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Abstract

The continental shelf that stretches from Brazil to Venezuela has historically been fished by many South American countries, and at a time supported one of the most important shrimp fisheries in the world. Suriname, formally a colony of the Netherlands until 1975, is the smallest sovereign state in South America. As approximately 85% of the population lives on the coast, fishing has become a vital livelihood. This study estimates Suriname's total marine fisheries catches for the 1950-2010 time period to be approximately 1.9 million tonnes, which is 3.4 times the landings presented by the Food and Agriculture Organization (FAO) of the United Nations on behalf of Suriname for this same period (536,121 t). This estimate includes unreported catches from the subsistence and artisanal sector as well as discards associated with the industrial shrimp and seabob fisheries. Fisheries statistics that are supplied to the FAO are commonly underreported and reconstructed catches account for catches from small-scale fisheries as well as other reported catches. Suriname is lacking the appropriate resources to control exploitation of resources and reduce over-fishing, which is resulting in a decline in total catch and leading to a decrease in profitability of the fishing industry.

Introduction

Suriname, formally known as Dutch Guiana, is located between French Guiana and Guyana on the northeast coast of South America (Figure 1). Although the country is culturally part of the Caribbean, Suriname remains the smallest independent nation in South America (Luxner 2006). After initially being occupied by the British, Suriname became a Dutch colony in 1667. Suriname gained its independence from the Netherlands in 1975, and although Dutch is still the primary language spoken, English, Sranang Tongo (Surinamese), Chinese, Hindustani and Javanese are also widely spoken (Luxner 2006).

Suriname has a land area of over 163,000 km² and only 46,000 km² of continental shelf (www.seaaroundus.org). The small coastal areas represent approximately 15% of the total land area and the Exclusive Economic Zone (EEZ) is approximately 128,000 km². Since the 1970s, Suriname has experienced major growth in the fisheries sector, which continues to make important cultural and economic contributions to the country. In 1995, Suriname became the first non-English speaking nation to be admitted to the Caribbean Community (CARICOM).

Due to hundreds of Surinamese people fleeing to Holland after independence was granted and never returning, Suriname's population has remained relatively low (Luxner 2006). According to the last census in 2004, Suriname's population was 456,829, which is only a marginal increase from 210,000 people in 1950 (van Gelderen 1951). Fishing in Suriname developed slowly, and in the early 1950s no more than 800 families were engaged in the industry, with the majority of catches confined to inland waters, and accounted for less than two million pounds per year (907 metric tonnes) (van Gelderen 1951). At present,

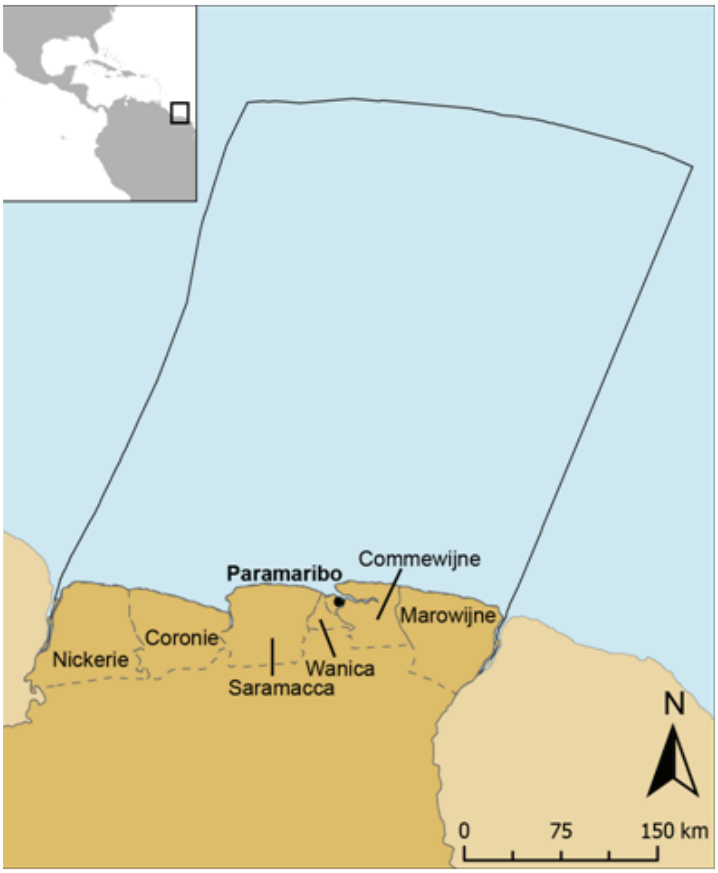

Figure 1. Map of Suriname and its Exclusive Economic Zone (solid line). Labeled are the 7 coastal districts, including the capital Paramaribo.

approximately 85% of the population is living on the coast and in 2005, 977 artisanal and 169 industrial vessels were operating in the waters of Suriname (Madharie 2006).

Fisheries in Suriname can be broken into three sectors: artisanal (small-scale, commercial), industrial (large-scale, commercial) and a subsistence fishery. The artisanal fishery typically occurs in near-shore coastal waters, river mouths and brackish waters, whereas the industrial fishery takes place from 12-15 fathoms (22-27 meters) depth, to the edge of the continental shelf (Madharie 1992). Fishing vessels operating in Suriname target multiple species and are typically multi-gear, commonly including trawlers, snapper boats, open or closed wooden vessels and canoes. Suriname has two main processing plants for shrimp, seabob and finfish located in Paramaribo, one is the government owned SALI (Suriname American Industries Limited) and the privately owned SUJAFI (Suriname Japanese Fisheries), with a third plant established in 1996, which mainly processes seabob (Guiana Seafoods) (Charlier 1999).

The Guiana-Brazil shrimp fishery, which emerged in the late 1950s, is a valuable international fishery cited as one of the most productive fisheries sectors in the western hemisphere (Dragovich and Coleman 1983). Suriname's offshore jurisdiction was extended to 200 nautical miles in 1978, but prior to this, shrimp trawlers were not subject to regulations such as area restrictions, catch, effort or size limitations, or required to keep records of discarded or landed by-catch (Dragovich and Coleman 1983). Thereafter, shrimp trawlers have been licensed and their numbers have been closely regulated by Suriname. The commercial shrimp fishery targets primarily brown shrimp (*Penaeus subtilis*) and pink-spotted shrimp (*Penaeus brasiliensis*) with smaller-scale catches of pink shrimp (*Penaeus notialis*) and white shrimp (*Penaeus schmitti*), which both make up less than 5% of total landings (Charlier 1999). The vessels used were predominately 'Florida type' double-rigged trawlers. However, since 1993, large stern trawlers with high opening trawls are more common. In the years 2000-2001, 170 vessels caught approximately 5,000 $t \cdot year^{-1}$. Today, much of the shrimp grounds have been depleted and only 30 licenses are given per year, of which 15 vessels are fishing actively. Of the two main processing plants, SALI processes over half of shrimp landings, with SUJAFI handling the remainder (FAO 1996).

The more recently developed Atlantic seabob (*Xyphopenaeus kroyeri)* fishery has contributed substantially to Suriname's shrimp industry, with peak landings of just over 13,000 $t \cdot year^{-1}$ in 2003 (FAO FishStat). The first industrial seabob company started operating in 1996, with a second one joining the following year (Charlier *et al.* 2000). Using 'Florida' twin rigged converted shrimp trawling equipment, or more commonly the Chinese seine vessels, the seabob fishery started out as one company, with a total of 10 boats and by 1999 had grown to two companies operating 24 vessels (Chin-A-Lin and Yspol 2000). There is also a small artisanal fishery for seabob, involving about 500 vessels, which sustain a large number of families, and is also one of the few profitable occupations in some rural areas (Chin-A-Lin and Yspol 2000). The seabob fishery contributes to domestic catches and supplies the rural population of the tropical rain forest; know in the Guyanas as the "bush". Seabob shrimp are typically caught in estuaries bordering the 'bush country' using primitive lift nets, and these shrimp are used exclusively to supplement the diet of the rural population (Dragovich and Villegas 1983).

