

## RECONSTRUCTION OF MARINE FISHERIES CATCHES FOR GUADELOUPE FROM 1950-2007<sup>1</sup>

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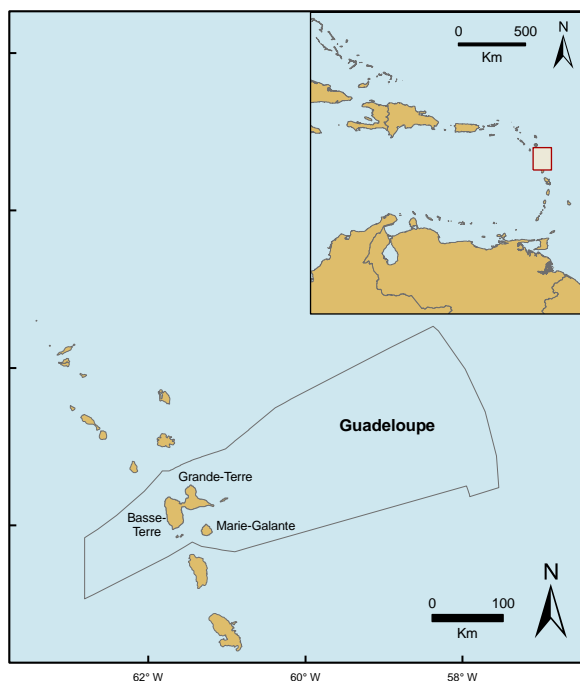
### ABSTRACT

A reconstruction of total marine fisheries catches for Guadeloupe was undertaken from 1950-2007. The catch reconstruction combines commercial landings based on data as supplied to the FAO with unreported catches based on estimates of subsistence catches taken from consumption information combined with trade and commercial data and recreational catch estimates. Total reconstructed catches were estimated to be approximately 502,696 t over the 1950-2007 time period, which is 35% larger than the total catches of 372,156 t as reported by the FAO on behalf of Guadeloupe. In the most recent years (2000-2007), total annual catches were on average 21% higher than the reported landings suggested. Reporting only commercial landings gives an incomplete picture of the fisheries of a country on both a local and global scale as it generally does not include small-scale and/or subsistence fisheries and recreational fisheries.

### INTRODUCTION

Guadeloupe is an island group located in the eastern Caribbean Sea, between 16° N and 61° W and is made up of two main islands, *La Basse-Terre* and *La Grande-Terre*, and four smaller islands *La Désirade*, *Les Saintes*, *Marie-Galante* and *Petite Terre*, comprising about 1,700 km<sup>2</sup>, with an Exclusive Economic Zone (EEZ) of over 95,000 km<sup>2</sup> (Figure 1). It is part of the Lesser Antilles group, between Montserrat in the north and Dominica Island in the south (Figure 1). The island is one of the four overseas departments of France, and thus has also been a part of the European Union (EU) since 1957. The territory is divided in two urban districts: Basse-Terre (prefecture of the Guadeloupe department) and Pointe-à-Pitre.

The FAO FishStat database, which offers time series data on marine fisheries landings from 1950 to the present, is based on national statistical data supplied by its member countries. Therefore, the quality of the FAO data depends on the capacity of statistical collection within these countries. The FAO data 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; 2007). Furthermore, data reported by FAO do not distinguish between fisheries sub-sectors such as commercial vs. subsistence. In addition, Illegal, Unreported and Unregulated (IUU)



**Figure 1.** Map of Guadeloupe and its EEZ. Inset map showing its location within the Caribbean.

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catches are a concern for fisheries worldwide (Bray, 2000) and presumably also add to total marine fisheries removals by Guadeloupe in the Caribbean Sea.

