimp landings as reported by FAO on behalf of French Guiana were similar to those obtained from independent reports of shrimp caught by France during this period. France does not report any catches to FAO that were caught in FAO statistical area 31, which includes the waters of French Guiana. We therefore assume that shrimp landings by French trawlers are reported to FAO as part of French Guiana's catch, even though the majority of it is brought back to Europe. While the FAO data seems to be a fair representation of local commercial landings, they may in fact be higher, as landings reported by the local commercial sector do not account for fish sold directly from fishers to consumers (Anon. 1983).

The largest component of our reconstruction was discarded by-catch associated with the shrimp trawl fishery, which for the domestic fleet (mainly French vessels) was estimated to be approximately 555,000 t over the study period. While it is known that shrimp trawl fisheries have large quantities of by-catch (Charlier 2000), these have not been accounted for in the fisheries landings statistics. Fish mortalities associated with trawl by-catch, often discarded at sea before the target catch is landed, can be quite significant and can have a considerable impact on the marine ecosystem. We assumed that all by-catch was discarded as the shrimp was the sole target species of this export-oriented fishery. High discard rates in shrimp trawl fisheries are common due to numerous factors including the fact that shrimp trawlers often operate far from markets making it uneconomical to retain and transport by-catch and that vessels often have limited holding and freezing capacity for by-catch (Keller 2005). Currently, these additional catches that are discarded are not accounted for in the catch statistics and thus underestimate the amount of fish being caught.

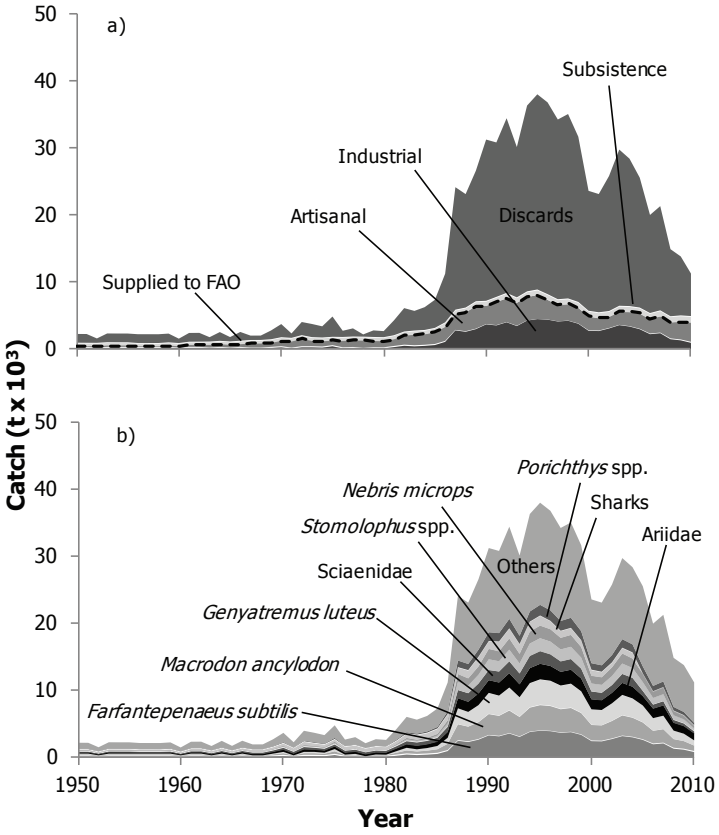

Figure 8. Reconstruction of total marine fisheries catches for French Guiana from 1950-2010, a) by sector and compared to the total presented by the FAO, and b) by species. 'Others' consists of 36 taxonomic groups.

The Venezuelan fleet in French Guiana's waters, which uses mainly hook and line gear, often inadvertently catch groupers, pelagic sharks, king mackerels and various Carangidae (Charuau and Die 1999). For Venezuelan snapper fleets throughout the region by-catch accounted for 93% of the fish caught, with a third of this sold in the market and the other two-thirds discarded at sea (Booth *et al.* 2000). The portion of the by-catch that is retained and sold at the market may not be accounted for as it is non-targeted catch. Even the targeted catch from the Venezuelan snapper fleet is not always reported and landings are often underestimated (Charuau and Die 1999). Charuau and Die (1999) estimated that 30% of large fish caught in the snapper fisheries of French Guiana are unreported. Aside from catches by the Venezuelan fishery, a new fleet of vessels from Martinique and Guadeloupe began exploiting French Guiana's snapper resources in 1996 (Charuau and Die 1999). We did not estimate the by-catch from the Venezuelan snapper fishery or catches by other country's fleets. Catches by Martinique and Guadeloupe would likely have been considered domestic catches as these two countries are also overseas departments of France.