Industrial shrimp and seabob trawler fleets fishing along the continental shelf (Venezuela to Northern Brazil) have an average discard rate greater than 70% (Kelleher 2005). However, many of the non-targeted by-catch species are of economic value and are increasingly retained on-board for eventual sale in local domestic markets. Bangamary (*Macrodon ancylodon*), Green weakfish or Seatrout (*Cynoscion virescens*), Rockhead (*Larimus brevicep*) and catfish (*Bagre bagre)* are four economically valuable species that comprise in excess of 90% of the retained by-catch (Southhall *et al.* 2011). Unfortunately, in most cases, processing of retained fish by-catch comes second to the more valuable species of shrimp. Fish can remain on deck for hours, in direct sunlight and often deteriorates by the time it is to be frozen. The less marketable species, which are typically less abundant, have limited use or are poisonous, and are discarded at sea (Furnell 1982). According to a study in the waters off Guyana (Furnell 1982), by-catch is much greater in shallow waters, which suggests that the inshore grounds are likely an important source of production for local artisanal fishers.

The small-scale, artisanal fishery is mainly carried out by rural families, with most of the catch consisting of finfish and shrimp, which is then sold in the local markets as fresh, smoked or sun-dried salted products (Dragovich and Villegas 1983). The artisanal fleet is divided into a coastal and inshore fleet. Inshore fishing is done by korjaal (canoes) using Chinese seine as well as longlines, pin seines, dragnets and beach seines targeting finfish (Madharie 2006). The coastal drifting gillnet ("drijfnet") fishery operates from two types of boats known as Guyana boats, either open or closed (decked). These vessels target large demersal finfish and recent surveys suggest that most of this resource has been exploited past its maximum sustainable yield (MSY) (FAO 2008). Interestingly, most of the coastal vessels are Surinamese owned but have a Guyanese crew. It is suspected that an unknown number of boats from Guyana are fishing illegally in Suriname's EEZ and landing their catch in Guyana (Madharie 2006).

Suriname's commercial finfish fishery is primarily artisanal in nature, with the largest portion of catches from two families, Sciaenidae (croakers and drums) and Arridae (sea catfish). Green weakfish (*Cynoscion virescens),* locally known as 'seatrout' or 'kandratik', is the most important commercial species and is landed by a number of gears, the most important being trawls, drifting gillnets and Chinese seines (FAO 2001). The family Sciaenidae accounts for 85% of landings in the trawl fishery and 80% in the pin seine landings (Babb-Echteld 1999). A small demersal fish known as bangamary (*Macrodon ancylodon*), although only of minor commercial importance, makes a large contribution to these landings. Lane snapper (*Lutjanus synagris*) has only recently gained importance in the landings in Suriname, contributing to a portion of landed by-catch from the Korean and Dutch vessels, as well as the shrimp trawlers (Charlier *et al.* 2000).

The shrimp fishery in Suriname is predominately a foreign access fishery, with more than 95% of the trawlers being foreign owned and operated (Charlier 1999). The first exploratory fishery survey of the continental shelf extending from Guinana-Brazil was completed in 1944 and was followed by similar surveys in 1957 and 1958 (Jones and Dragovich 1977). These surveys confirmed the presence and abundance of many species of penaeid shrimp, and it was apparent that many countries were eager to benefit from "the greatest shrimping grounds in the Western Hemisphere" (Naidu and Boerema 1972). The United States was the first foreign country to fish commercially in Suriname, after they sent their fleet to the area in 1958. Major countries such as Japan, Korea, and other fleets from the Caribbean region joined the fishery in the late 1950s and early 1960s (Jones and Villegas 1980). Prior to the establishment of EEZs for countries on the Guiana-Brazil continental shelf, all foreign fishing fleets were fishing the shelf without restrictions on area, season or catch amounts.

After Suriname declared a 200 nm EEZ in 1978, like other neighboring countries, all foreign vessels required permits under bilateral agreements (Jones and Villegas 1980). The government initiated a licensing system to regulate the number of permits, which forced some foreign vessels to fish outside the country's EEZ (Dragovich 1981). This agreement also required US vessels to record information on catch and effort, as well as biological data pertaining to the shrimp fishery. However, no estimates were made for discarded catch (Jones and Dragovich 1977). All foreign vessels were still required to land their catch within the country, and many vessels shifted to either Brazilian or Venezuelan waters (Kawahara 1983). A steep rise in fuel prices in 1975, also restricted offshore fishing and forced fleets to either fish locally (through joint ventures), relocate or sell their fleet all together. By 1995, there were 22 companies managing three fleets: a Japanese fleet (2 companies operating under Japanese flag), a Korean fleet (using a variety of flags) and the Surinamese fleet (FAO 2000b). The Japanese fleet fishes in deeper waters, operating mainly at night, targeting *P. brasiliensis,* and landing at SUJAFI. The Korean fleet exploits all species and lands their catch at SALI and SUJAFI (Charlier and Babb-Echteld 1999). The US stopped fishing for shrimp within Suriname's waters shortly after the EEZ was established in 1978. Interestingly, in 1991 the US banned shrimp imports from Surinamese waters because Suriname fishers refused to use Turtle Excluder Devices (TEDs) in their nets as a measure to protect endangered sea turtles (McDonough 2002).

In Suriname, Atlantic red snapper (*Lutjanus purpureus*) along with lane snapper (*Lutjanus synagris*) and vermillion snapper (*Rhomboplites aurorubens*), are targeted by Venezuelan distant water fleets. At the start of the fishery (early 1960s), all landings were taken back to Venezuela. Since the 1980s, in order to have access to fish within Suriname's EEZ, the Venezuelan fleet has been required to land part of their catch in the host country (Charuau *et al.* 2001). A bilateral agreement between the two governments (1985) established regulations such as license fees, and the prices and limitations on the number of vessels allowed to fish. However, there is no control over what happens at sea, actual fishing effort is not known and there are no data available on red snapper landings outside Suriname, originating from Surinamese waters (Charlier 1988). The amount that is landed in Suriname is only a portion of the total tonnage caught by Venezuelan vessels, with the remaining catch being landed in Venezuela. In 2005, there were 43 Venezuelan hook and line vessels fishing red snapper and 15 targeting mackerel species (Yspol 2006). There is no significant by-catch associated with this fishery, however, it has been noted that other non-snapper species are sometimes taken as by-catch.

The Food and Agriculture Organization's (FAO) FishStat database supplies marine catch records from 1950-2010.[1] The data supplied by the FAO are based on national fisheries statistics supplied by its member countries, therefore the quality and accuracy of the data depend on the capacity of statistical collection completed within these countries. For many developing countries, official fisheries statistics for small-scale, artisanal and subsistence catches are either missing or underestimated (Zeller *et al.* 2007), and therefore undervalued in terms of their economic and social importance (Zeller *et al.* 2006; Watson *et al.* 2011). This report will provide a more detailed understanding of the fisheries activities in Suriname by including all domestic sectors, such as commercial catches destined for the local market, catches from the subsistence fishery and discarded by-catch from the industrial sector. The purpose of this study is to reconstruct the total marine catch for the 1950-2010 time period to serve as a scientific baseline for the assessment of resource availability and management.

Methods

The Suriname Fisheries Department collects commercial catch data from inshore and offshore fleets that land their catch in Suriname. The department has been collecting catch, effort, and by-catch data for the past 20 years, either from landing sites, main markets or processing facilities (Anon. 2000). Marine fisheries are currently regulated in Suriname by the Decree on Marine Fishery (Decree C-14), which has been in operation since 1981. Revisions to the fisheries law were completed in 1992, with technical assistance from the FAO. In conjunction with other local programs, these efforts have led to a funded project called the Fisheries Information System (FIS) (Mahon 2001). Current data collection and management systems were initiated in 1991, and the FIS has only received minor modifications since to better account for new fisheries sectors (e.g., industrial seabob). A lack of information on discards, subsistence fishing and unreported catches is a global issue (Zeller *et al.* 2007), but one that presents itself fundamentally in Suriname. Suriname's total reconstructed catches from 1950-2010 include estimates of subsistence catches, discards, and underreported catches from the commercial sector.