Fishing in Guadeloupe is traditionally concentrated around the island shelf due to the large number of species and the fact that the EEZ of other neighboring island countries are more difficult to reach. The main species caught are tunas, bonitos, king mackerel (*Scomberomorus cavalla*), bigeye scad (*Selar crumenophthalmus*), sea bream (*Archosargus rhomboidalis*), saury (*Scomberesox saurus saurus*), snapper (*Lutjanus* spp.), queen snapper (*Etelis* spp.), deep-sea sharks, crustaceans, mollusks and sea urchins, which can all be sold commercially. Queen conch (*Strombus gigas*) and spiny lobster (*Panulirus argus*) fisheries are significant in some areas of the Caribbean Sea (Agard and Gobin, 2000); however, Guadeloupe mainly imports these to meet their consumption demand.

Guadeloupe's fishing fleet is comprised mainly of small boats less than 12 m in length with powerful motors that enable them to operate over the entire continental shelf, and a few boats greater than 12 m in length that operate offshore (Anon., 2006). In 2005, there were an estimated 1,000 registered fishers, the majority of which were small-scale fishers (Anon., 2009a). The recreational fishing sector was estimated in 2005 to have 106 fishers who mainly targeted fish in the Labridae and Scaridae families, dolphinfish, and shellfish such as Conch (Guyader, 2008).

The expansion of fisheries in the Caribbean has been limited by over-exploitation of inshore fisheries by small-scale fisheries, a reliance on small vessels and a lack of cold storage facilities (Agard and Gobin, 2000). Fishing in Guadeloupe and other nearby islands are also affected by the presence of a naturally occurring but toxic alga (*Ciguatera*) which contaminates fish flesh and renders it inedible (Olsen *et al.*, 1984). The risk of Ciguatera limits the trade of seafood products, particularly with respect to exports from Guadeloupe but also imports from other nearby islands. Efforts in the 1970s were made by the FAO in conjunction with the Canadian International Development Agency (CIDA) to expand the fisheries sector in the Caribbean Islands through fleet upgrades and processing infrastructure (Mohammed, 2003a).

The objective of the present study is to provide an estimate of total marine fisheries catches for Guadeloupe from 1950-2007, which will serve as a scientific baseline for examining issues such as food security and resource depletion in the Caribbean Sea. Although several studies and reports have been published previously, there has been no comprehensive review of potential historical catches that account for subsistence and recreational catches in addition to reported commercial landings, and there has been no expansion to cover Guadeloupe as a whole.

## MATERIALS AND METHODS

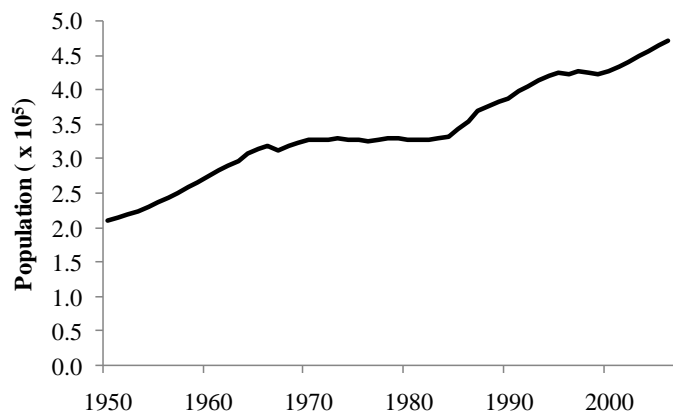
Total marine fisheries catches for Guadeloupe were estimated from 1950-2007 using a combination of FAO landings data and global trade statistics assessed by the *Sea Around Us* Project ([www.seaaroundus.org](http://www.seaaroundus.org)). The FAO statistics were taken as representing only commercial landings, to which we added estimates of subsistence catches, being interpreted as non-commercial catches and estimates of recreational catches. Commercial catch data from other reliable sources were used in place of the FAO commercial landings data for years when such data were available. The resulting time series, which includes commercial catches, subsistence catches and recreational catches represents the total reconstructed catch estimates for Guadeloupe from 1950-2007.