While the Venezuelan snapper fleet has a license to fish in the waters of French Guiana sanctioned by the European Union (Booth *et al.* 2000), it is likely that other foreign vessels operate illegally in the waters of French Guiana. Attempts have not been made to quantify these illegal catches.

Reported landings for French Guiana's marine fisheries substantially underestimate the amount of fish actually being caught. As an overseas department of France, French Guiana is under the direction of the Common Fisheries Policy of the European Economic Community (EEC), which delineates a code of conduct for fisheries development. Fisheries in French Guiana, however, may escape the rigor of such a policy as the country lacks many of the resources available to its European relatives. This report illustrates the large discrepancy between the officially reported fisheries landings and the estimated total catch, which accounts for discards and subsistence catch. Accounting for all fisheries components is fundamental to effectively managing the fisheries which provide food, employment and valuable earnings for French Guiana.

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

Year	FAO landings	Reconstructed total catch	Industrial	Artisanal	Subsistence	Discard
1950	400	2,100	200	200	410	1,300
1951	400	2,100	200	200	400	1,300
1952	400	1,500	100	300	390	700
1953	500	2,200	200	300	390	1,300
1954	500	2,200	200	300	380	1,300
1955	500	2,200	200	300	370	1,300
1956	400	2,100	200	200	370	1,300
1957	400	2,100	200	200	370	1,300
1958	400	2,100	200	200	370	1,300
1959	500	2,200	200	300	370	1,300
1960	400	1,400	100	300	360	700
1961	600	2,300	200	400	360	1,300
1962	600	2,300	200	400	370	1,300
1963	600	1,600	100	500	380	700
1964	700	2,400	200	500	390	1,300
1965	600	1,700	100	500	400	700
1966	700	2,400	200	500	410	1,300
1967	800	1,900	100	700	420	700
1968	800	1,900	100	700	430	700
1969	900	2,600	200	700	430	1,300
1970	1,200	3,600	300	900	440	2,000
1971	1,100	2,200	100	1,000	440	700
1972	1,500	3,900	300	1,200	450	2,000
1973	1,200	3,600	300	900	450	2,000
1974	1,142	3,300	260	890	450	1,700
1975	1,241	4,700	460	780	460	3,000
1976	1,207	2,600	140	1,070	470	900
1977	1,266	3,000	190	1,080	480	1,200
1978	1,240	2,100	50	1,190	480	300
1979	1,186	2,700	150	1,040	490	1,000
1980	1,150	2,600	140	1,010	490	900
1981	1,436	4,200	340	1,100	500	2,200
1982	1,992	6,000	530	1,460	500	3,500
1983	2,118	5,600	450	1,670	520	2,900
1984	2,184	6,100	520	1,660	540	3,400
1985	2,476	7,300	640	1,840	560	4,200
1986	3,290	11,200	1,110	2,180	580	7,300
1987	5,178	24,200	2,800	2,380	600	18,400
1988	5,477	23,100	2,590	2,890	620	17,000
1989	6,410	26,600	2,980	3,430	630	19,600
1990	6,465	31,300	3,680	2,790	640	24,200
1991	7,036	30,900	3,530	3,510	660	23,200
1992	7,617	34,500	3,990	3,630	670	26,200
1993	6,931	30,200	3,430	3,500	690	22,600
1994	7,819	36,400	4,240	3,580	700	27,900
1995	8,089	38,100	4,460	3,630	720	29,300
1996	7,377	36,900	4,380	3,000	730	28,800
1997	6,602	34,300	4,100	2,500	740	27,000
1998	6,709	35,100	4,210	2,500	750	27,700
1999	6,171	31,700	3,770	2,400	760	24,800
2000	4,837	23,600	2,740	2,100	770	18,000
2001	4,599	23,100	2,700	1,900	780	17,800
2002	4,782	25,800	3,080	1,700	790	20,300
2003	5,565	29,800	3,570	2,000	800	23,500
2004	5,514	28,400	3,360	2,150	800	22,100
2005	5,285	25,600	2,940	2,340	810	19,500
2006	4,458	20,000	2,220	2,220	810	14,700
2007	4,874	21,300	2,360	2,500	800	15,600
2008	3,958	14,900	1,500	2,460	830	10,100
2009	4,061	13,800	1,330	2,730	850	8,900
2010	3,936	11,200	940	2,970	880	6,400

Appendix Table A2. Reconstructed total catch (in tonnes) by major taxonomic group for French Guiana (domestic fisheries), 1950-2010. 'Others' contain 35 additional taxonomic categories.