[1] www.fao.org/fishery/statistics/en

Human population data

Population data were obtained from the population statistics historical demography website in order to estimate Suriname's subsistence catch from *per capita* subsistence catch rates.[2] Population data were available from 1950 to 2004, when the last census was completed. A linear interpolation between the population in 2004 and a 2010 estimate from the World Bank was done to estimate the population for years of missing data (Figure 2).[3] As we were also interested in the proportion of people living coastally versus inland, population data from each of Suriname's districts were used for the years 1958, 1971, 1980, 1996 and 2005, to estimate the proportion of people living along the coast.[4] Of Suriname's 10 districts, seven, including the capital district of Paramaribo, were considered coastal (Figure 1). The percentage of people living on the coast ranged from 99% in 1958 to 85% in 2005. A linear interpolation between these two percentages provided a time series which was then applied to the total population to estimate coastal population. The percentage of rural and urban populations in Suriname was obtained from the World Bank and combined with the coastal population data to calculate both a rural and urban coastal population.[3] This information was then used to estimate catch from the subsistence sector using *per capita* coastal rural and coastal urban subsistence catch rates.

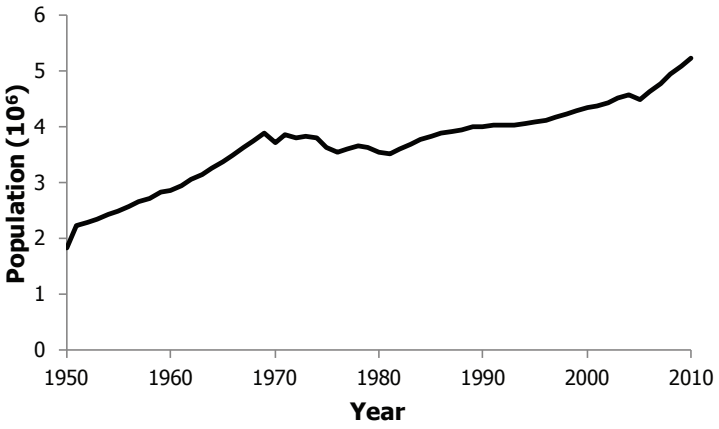

Figure 2. Suriname's human population data from 1950-2010.

Subsistence sector

Catch data for the subsistence (non-commercial) sector were unavailable despite references to the existence of such a sector (Dragovich and Villegas 1983). In the absence of subsistence fisheries data, the subsistence catch rates used were based on similar work done for the neighboring country of French Guiana (Harper *et al.* 2014, in prep). The *per capita* subsistence catch rate derived from French Guiana (35.8 kg·person^{-1}·year^{-1}), was applied to Suriname's coastal rural population for 1950, as we assumed the two countries had a similar rate of subsistence consumption at that time. We further expected that people over time gained better access to commercially caught fish and other protein sources sold at the main market, due to improved infrastructure such as roads, cars, and processing facilities. Therefore, the *per capita* subsistence catch rate assumed for 2010 was half the 1950 rate (i.e., 17.9 kg·person^{-1}·year^{-1}), due to a greater availability and access to commercial catch. A linear interpolation between these two subsistence rates was then applied to the entire time series to calculate annual estimates of subsistence catches for the coastal rural population. The subsistence rates for the coastal urban population for 1950 and 2010 were assumed to be half of the rural population rates (i.e., 17.9 kg·person^{-1}·year^{-1} and 8.95 kg·person^{-1}·year^{-1}, respectively), as people living close to the main markets would always have better access to commercial products. Finally, by combining the rural and coastal subsistence catches we were able to estimate the total catch for Suriname's subsistence sector from 1950-2010.

Table 1. Fish sold at the Central Market of Paramaribo in 1979 (Dragovich and Villegas 1983).

Commercial name	Taxon	Landings (t)
Green weakfish (seatrout)	Sciaenidae	420
Gillbacker sea catfish	Arridae	297
Shrimp	Penaeidae	224
King weakfish	Sciaenidae	113
Snooks	Centropomidae	95
Acoupa weakfish	Sciaenidae	95
Pacora (Koebi)	Sciaenidae	77
Smalleyed croaker	Sciaenidae	73
Croakers	Sciaenidae	40
Tarpon	Megalopidae	28
Miscellaneous marine fish	-	1,077
Total	-	2,539

Table 2. Where fish is sold or used (Anon. 2000).

Place of marketing catch	%
Landing site	37
Public market	22
Road side	1
Direct to customer	38
Home	10
Own company	0
Total	100

Artisanal (commercial) fishery

Catches from Suriname's commercial fishery were noted in the FAO Yearbooks as being 'underreported' from 1970-1998, as "catch data refer to the quantities marketed in Paramaribo Central Market only" (FAO 1998). Furthermore, Dragovich and Villegas (1983) stated that the official statistics did not cover landings of the entire country, and provided an estimate of commercial species sold at the Central Market of Paramaribo in 1979 of 2,539 t (Table 1), which is comparable to the 2,598 t of artisanal catch reported to the FAO for the entire country that same year. To estimate underreported catch prior to 1998, we used information from a multidisciplinary CARICOM survey on

[2] http://www.populstat.info/
[3] http://data.worldbank.org/
[4] www. populstat.info, www.isocarp.net/Data/case_studies/1107.pdf

where catches were sold (Anon. 2000) (Table 2). The survey included prominent fishers in the community, boat owners and captains, fisheries administration, retired fishers, and others involved in the fishing industry.

To calculate unreported catch from 1950-1970, we subtracted reported commercial catch (800 t) from a catch estimate based on a national report stating total marine catch in 1950 was approximately 907 t (van Gelderen 1951). At that time, ocean fishing was in early stages of exploration and all fish sold at the local market, with a portion retained for human consumption, were from inshore waters or a few miles off the coast of Paramaribo (van Gelderen 1951). This data point was then linearly interpolated from 1950-1970 to estimate all unreported catches before the reporting system was changed.

Assuming that the national catch data only includes quantities marketed at Paramaribo Central Market from 1970-1998 (as suggested in the FAO yearbook notes), then 78% of landings are not being accounted for in the national landings. To estimate underreported artisanal catches we calculated the missing 78% of catches using the reported FAO data from 1970-1988 (excluding industrial shrimp and seabob landings). We did not extend this adjustment to 1998, as to remain conservative in our approach and to account for a gradual increase in resources and personnel available to monitor and record landings from 1988-1998. To estimate unreported catches from 1989-2010, we assumed FAO data (excluding industrial shrimp and seabob landings) represented catches from the landing sites and public market (i.e., 59%, Table 2). We then derived the remaining 41% as unreported catches (i.e. catch which is marketed on the road side, sold directly to the customer or taken home for consumption), that was missing from the official data for that time period. We considered the 41% applies to catches from 1988 onwards, as reporting would have improved over the years, as previously mentioned.

Industrial fisheries

Seabob fishery

The industrial seabob fishery began operations in 1996. Therefore, we assume industrial catches before this time were zero, as is also suggested by the FAO data. The national reported data for the seabob fishery is comparable to the FAO data from 1996-2003, however, the FAO Fishery Country Profile for Suriname states that in 2003 and 2004, seabob landings were 24,304 t and 20,609 t, respectively.[5] The FAO data reports 10,567 t was landed in 2003 and 8,926 t in 2004. These numbers are notably different and therefore cause some concern in the reliability of seabob data being documented in Suriname. In 2009, the most recent year for which complete statistics are available, 9,195 t of seabob were landed by the Surinamese fleet (Southhall *et al.* 2011). Using data points from a 2006 report by the Ministry of Agriculture, Livestock and Fisheries in Suriname, we linearly interpolated to estimate catches for missing years between 1996 and 2010. There is a high level of by-catch associated with the type of gear used by this fishery, and most of the by-catch is discarded. An estimated discard rate of 70% was given in Kelleher (2005) for the region's seabob fishery, however data collection from a 2009 government observer program revealed that seabob trawls consisted of on average 69% seabob, while 19% of catch was retained fish and only 12% was considered discarded by-catch (Southhall *et al.* 2011). Thus, we conservatively applied a 12% discard rate to total seabob catches from 1996 onward.