### *Human population*

Human population data were taken from the historical population demography website ([www.populstat.info](http://www.populstat.info)). Data are provided for most years. In years without population data, a linear interpolation between neighboring years was done to estimate missing values. The population doubled from 210,000 in 1950 to 421,000 by 2000 (Figure 2). Guadeloupe, like other Caribbean Islands, is a popular holiday destination. Visitors to Guadeloupe totaled 623,134 in 2006 with an average length of stay of 3.5 nights (Anon., 2009b), resulting in 2.2 million visitor days-year<sup>-1</sup>. Averaged over a full year, this effectively added the equivalent of approximately 6,000 full-time residents to the population of Guadeloupe that year.

## Commercial fisheries

Reported commercial landings consist of fishery products that are sold in the domestic market or exported. A review by Desse (1989) of studies describing commercial catches of marine fishes, taken in Guadeloupe, provided four FAO independent anchor points of commercial catches between 1982 and 1985. All other commercial data were taken from the FAO landings statistics database.



**Figure 2.** Population estimates for Guadeloupe, 1950-2007.

## Trade

While trade data for Guadeloupe were available from the FAO trade database, an alternative source was used here. Trade data were obtained from the *Sea Around Us* Project global trade database and transformed from trade product weight to live weight using FAO conversion factors as well as an independent collection of conversion factors (from EuroStat, Japanese customs, US Census Bureau, and UN ComTrade) integral to the global trade database. Import and export data from 1963-1995 were available for Guadeloupe and estimates for earlier years were derived through linear interpolation from an assumption of zero trade in 1944, i.e. during WWII, to the first good anchor point in 1963. This may result in an underestimate of trade in the early years. To estimate trade in the later period where data were either missing or incomplete, we used the five-year average of live weight from 1991-1995 and carried it forward as a constant value from 1995 to 2007. Estimates of net trade (import – export) were then used in estimating seafood consumption based on Aldrich and Connell’s (1992) claim that half of all seafood consumed in Guadeloupe were supplied through imports. The consumption rate in comparison with the reported landings and net trade was then used as the basis for our calculation of subsistence catches.

## Subsistence fisheries

Data regarding subsistence or artisanal fishing in Guadeloupe were not readily available. Small-scale fisheries in Guadeloupe likely comprise both artisanal and subsistence sectors. We assumed conservatively that artisanal catches were included in the reported landings as they are part of the commercial sector, while subsistence catches were not accounted for in the reported landings. Subsistence catches were estimated as the portion of the total demand (i.e., consumption) that is neither met through commercial catches nor imports. The US National Marine Fisheries Service (NMFS) released a set of estimates for annual seafood consumption in Guadeloupe, but these appear to be based on the data supplied to the FAO, which are likely underestimates as they are based on the amount of seafood products available from commercial fishing and net trade (imports - exports) only. Aldrich and Connell (1992) state that in Guadeloupe “about half of all fish consumed are imported”, which was used here to estimating seafood consumption. Hence, the *per capita* consumption rate was assumed to be twice the *per capita* import rate. To derive subsistence catch rates, we first took our estimated consumption rate, subtracted *per capita* net trade (imports- exports) to get an estimate of the portion of the total consumption demand that is met through local supply (which includes commercial and subsistence sectors) and then removed the *per capita* commercial catches. Thus,

$$C_s = S_t - T_N - L_C$$

where  $C_s$  is Subsistence catch,  $S_t$  is Total Supply (= total consumption),  $T_N$  is Net Trade (imports - exports) and  $L_C$  is Commercial landings.

In cases where there was substantial annual variation in the *per capita* subsistence rates due to large variations in net trade, an average was taken from the two years before and after the anomaly. This adjustment was necessary for 10 of the 56 years in the time series. The first few years in the time series likely had higher consumption rates than those calculated here, as trade was just getting started and probably accounted for less than half of consumption in these early years.