Year	*Farfantepenaeus subtilis*	*Macrodon ancylodon*	*Genyatremus luteus*	Ariidae	Sciaenidae	*Stomolophus* spp.	*Nebris microps*	Sharks rays and chimaeras	*Porichthys* spp.	Others
1950	180	170	170	230	130	90	90	80	70	920
1951	180	170	170	230	130	90	90	80	70	910
1952	90	90	80	200	130	40	40	120	40	620
1953	180	170	170	240	150	90	90	120	70	930
1954	180	170	170	230	150	90	90	120	70	920
1955	180	170	170	230	150	90	90	120	70	920
1956	180	170	170	220	130	90	90	80	70	890
1957	180	170	170	220	130	90	90	80	70	890
1958	180	170	170	220	130	90	90	80	70	890
1959	180	170	170	230	150	90	90	120	70	910
1960	90	90	80	190	120	40	40	120	40	600
1961	180	170	170	240	170	90	90	160	70	940
1962	180	170	170	250	170	90	90	160	70	940
1963	90	90	80	230	170	40	40	200	40	660
1964	180	170	170	270	190	90	90	200	70	980
1965	90	90	80	240	170	40	40	200	40	670
1966	180	170	170	270	200	90	90	200	70	990
1967	90	90	80	270	220	40	40	280	40	730
1968	90	90	80	270	220	40	40	280	40	730
1969	180	170	170	310	240	90	90	280	70	1,050
1970	270	260	250	380	310	130	130	360	110	1,410
1971	90	90	80	320	280	40	40	400	40	810
1972	270	260	250	420	370	130	130	480	110	1,490
1973	270	260	250	380	310	130	130	360	110	1,420
1974	230	220	210	360	300	110	110	360	90	1,280
1975	420	400	390	420	320	200	200	310	170	1,910
1976	130	120	120	350	310	60	60	430	50	970
1977	170	160	160	370	320	80	80	440	70	1,120
1978	50	40	40	350	310	20	20	480	20	720
1979	140	130	130	360	310	70	60	420	50	1,000
1980	120	120	120	350	300	60	60	410	50	960
1981	310	290	290	440	360	150	140	440	120	1,620
1982	480	460	450	560	490	240	230	590	190	2,320
1983	400	390	380	570	520	200	190	670	160	2,110
1984	470	450	440	600	530	230	220	670	190	2,350
1985	580	550	540	670	600	280	270	740	230	2,780
1986	1,000	960	930	890	790	490	470	880	400	4,350
1987	2,520	2,410	2,350	1,520	1,240	1,230	1,200	960	1,010	9,730
1988	2,330	2,230	2,180	1,530	1,300	1,140	1,110	1,170	940	9,210
1989	2,680	2,570	2,510	1,750	1,510	1,310	1,270	1,390	1,080	10,580
1990	3,310	3,170	3,100	1,910	1,540	1,620	1,570	1,130	1,330	12,640
1991	3,170	3,040	2,970	1,960	1,660	1,550	1,510	1,420	1,280	12,330
1992	3,590	3,440	3,360	2,150	1,790	1,760	1,700	1,470	1,440	13,820
1993	3,090	2,960	2,890	1,940	1,630	1,510	1,470	1,410	1,240	12,050
1994	3,820	3,650	3,570	2,240	1,850	1,870	1,810	1,450	1,530	14,630
1995	4,010	3,840	3,750	2,330	1,910	1,960	1,900	1,470	1,610	15,330
1996	3,940	3,770	3,690	2,210	1,760	1,930	1,870	1,210	1,580	14,940
1997	3,690	3,530	3,450	2,050	1,590	1,810	1,750	1,010	1,480	13,960
1998	3,790	3,630	3,540	2,090	1,610	1,860	1,800	1,010	1,520	14,300
1999	3,390	3,250	3,180	1,920	1,490	1,660	1,610	970	1,360	12,900
2000	2,460	2,360	2,300	1,520	1,180	1,210	1,170	850	990	9,580
2001	2,430	2,330	2,270	1,480	1,130	1,190	1,150	770	980	9,420
2002	2,770	2,660	2,600	1,580	1,180	1,360	1,320	690	1,120	10,580
2003	3,210	3,070	3,000	1,800	1,360	1,570	1,520	810	1,290	12,180
2004	3,030	2,900	2,830	1,750	1,340	1,480	1,440	870	1,220	11,580
2005	2,650	2,550	2,500	1,420	790	1,310	1,270	-	1,070	12,030
2006	2,000	1,930	1,890	1,440	620	990	960	-	810	9,350
2007	2,130	2,050	2,000	1,550	650	1,050	1,020	-	860	10,000
2008	1,350	1,320	1,290	1,190	450	670	650	-	550	7,380
2009	1,200	1,160	1,130	1,170	410	590	580	-	490	7,050
2010	850	840	820	1,070	320	430	410	-	350	6,080