Snapper fishery

Since the start of the snapper fishery along the Guiana-Brazil continental shelf in the 1940s, it has been dominated by Venezuelan fleets. From 1997 to 2000, the number of Venezuelan vessels licensed to fish in Suriname oscillated between a maximum of 134 in 1999 and a minimum of 82 in 2000 (Charuau *et al.* 2001). The red snapper fishery in Suriname started in 1961, and at the time approximately 200 t was landed in Suriname, this increased to 500 t in the 1970s and 1,500 t in 1997 (Table 3) (Charuau *et al.* 2001). These catches, which are only a portion of the total catch landed by Venezuelan vessels, are considered domestic by Suriname. Catches by these vessels were only reported to the FAO as a separate category from 2003-2005, suggesting a change in reporting during this time. It is assumed that prior to 2003, all red snapper would have been categorized as miscellaneous marine fish.

Table 3. Anchor points for estimating Venezuelan snapper catch from 1961-2010.

Year	Catch (t)	Source
1961	200	FAO (2000)
1970	500	FAO (2000)
1997	1500	Charuau et al. (2001)
2004	644	National (2012)
2005	604	National (2012)
2006	1013	National (2012)
2007	871	National (2012)
2008	907	National (2012)
2009	844	National (2012)
2010	1367	National (2012)

We assume that prior to 1961, total catch was zero and preformed a linear interpolation between missing data from 1960-2010 to estimate total catch. An observed decrease in landings from 1997-2005 could suggest changes in the fisheries licensing system or declining stock availability. The management priority for the Surinamese government is to gain as much profit from the red snapper fishery as possible and this can only be done by requiring an increase in landings for domestic use, changing license fees or attempting to establish a domestic fleet (Charuau *et al.* 2001).

[5] http://ftp.fao.org/FI/DOCUMENT/fcp/en/FI_CP_SR.pdf

Foreign fisheries

Shrimp fishery

After the establishment of Suriname's EEZ in 1978, all foreign vessels were required to have fishing access agreements in order to fish in domestic waters and were required to land their catch in Suriname at select landing sites. Due to the bilateral agreement between the US and Suriname, all of the landing reports collected prior to 1981 are combined landing data from both countries (Baisre and Dragovich 1983). In addition, the FAO noted that "the 1970-1975 catch data for 'Natantian decapods nei' include quantities caught by foreign fishing craft" (FAO 1976). Due to combined landings of domestic and foreign fleets, it was not possible to disaggregate industrial shrimp landings by country from 1950-2010; therefore we accept the FAO shrimp landings for Suriname as is. In 1999, there were only two foreign fleets involved in the industrial shrimp fishery, Japan and Korea, and a small fleet flying the Surinamese flag, but listed as a Korean fleet under chartering agreements (Charlier and Babb-Echteld 1999). Landings data from 1960-1995 included in a national report, combines shrimp caught by Japanese, Korean and Surinamese flag vessels (Charlier and Babb-Echteld 1999). A table from Engel (1983) describes flag vessels fishing is Suriname's waters from 1974-1981, this was used to estimate proportion of catches from vessels flying under the Surinamese flag, compared to foreign fleets (Table 4). Estimates of domestic catch in 1974 and 1975 were derived using the number of vessels and catch per unit effort, and landings from 1976-1981 were taken as is from the FAO data. Foreign fleets were not included in the total reconstructed catch for Suriname. However, an estimate of total catches for each foreign fleet as well as their discards was derived for the time periods in which these vessels were fishing in Suriname's waters, and are included in the *Sea Around Us* database.

Table 4. Breakdown of foreign shrimp vessels with landings (tonnes) compared to national landing reports from 1974-1981.

Year	Japan		Korea		Suriname		Estimated Totals	National Reported Landings
	Catch (t)	No. vessels	Catch (t)	No. vessels	Catch (t)	No. vessels		
1974	1027	76	1829	20	1000[a]	11	3856	3376
1975	1096	34	3131	40	1000[a]	20	5226	5289
1976	1164	42	4127	73	1078	20	6369	6316
1977	1232	41	3795	88	1407	20	6434	6622
1978	1016	26	2739	80	713	19	4469	4594
1979	913	35	3496	72	803	19	5212	5391
1980	1000	37	3074	61	835	18	4909	5129
1981	1212	40	4002	69	974	17	6188	6424

[a] 1974 and 1975 data are estimates (Engel 1983), domestic landings from 1976-1981 are based on FAO data.

United States

Agreements between the United States and Suriname began in 1958 and continued until 1978-1979. From 1960 to 1974, 14% of the total shrimp caught by the US throughout Northeastern South America, were from Surinamese waters (Jones and Dragovich 1977). We applied this portion of catches from Suriname's waters to the total shrimp landings between 1972 and 1979, from US flag vessels given in Jones and Dragovich (1977) and Dragovich and Coleman (1983), for the Guiana's-Brazil fishery. Due to an increase in fuel prices in 1975, foreign offshore fleets were either forced to relocate, withdraw from the fishery or fish locally (Jones and Villegas 1980). Catches by US vessels were observed to decrease from 1973-1978, and once Suriname established their EEZ in 1978, the US could no longer fish without permission from the Surinamese government. Assuming that catches before the fishery began in 1958 were zero, we performed a liner interpolation from 1958-1972, to estimate missing data for these years. A FAO conversion factor of 1.67 was used to convert the amount of heads-off shrimp landings to whole weight (FAO 2000a).

Japan

At the beginning of the Japanese exploitation of shrimp along the Guianas in 1959, Japan had 10 vessels in Surinamese waters, which increased to 70 by the late 1960s (Kawahara 1983). Reported annual landings were available from 1976-1995 at the two main processing plants SAIL and SUJAFI in Paramaribo, at which time Japan landed their catch only at SUJAFI (Charlier and Babb-Echteld 1999). Shrimp landings from Japanese vessels were estimated from 1958-1976, when accurate reporting was completed. Independent data were only available to 1995, however total shrimp catch was observed to decrease to approximately 500 t by 2010. This was divided in half to account for the two foreign fleets. A linear interpolation from 1995-2010 was completed to estimate landings for that time period. The FAO conversion factor of 1.67 was used to convert all heads-off shrimp landings to whole weight (FAO 2000a).

Korea

To estimate the proportion of catches from Korean vessels, we used the landing data for SUJAFI presented in Charlier and Babb-Echteld (1999). In addition, we assumed that all landings at SAIL included landings from Korea and Surinamese flag vessels, fishing under chartering agreements. To estimate catches over the desired time period, we subtracted reported FAO domestic shrimp data after 1975, from the total landings at SAIL, to estimate shrimp caught by Korean flagged vessels. Since reported landings from 1970-1975 included catches from foreign vessels, we assumed that from 1976-1995 catches reported to the FAO should pertain to shrimp caught solely by domestic fleets. Independent data were only available to 1995, however a linear interpolation was completed from 1995 to the 2010 estimate of 250 tonnes (half of total 500 tonnes), to estimate missing landings for that time period. All Korean heads-off shrimp landings were converted to whole body weight using a conversion factor of 1.67 (FAO 2000a).

Discards

Discarded by-catch for both the domestic and foreign shrimp trawl fisheries operating in Surinamese waters were calculated using a discard rate of 84.3% stated in Kelleher (2005) and was applied to the FAO shrimp landings from 1950-2010. Allsopp (1980) suggests a discard ratio for Suriname of 5:1, which is similar to the 5.4:1 ratio used in this report, based on Kelleher (2005). The similarities in these estimates suggest that the discard rate has not changed significantly over the past 30 years.