To determine the species composition of the subsistence catch, we used species composition data from Mohammed *et al.* (2003a) for the nearby island of St. Lucia. The species composition used was from St Lucia's inshore fishery, which is assumed to be essentially artisanal and/or subsistence in nature. From this data set, we excluded turtles and species

**Table 1.** Estimated species composition (%) of subsistence catches for Guadeloupe based on St. Lucia's species composition for inshore fisheries (Mohammed, 2003a).

| Common name          | 1950-1959 | 1960-1969 | 1970-1980 <sup>1</sup> | 1981-1990 | 1991-2001 |
|----------------------|-----------|-----------|------------------------|-----------|-----------|
| Barracudas           | 0.0       | 0.5       | 4.3                    | 15.8      | 2.1       |
| Bermuda chub         | 0.0       | 0.0       | 0.0                    | 0.4       | 0.3       |
| Bonefishes           | 0.0       | 0.0       | 0.0                    | 0.0       | 0.1       |
| Butterfishes         | 0.0       | 0.1       | 0.0                    | 0.0       | 0.0       |
| Croakers             | 0.0       | 0.0       | 0.0                    | 0.2       | 1.5       |
| Demersal sharks      | 0.0       | 0.0       | 0.0                    | 1.3       | 1.2       |
| Goatfishes           | 0.0       | 0.0       | 0.0                    | 0.0       | 3.2       |
| Groupers             | 4.2       | 3.5       | 6.4                    | 19.9      | 3.6       |
| Grunts               | 0.0       | 0.0       | 0.0                    | 13.7      | 3.2       |
| Halfbeaks            | 5.5       | 0.9       | 0.0                    | 0.0       | 19.5      |
| Herring and sardines | 0.0       | 0.9       | 0.0                    | 0.0       | 5.1       |
| Jacks (reef)         | 0.8       | 0.0       | 0.7                    | 2.6       | 1.7       |
| Jacks (coastal)      | 76.0      | 87.3      | 34.5                   | 14.4      | 19.7      |
| Lobsters             | 2.6       | 4.0       | 0.7                    | 0.8       | 4.7       |
| Marine fish nei      | 7.6       | 0.0       | 45.9                   | 0.0       | 2.2       |
| Octopus              | 0.0       | 0.0       | 0.0                    | 0.0       | 0.2       |
| Parrotfish           | 0.0       | 0.0       | 0.0                    | 4.2       | 4.7       |
| Queen conch          | 0.0       | 0.0       | 0.0                    | 1.9       | 10.7      |
| Rays                 | 0.0       | 0.0       | 0.0                    | 0.1       | 0.2       |
| Snappers             | 3.7       | 2.7       | 7.4                    | 24.7      | 16.1      |

<sup>1</sup> Note change in time period coverage

that were likely caught for sale to the Aquarium trade industry. The resulting species composition was applied to the annual subsistence catch totals for Guadeloupe as time series averages (Table 1). The time series averages were calculated based on breaks in the taxonomic accounting related to reporting changes in the species composition reported by Mohammed *et al.* (2003a), but were approximately decadal. In recent years, more species were reported, which likely reflected better species identification and improved reporting. The decadal averages from the St. Lucia species composition data were then applied to Guadeloupe's annual subsistence catch totals to derive tonnages, disaggregated by taxa.