Taxonomic breakdown

The taxonomic composition for artisanal catches was derived using information from a 2006 Ministry of Agriculture, Livestock and Fisheries report (Yspol 2006). The report gave landings by species and gear type for the year 2005. The species breakdown was calculated and applied to all reported FAO data excluding industrial shrimp, artisanal and industrial seabob, red snapper and marine crab nei category, which were disaggregated from the total catch and calculated separately. These proportions, including the red snapper and artisanal seabob, were also applied to the estimated unreported artisanal catch species composition from 1950-2010 (Figure 8b).

The species composition for the foreign shrimp trawl industry were derived from reports by Dragovich (1981) and Jones and Dragovich (1977), in which species composition was examined from 1972-1974 for the US shrimp fleet and 1969-1973 for the Japanese fleet. During the early stages of the fishery, the most abundant species caught within the Guianas-Brazil continental shelf was brown shrimp (*P. subtilis*). However, off the coast of Suriname, pink-spotted shrimp (*P. brasiliensis*) is most abundant and is typically caught mixed with brown shrimp (Jones and Dragovich 1977). From 1972-1974, the US caught an average of 64% of pink-spotted shrimp, 34% brown shrimp and the rest a combination of pink and white shrimp. The Japanese catches were reported to include 65-80% pink-spotted shrimp and 20-35% brown shrimp (Jones and Dragovich 1977). There was no information available for the Korean shrimp fleet therefore we applied the species composition of the Japanese fleet to Korean catches. The species composition of domestic shrimp was calculated using FAO data for the years 2003-2005, in which the reported species lists catches of brown shrimp separate from the penaeus shrimp category (remaining pink-spotted, pink, white shrimp); proportions were derived from this.

The species composition of discarded by-catch from the shrimp fishery was taken from a study on discards from the shrimp trawl fishery in Venezuela (Marcano *et al.* 2001). There were three regions analyzed in the study, we used the Atlantic coast region as it was considered the best representation of discards in Suriname's shrimp fishery (Table 5). The discards from Suriname's fishing area were dominated by eleven families; the remaining 28 species were grouped in miscellaneous marine fish (MMF). All species listed were cross-referenced in FishBase[6] to verify the species were also found in Suriname's waters.

[6] www.fishbase.org, Froese R and Pauly D (2012) [accessed March 5, 2012]

Table 5. Species composition of discards (%) from the shrimp trawl fishery in Suriname based on Marcano *et al.* (2001).

Family	Species	Discards (%)
Batrachoididae	*Porichthys* spp.	5.5
Bothidae	*Trichopsetta caribbaea*	4.3
Clupeidae	*Harengula clupeola*	2.3
Cnidaria-Sciphozoa-Rhizostomae	*Stomolophus* spp.	6.7
Garreidae	*Diapterus rhombeus*	3.7
Haemulidae	*Genyatremus luteus*	12.8
	Haemulon boschmae	4.3
	Haemulon steindachneri	2.8
Rhinobatidae	*Rhinobatus percellens*	2.4
Sciaenidae	*Macrodon ancylodon*	13.1
	Nebris microps	6.5
	Larimus breviceps	2.5
Serranidae	*Diplectrum formosum*	3.5
Tetraodontidae	*Lagocephalus laevigatus*	3.6
Trichiuridae	*Trichiurus lepturus*	3.0
Miscellaneous marine fish	Approximately 28 species	18.5

Table 6. Species composition of the discarded by-catch from the seabob fishery based on Southhall *et al.* (2011).

Family	Species/Taxa	Discards (%)
Achirida	*Trinectes paulistanu*	10.0
Cynoglossida	*Symphurus plagusia*	10.0
Dasyatida	*Dasyatis guttat*	10.0
Gymnurida	*Gymnura micrur*	10.0
Rhinobatidae	*Rhinobatus percellens*	10.0
Sciaenidae	*Macrodon ancylodon*	15.0
	Cynoscion virescens	15.0
	Larimus breviceps	15.0
	Miscellaneous marine fish	5.0

Table 7. Species composition of retained by-catch from the seabob fishery based on Southhall *et al.* (2011).

Family	Species/Taxa	Discards (%)
Ariidae	*Bagre bagre*	22.0
	Arius grandicassis	1.0
	Arius phrygiatus	1.0
Clupeidae	*Odontognathus mucronatus*	1.0
Sciaenidae	*Macrodon ancylodon*	22.0
	Larimus brevicep	22.0
	Cynoscion virescens	22.0
	Nebris microps	2.0
	Menticirrhus americanus	1.0
Trichiuridae	*Trichiurus lepturus*	1.0
	Miscellaneous marine fish	5.0

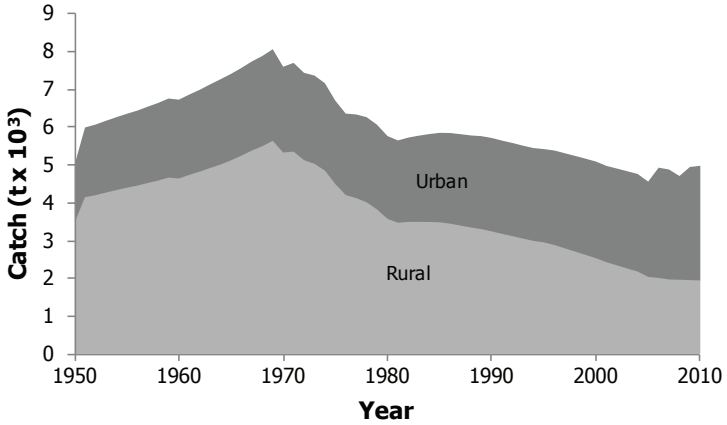

Figure 3. Estimated rural and coastal subsistence catches from Suriname's waters.

The species composition of discarded by-catch associated with the seabob trawl fishery was calculated using a list of discarded species included in a Marine Stewardship Council (MSC) report on Atlantic seabob shrimp (Southhall *et al.* 2011). Discarded by-catch typically consists of 60-70% demersals, 50% of which are undersized Bangamary or 'King weakfish' (*Macrodon ancylodon)*, Green weakfish (*Cynoscion virescens*) and Shorthead drum (*Larimus breviceps*) (Table 6). The remaining discards consist of pelagics (16%), brackish water finfish (5%), and sharks and rays (3%) (Southhall *et al.* 2011). Twelve by-catch species were considered reported 'retained by-catch', the most commercially important species (*M. ancylodon, C. virescens*, and *L. breviceps*) are landed and recorded each fishing trip and the less abundant species are grouped and recorded as 'mixed retained' (Table 7).

Results

Subsistence sector

Total subsistence catches were estimated to be 5,041 t·year^{-1} in 1950, increasing steadily to a peak of 8,061 t·year^{-1} in 1969 and then decreasing to 4,983 t·year^{-1} in 2010. Total subsistence catches from 1950-2010 were estimated to be 370,800 t. Subsistence catches for the rural population were estimated to be 228,481 t from 1950-2010, while the urban subsistence sector catches were estimated to be 142,318 t (Figure 3).

Artisanal fishery

Total reported FAO landings considered to be from the artisanal sector from 1950-2010 were reported as 307,153 t, while the unreported artisanal catches were estimated to be approximately 520,000 t (Figure 4). The combined artisanal catches from the reported and unreported components totaled to approximately 827,000 t from 1950-2010. Total artisanal catches were estimated to be 970 t·year^{-1} in 1950, increasing to a peak of 17,600 t·year^{-1} in 1972. Catches declined slightly but remain stable until 1989 at which point catches decrease to 6,600 t·year^{-1}. Total artisanal catch increased from 1989-2010, with a peak of 30,900 t in 2007.

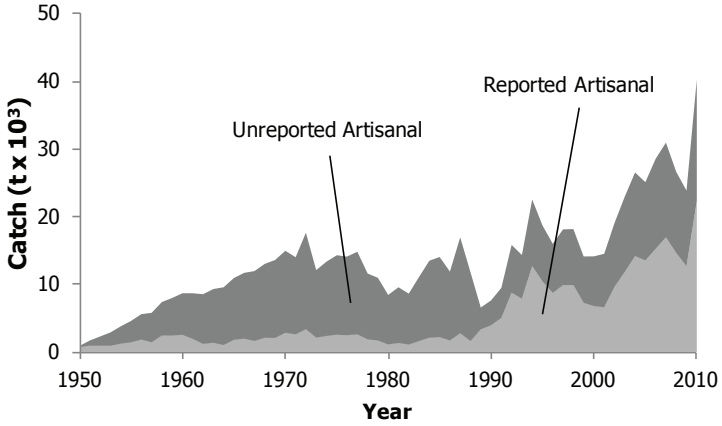

Figure 4. Estimated catches by Surinamese artisanal fishing sector (1950-2010).

Industrial fisheries

Snapper fishery

The estimated catch of red snapper was 43,680 t from 1950-2010. At the start of the fishery (1960) catches were approximately 200 t and steadily increased to a peak of 1,500 t in 1997. Catch data begins to decline to approximately 600 t·year^{-1} in 2005 to 2006 and then increases to 1,370 t by 2010.

Seabob fishery

The industrial Atlantic seabob fishery began in the late 1990s, and unlike the shrimp industry, is entirely Surinamese-owned. From 1996-2010, total seabob catches were reported to be 148,000 t (Figure 5). The estimated discards associated with this fishery were estimated at 19,700 t, while retained by-catch totaled to 31,700 t, which had been reported as 'miscellaneous marine fish' for all years except 2003-2005, accounted for 19% of the total catch (Figure 5).

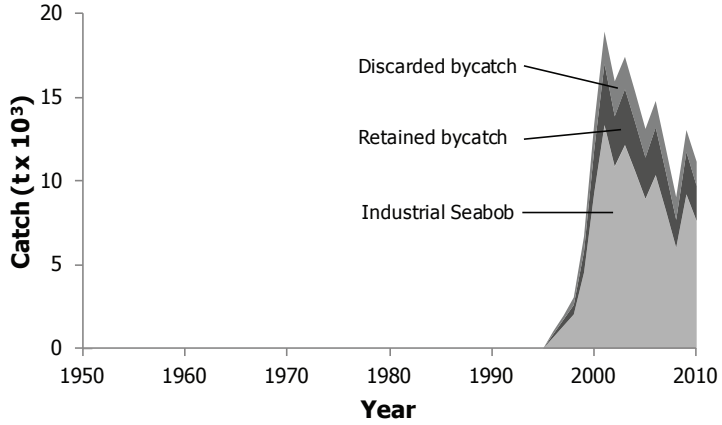

Figure 5. Suriname's industrial seabob landings with estimates of retained and discarded by-catch from 1950-2010.

Shrimp fisheries

The FAO industrial shrimp landings were accepted unaltered and the domestic catch totaled 81,866 (14,5460) t for the 1950-2010 time period (Figure 6). As previously discussed, from 1971-1975 foreign and domestic shrimp landings was recorded together, however, due to a lack of records we were not able

to disaggregate the catch for all years. Estimates for domestic catch for the 1974-1981 time period were derived as catch records from foreign countries were available (Table 4) and outline the large contribution in this sector from foreign fleets.

Foreign Fisheries

United States

Shrimp extracted from Suriname's EEZ by US fleets totaled 14,500 t for the 1958-1979 period (Figure 7). Landings increased to 1,041 t in 1972, decreasing to 619 t in 1976 and again slightly increasing to 934 t at the end of the period, when Suriname's EEZ was established in 1978. Estimated discards by US shrimp trawlers totaled to 78,900 t over the 1958-1979 time period (Figure 7).

Japan

Japan continues to be involved in the fishing and processing of shrimp in Suriname, however, data from the main landing sites were only available from 1977-1995. Estimated shrimp caught by Japanese trawlers totaled to 33,790 t from the 1959-2010 time period (Figure 7). Landings peaked in 1977 at 1,232 t and declined to an average of 697 t·year^{-1} over the 1982-1995 time periods. Landings then gradually decreased to approximately 250 t by 2010. The total discards were estimated to be 181,430 t from 1959-2010 (Figure 7).

Korea

Estimated catch from Korean shrimp fleets was 102,580 t from 1968-2010 (Figure 7). The Korean fleet targets multiple species of shrimp and their catch was three times higher than that of Japan over the same time period. Catches were constant over time, peaking at 4,000 t in 1981 and catching an average of 3,100 t·year^{-1} from 1982-1995. The discards associated with this fishery were estimated to be 550,810 t from 1968-2010 (Figure 7).

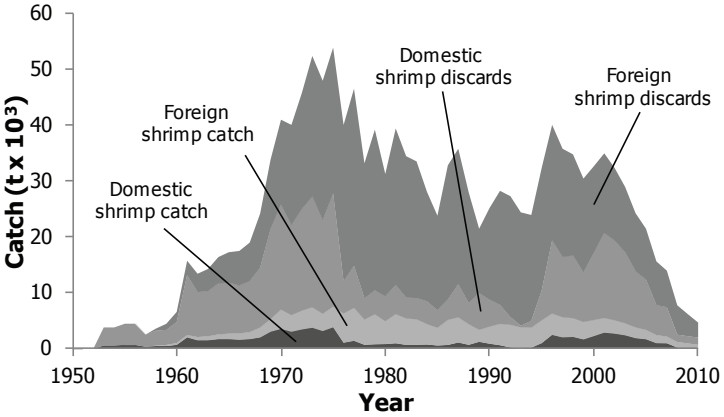

Figure 6. Domestic and foreign (US, Korea, Japan) shrimp catches from 1950-2010.

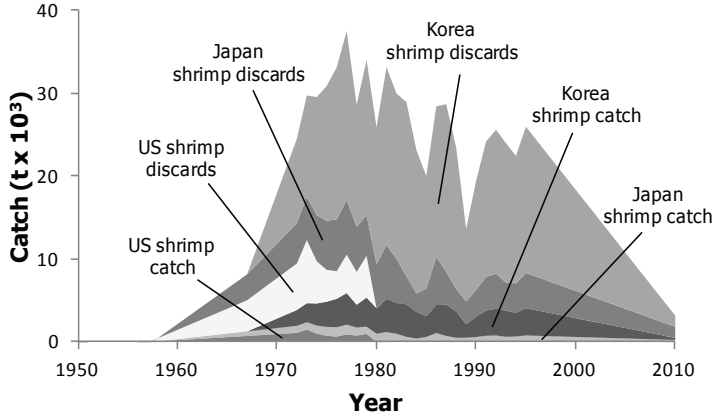

Figure 7. Estimated catches and discards by foreign shrimp fleets in Suriname's waters: United States (1958-1979), Japan (1959-2010) and Korea (1967-2010).

Reconstructed total domestic catch

Reconstructed total catches for Suriname's marine fisheries, excluding foreign catches, were estimated at approximately 1.9 million tonnes for the period 1950-2010 (Figure 8a). This total is 3.4 times the officially reported data presented by the FAO on behalf of Suriname. This large discrepancy was due to underreported artisanal catches, unreported subsistence catch and discards associated with the shrimp and seabob industrial fisheries. Subsistence catches, which were entirely unreported, amounted to 370,800 t and accounted for 14% of the total reconstructed catch over the entire study period. Discards from the domestic industrial seabob and shrimp fishery totaled 460,100 t and represented 24% of the total reconstructed catch. The taxonomic breakdown applied to Suriname's reconstructed fisheries catches (Figure 8b) is based on the reported catch composition given by Yspol (2006) for commercial catches by the artisanal sector and also catches by the subsistence sector. Catches were dominated by three main families: Sciaenidae, Penaeidae and Arridae.

Total catches by foreign vessels were estimated separately from the domestic catch estimates. These include shrimp catches and discards from US, Korean and Japanese vessels. The Venezuelan and Surinamese snapper fleet landed an estimated 43,680 t of red snapper in Suriname that was reported but included in the FAO miscellaneous marine fish category. Catches by foreign vessels fishing in Suriname's waters were estimated to be 147,350 t from 1958-2010 (Table 6). Total discards for the foreign shrimp industry was estimated to be 811,135 t (Table 6) over the same time period.