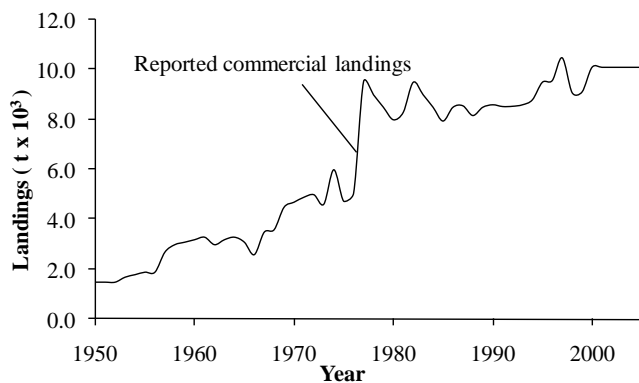
## Recreational Catches

Catches for the recreational fisheries sector were based on a preliminary study by Ifremer (2008), which estimated that the 2005 recreational fisheries catch for Guadeloupe was about 323 t, or 0.74 kg·person<sup>-1</sup>. Assuming that recreational catches were zero in 1950, we derived a complete time series by linear interpolation from zero in 1950 to 0.74 kg·person<sup>-1</sup> in 2005. The 2005 value was carried forward unaltered as the *per capita* recreational fishing rate for 2006 and 2007. This is likely an underestimate of recreational catches as this fishery sector is likely to increase alongside the tourism industry. Of the total recreational catch, 90% were fish and 10% were shellfish (O. Guyader, 2008). This ratio was used throughout the time series to estimate annual tonnage for these two categories.

## RESULTS

### Commercial landings

Commercial landings in 1950, as reported by Guadeloupe to the FAO were 1,500 t·year<sup>-1</sup> and increased substantially to 9,525 t·year<sup>-1</sup> by 1977 (Figure 3). From 1978 to 1999, annual landings as reported by the FAO and Desse (1989) were less variable, with an average of 8,786 t·year<sup>-1</sup> during this period (values ranged from 8,000 t·year<sup>-1</sup> to 10,480 t·year<sup>-1</sup>). From 2000 onward estimated landings were about 10,100 t·year<sup>-1</sup>.



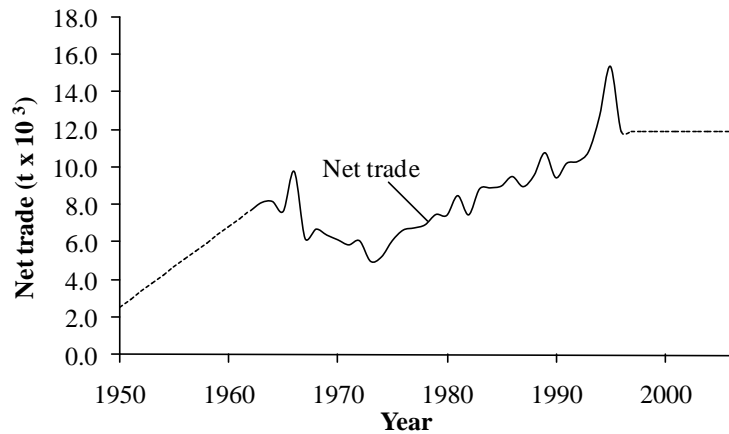
**Figure 3.** Commercial landings for Guadeloupe, 1950-2007.

### Trade

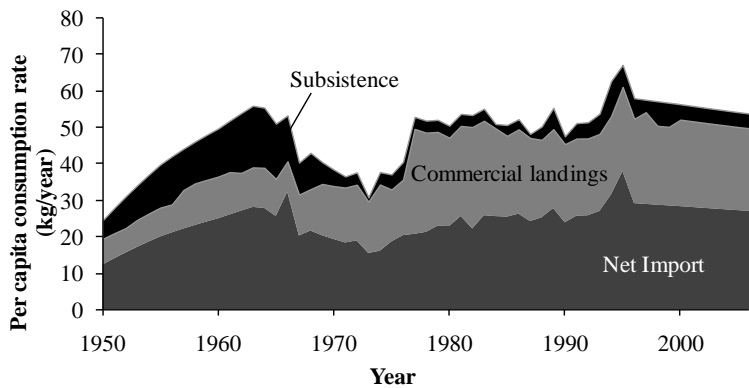
The net trade (imports – exports) data for Guadeloupe was linearly interpolated from 2,569 t·year<sup>-1</sup> in 1950 to the first anchor point of 8,135 t·year<sup>-1</sup> in 1963 (Figure 4). Net trade, when positive, implied net imports. Net trade (i.e. imports) increased to 9,793 t·year<sup>-1</sup> in 1966, then decreased to 5,016 t·year<sup>-1</sup> by 1973. Subsequently, imports increased to a peak level of 15,384 t·year<sup>-1</sup> in 1995. From 1996 onward data were incomplete, so the 5-year average from 1991-1995 (i.e., 11,898 t·year<sup>-1</sup>) was used as the estimated value for all remaining years (1996-2007). Again, it is likely that this value was higher due to the increasing trend displayed in the previous period of reported data, but was held constant to remain conservative in our estimate.