The total marine fisheries catches by Suriname from 1950-2010 were estimated to be 1.9 million t. This reconstructed total catch was 3.4 times larger than the landings presented by the FAO on behalf of Suriname for this same period (567,319 t). This large difference is mainly due to unreported artisanal, subsistence catch and discards associated with the shrimp and seabob fisheries, which were unaccounted for in the officially reported data. This large discrepancy indicates an apparent need for improvements in the collection and reporting of fish and shrimp catches within the country, including regular estimates of discards. The landing sites in Suriname are used by various fleets, foreign and domestic, and catch data are often improperly reported or not categorized based on fleet flag and ownership or species.

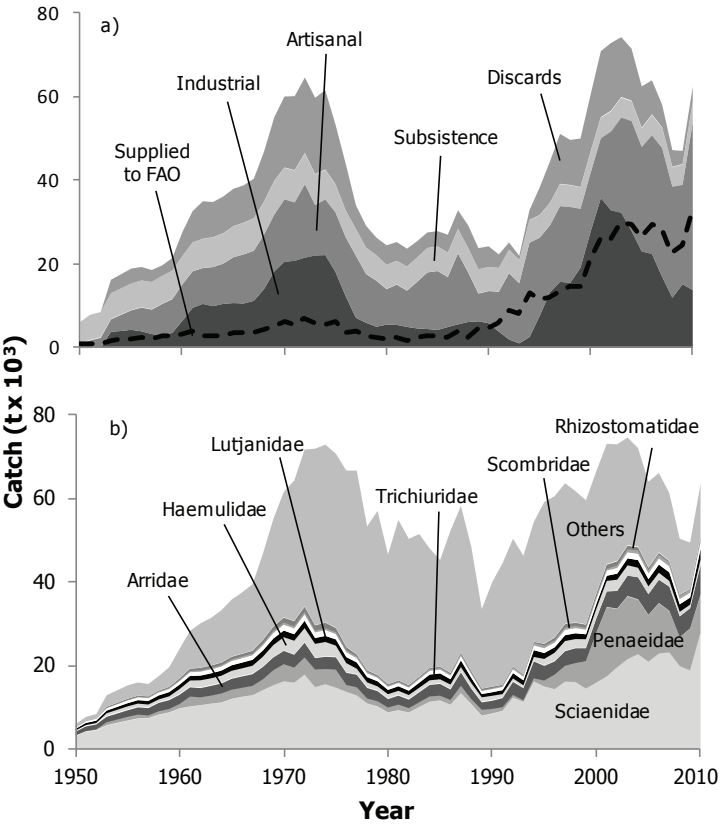

Figure 8. Reconstructed total catch of Suriname's marine fishery from 1950-2010. a) by sector, b) main taxa caught. All other taxa (MMF + the remaining 23 families) were grouped into 'Others' category.

Suriname's shrimp production is currently valued at approximately 60 million USD annually (Anon. 2004). Since 1996, intense fishing pressure has depleted shrimp populations and the fishery has reached a state of economic overexploitation (Chin-A-Lin and Yspol 2000). Observations by local fishers describe a situation in which shrimp populations are failing to recover from one fishing season to the next (Miglino *et al.* 2005). Two likely causes of this decline are license holders not abiding by the catch regulations and the use of dragnets in shallow water, which damages shrimp breeding and production grounds. Foreign shrimp fleets are extracting multiple species, using specialized gears and fishing techniques. Another added pressure is illegal fishing, typically by Guyanese and Venezuelan vessels in Suriname's EEZ (Madharie 2006). As stocks decline inshore, fishers are forced to target other resources, such as deep water shrimp species (Miglino *et al.* 2005). Since these shrimp stocks are shared along the continental shelf extending from Guiana to Brazil, management decisions must therefore also be implemented at a regional level.

Despite a global concern for by-catch, Suriname is one of several small countries that continues to have a discarded rate in excess of 80% (Kelleher 2005). This high discard rate may be partly attributed to the long distances between fishing grounds and local markets and/or the poor demand for discarded species (Kelleher 2005). Most of the landed by-catch is caught during the last few hauls of the trip and is from shallow or inshore waters. Seabob trawlers are thought to catch valued shrimp species such as brown shrimp as by-catch, further adding to overfishing of the stock, however, preliminary studies show that quantities of *P. schmitti* and *P. subtilis* in the catch are only about 1% of the total landed catch (Charlier *et al.* 2000; Southhall *et al.* 2011). Since the industrial seabob fishery is a relatively new fishery, the overall impact on other resources and other fleets has not been fully investigated.

In a recent news report, Guyanese fishing vessels are being accused of illegally landing a large percentage of their catch outside of Suriname (Anon. 2011). An updated licensing system in Suriname was designed to help reduce over-fishing, however unlike Guyana, the fishing grounds still contain an abundant supply of fish resources. This ultimately leads to fishers legally and illegally moving into Suriname's waters and taking their catch back to Guyana, where it will sell for a much higher price due to the present scarcity of seafood in their country (Anon. 2011). Addressing this issue requires the cooperation of the Guyanese Fisheries Division and assumes that data on catches taken from Suriname's waters are accurate (Mahon 2001). Since November 1, 2011, current prospective license holders must re-register and the government is increasing inspections to curb the illegal extraction and sale of fishery resources (Anon. 2011).

Landing statistics in Suriname, for much of the 1970s and 1980s, only reflect landings from the most important landing sites (Madharie 1992). Due to unknown amounts of catch being landed elsewhere, the Surinamese government along with help from the UNDP and FAO, began a project called the Establishment of Fisheries Information and Resource Assessment System (FIS). The purpose of the FIS is to regularly collect data on landings and effort, however, one of the main challenges in relation to small-scale fisheries is that fishers land at numerous sites along the coastline (Charlier *et al.* 2000). Therefore, in order to effectively monitor the fishery, the system would require a large team of researchers, fisheries officers or on-site personnel, who are responsible for recording daily landings at all of these sites. However, the human and financial resources required for such monitoring programs would rapidly exceed capacity and economic value of fishers. Therefore, in order to resolve some of these persistent reporting issues within the country, it is suggested that regular estimation procedures such as census work (i.e. household and creel

surveys), be included at least every 5-8 years to account for unreported (often non-commercial) components of the fisheries sector (Zeller *et al.* 2007). These estimates of total catches can then be interpolated or 'scaled-up' to account for years without reporting (Zeller *et al.* 2007). For Suriname, such historical catch data could provide a more accurate baseline for policy makers when creating management plans that will ensure sustainable fisheries in the future.