### Subsistence catches

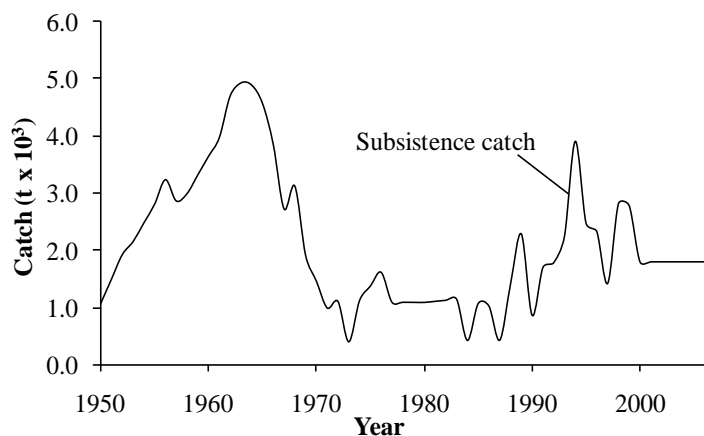
Subsistence catch estimates were derived from estimated *per capita* consumption rates, net trade and commercial landings. Subsistence catches make up the portion of the consumption that is neither supplied by the commercial sector nor through trade (Figure 5). Subsistence catch estimates varied greatly, and although it is likely that the population was larger than was reported at the beginning of the time series, a conservative approach was taken (Figure 6). In 1950, the subsistence catch was estimated to be just over 1,000 t·year<sup>-1</sup>, which increased substantially to 4,935 t·year<sup>-1</sup> by 1963. Subsistence catch decreased to 396 t·year<sup>-1</sup> in 1973, then averaged 1,183 t·year<sup>-1</sup> for the following decade, and decreased again to about 420 t·year<sup>-1</sup> in both 1984 and 1987. The catch continued to vary over the following decade with an average catch of 2,168 t·year<sup>-1</sup> (values between 861 t·year<sup>-1</sup> and 3,911 t·year<sup>-1</sup>). From 2000 onward, derived catches were stable with an average of approximately 1,800 t·year<sup>-1</sup> (in response to the net trade data being carried forward at a constant rate in the absence of complete trade data).



**Figure 4.** Net trade for Guadeloupe estimated for the period 1950-2007. Dashed lines indicate interpolated periods. Source: (W. Swartz, unpubl. data).



**Figure 5.** Guadeloupe's *per capita* consumption rate used in combination with commercial landings and trade data to derive subsistence catch rates, 1950-2007.



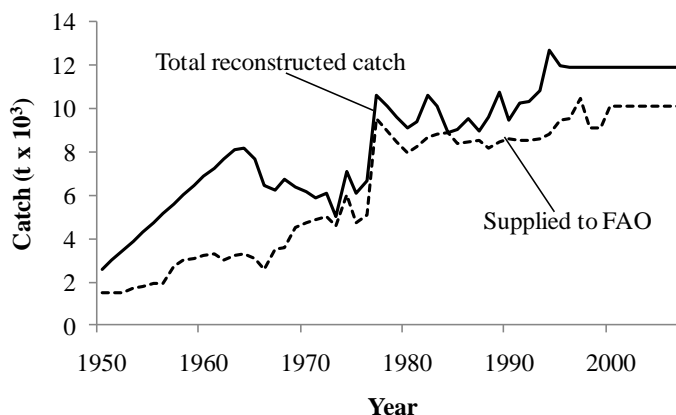
**Figure 6.** Estimated subsistence catches for Guadeloupe, 1950-2007.