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

Year	FAO landings	Reconstructed total catch	Industrial	Artisanal	Subsistence	Discard
1950	800	5,200	-	970	5,010	-
1951	1,000	6,800	-	1,760	5,990	-
1952	1,000	7,400	-	2,360	6,070	-
1953	1,600	11,300	3,820	2,950	6,170	3,220
1954	1,900	12,200	3,990	3,850	6,270	3,390
1955	2,200	13,100	4,270	4,640	6,360	3,570
1956	2,600	13,400	3,920	5,640	6,440	3,220
1957	1,900	13,700	3,260	5,830	6,540	2,860
1958	3,000	14,100	3,000	7,420	6,640	2,500
1959	3,000	15,300	3,540	8,020	6,760	3,040
1960	3,300	18,600	6,420	8,710	6,730	5,720
1961	4,000	21,100	9,500	8,710	6,860	7,500
1962	2,767	23,200	10,430	8,570	6,990	8,930
1963	2,933	23,400	9,900	9,330	7,130	8,400
1964	2,800	24,500	10,450	9,590	7,270	8,750
1965	3,567	25,400	10,630	10,950	7,410	8,930
1966	3,633	26,200	10,530	11,710	7,570	8,930
1967	3,400	27,500	11,170	11,970	7,740	9,470
1968	4,167	30,700	13,970	13,030	7,880	11,970
1969	5,133	34,700	18,190	13,590	8,060	15,190
1970	6,400	36,600	20,470	14,960	7,600	16,970
1971	5,663	36,700	20,690	14,010	7,700	17,690
1972	6,826	39,700	21,450	17,610	7,440	18,050
1973	5,889	35,600	21,960	12,120	7,370	18,260
1974	5,554	37,000	22,040	13,360	7,160	18,920
1975	6,381	32,600	18,010	14,300	6,700	14,240
1976	3,618	29,100	12,250	14,110	6,360	11,180
1977	4,074	24,200	7,120	14,810	6,340	5,710
1978	2,648	21,200	5,940	11,620	6,270	5,220
1979	2,568	19,500	5,000	10,980	6,070	4,200
1980	2,019	17,700	5,500	8,470	5,770	4,670
1981	2,377	18,300	5,450	9,590	5,650	4,480
1982	1,864	17,500	4,960	8,650	5,730	4,260
1983	2,394	19,100	4,600	11,110	5,780	3,890
1984	2,938	20,800	4,460	13,500	5,820	3,700
1985	2,857	21,300	4,230	14,040	5,850	3,640
1986	2,449	20,200	4,940	11,900	5,850	4,260
1987	3,950	24,400	5,570	16,930	5,820	4,460
1988	2,391	21,300	6,140	11,800	5,780	5,440
1989	4,634	14,000	6,290	6,610	5,770	5,070
1990	4,909	14,300	5,840	7,660	5,720	4,940
1991	5,720	13,300	3,850	9,500	5,650	3,210
1992	9,054	14,300	1,970	15,820	5,580	1,710
1993	7,961	12,900	1,040	14,330	5,510	980
1994	12,938	17,600	2,540	22,500	5,450	2,300
1995	11,434	20,200	7,570	18,680	5,420	6,570
1996	12,069	22,500	13,180	15,990	5,390	9,870
1997	13,664	25,400	15,690	18,100	5,310	11,940
1998	14,617	24,200	15,460	18,150	5,240	10,750
1999	14,745	23,600	19,060	14,120	5,170	11,620
2000	20,927	26,000	27,700	14,140	5,090	13,600
2001	26,470	28,600	35,600	14,520	4,980	15,780
2002	26,154	30,500	32,690	19,040	4,910	16,180
2003	29,687	30,200	32,140	22,930	4,840	14,300
2004	29,516	29,500	27,780	26,480	4,770	12,430
2005	26,589	26,000	22,930	25,050	4,570	9,870
2006	29,408	26,300	22,320	28,480	4,930	8,130
2007	28,406	24,200	16,880	30,870	4,890	5,400
2008	22,554	20,600	11,910	26,570	4,710	3,980
2009	24,628	19,200	15,100	23,810	4,950	3,130
2010	32,475	26,400	13,720	40,130	4,980	3,500

Appendix Table A2. Total reconstructed catch (in tonnes) by major taxa for Suriname, 1950-2010. 'Others' contain 24 additional taxonomic categories.

Year	Sciaenidae	Penaeidae	Haemulidae	Arridae	Lutjanidae	Rhizostomatidae	Trichiuridae	Batrachoididae	Others
1950	3,260	190	840	150	430	190	180	-	740
1951	4,220	250	1,090	200	560	240	230	-	960
1952	4,590	280	1,190	220	610	260	250	-	1,040
1953	5,700	880	1,280	760	660	380	270	230	2,760
1954	6,290	910	1,430	810	730	420	300	240	2,980
1955	6,820	1,030	1,550	860	790	450	330	250	3,180
1956	7,340	1,060	1,710	830	850	480	360	230	3,140
1957	7,390	790	1,740	780	890	470	370	200	2,980
1958	8,270	920	1,990	770	980	520	430	180	3,470
1959	8,780	940	2,090	880	1,040	560	450	210	4,680
1960	9,760	1,160	2,180	1,330	1,080	660	470	400	6,980
1961	10,220	2,440	2,200	1,620	1,120	720	470	530	8,990
1962	10,510	1,990	2,180	1,860	1,150	760	470	630	10,580
1963	10,880	2,010	2,310	1,790	1,210	770	490	590	11,310
1964	11,160	2,230	2,360	1,860	1,250	800	500	610	12,440
1965	12,040	2,260	2,580	1,930	1,340	850	550	630	13,610
1966	12,540	2,190	2,710	1,950	1,400	880	580	630	14,620
1967	12,890	2,320	2,770	2,050	1,450	910	590	660	15,830
1968	14,140	2,640	2,940	2,490	1,520	1,020	630	840	20,560
1969	15,280	3,640	3,050	3,030	1,580	1,150	650	1,070	25,610
1970	16,210	4,130	3,180	3,350	1,620	1,230	680	1,190	29,950
1971	15,910	3,620	3,060	3,440	1,560	1,230	650	1,240	33,510
1972	17,820	4,100	3,530	3,590	1,790	1,350	750	1,270	37,430
1973	14,820	4,230	2,740	3,480	1,410	1,180	590	1,280	42,110
1974	15,520	3,700	2,880	3,610	1,480	1,230	620	1,330	42,430
1975	14,690	4,340	2,950	2,860	1,510	1,100	630	1,000	41,560
1976	13,710	1,710	2,880	2,350	1,470	990	620	780	42,110
1977	12,820	2,050	2,980	1,470	1,520	840	640	400	43,870
1978	10,920	1,280	2,510	1,310	1,300	720	540	370	34,320
1979	10,220	1,350	2,390	1,120	1,240	660	510	290	39,190
1980	8,780	1,300	1,990	1,120	1,050	590	430	330	30,970
1981	9,290	1,460	2,140	1,120	1,120	610	460	310	38,310
1982	8,760	1,170	2,010	1,060	1,060	580	430	300	34,940
1983	10,060	1,260	2,370	1,060	1,230	640	510	270	34,050
1984	11,340	1,380	2,710	1,100	1,400	710	580	260	28,530
1985	11,640	1,230	2,800	1,100	1,440	730	600	260	25,450
1986	10,610	1,260	2,490	1,150	1,290	680	530	300	33,930
1987	13,380	1,810	3,200	1,310	1,640	840	680	310	34,990
1988	10,780	1,280	2,470	1,330	1,280	710	530	380	29,610
1989	8,000	1,530	1,770	1,150	820	550	380	360	19,000
1990	8,530	1,220	1,910	1,150	870	580	410	350	24,910
1991	9,140	990	2,170	920	960	580	460	230	29,030
1992	12,330	720	3,090	840	1,300	730	660	120	30,530
1993	11,280	500	2,860	680	1,210	660	610	70	28,400
1994	16,180	790	4,050	1,110	1,640	960	870	160	28,590
1995	14,980	1,480	3,490	1,700	1,440	970	740	460	33,830
1996	14,360	3,520	3,130	2,150	1,300	990	660	680	33,720
1997	16,140	3,820	3,470	2,530	1,410	1,120	720	820	33,550
1998	16,040	4,580	3,520	2,290	1,400	1,070	720	720	31,330
1999	14,480	6,590	3,080	2,250	1,190	960	590	750	29,640
2000	15,920	11,930	3,380	2,470	1,210	1,010	590	840	29,120
2001	17,400	16,550	3,680	2,770	1,230	1,090	600	970	28,710
2002	19,600	13,970	4,170	2,920	1,460	1,230	740	990	27,800
2003	21,550	15,020	4,820	2,750	1,660	1,310	860	870	25,680
2004	22,750	13,020	5,220	2,550	1,840	1,360	970	740	23,530
2005	20,930	11,150	4,880	2,110	1,740	1,230	920	570	20,430
2006	22,890	11,990	5,520	1,950	1,960	1,300	1,030	460	18,920
2007	23,170	9,880	5,730	1,590	2,080	1,290	1,110	280	16,140
2008	19,890	6,880	4,940	1,250	1,820	1,100	970	180	13,300
2009	18,840	10,030	4,770	1,050	1,710	1,000	890	130	11,000
2010	27,910	8,960	7,060	1,520	2,580	1,530	1,400	140	12,270