## Recreational catches

Recreational catch estimates totaled 8,343 t for the period 1950-2007. Over the time series, we estimated that 7,509 t of fish were caught recreationally and 834 t of shellfish were caught recreationally.

## Total catch reconstruction

The reconstructed total catch for Guadeloupe from 1950-2007 was estimated to be 502,696 t (Figure 7). This reconstructed catch was 35% larger than the landings reported by the FAO on behalf of Guadeloupe (372,156 t) over the same time period (Figure 7). The biggest discrepancy occurred in the first two decades of the time period, and in the more recent period. Since the early 1990s, total annual catches seem to be 24% higher than the data reported annually to the FAO (Figure 7).



**Figure 7.** Total reconstructed catch compared to total landings supplied to the FAO by Guadeloupe, 1950-2007.

## DISCUSSION

Guadeloupe's total catches from 1950-2007, as estimated in our reconstruction, were approximately 502,696 t. Over the same time period, FAO FishStat reports 372,156 t. The reconstructed catch, which includes estimates of subsistence catches, was 35% higher than the total landings as supplied to the FAO. While Guadeloupe relies heavily on imports from neighboring islands and overseas regions, they continue to source a portion of their seafood supply domestically. Of this, only commercial landings are officially reported. The majority of the fishing fleet is made up of small vessels, which primarily target pelagic fish species for commercial purposes (FAO, 2002). Some vessels operate near shore, targeting smaller reef-fish for commercial and subsistence purposes. Subsistence fisheries catches are often unaccounted for in fisheries statistics (Zeller *et al.*, 2006; 2007), and are therefore not included when estimating the scale and impact of fisheries for a particular region. Fish resource depletion, particularly of inshore fisheries of the Lesser Antilles have been, in part, the result of open-access, small-scale fisheries (Chakalall *et al.*, 1998). If these fisheries sectors continue to be unaccounted for, effective management of these areas will remain a challenge and these marine habitats will continue to be compromised.

Our estimates of subsistence catches for Guadeloupe may be underestimates, as our approach attempted to remain conservative. Given the lack of data on Illegal, Unreported and Unregulated (IUU) catches in this region, we did not estimate other IUU components which may also factor into the equation. It is known that commercial vessels from other countries outside the Caribbean exploit fish stocks within the EEZ of this region, without the consent of the islands' governments (Agard and Gobin, 2000). However, the extent to which this occurs has not been quantified.

The recreational fishing sector is another fisheries component that is currently unaccounted for in most reported landings (e.g., Zeller *et al.*, 2008). Recreational fishing targets large sport fish as a component of the well-developed tourism industry in the Caribbean. Research by the French Research Institute for Exploitation of the Sea (Ifremer) has begun to assess recreational fishing in the region, but the results of this study are only preliminary (O. Guyader, pers. comm., Ifremer). While these preliminary findings were included in our reconstruction, further investigations into recreational fishing may provide a more detailed species breakdown of this fisheries sector.

While the population continues to increase, the numbers of visitors to Guadeloupe also continues to grow, placing an ever increasing demand on the Island's resources. Seafood supplies are limited and tourists often seek highly prized items and local delicacies such as lobster, conch and urchin, which have been over-harvested in many areas of the Caribbean (Agard and Gobin, 2000; Chakalall *et al.*, 1998). Imports are increasingly required to meet both local consumption demands as well as the tourist market. Hotels and resorts often source their seafood directly from fishers (Mohammed *et al.*, 2003b) or import products

from elsewhere. Although known to be unreported in many cases, we assumed these catches would be accounted for in the reported landings, as they are technically caught by its commercial sector.

This report shows that the current method of fisheries catch reporting is inadequate, and that more comprehensive reporting is necessary to account for total catches taken by the subsistence and recreational fishing sectors, which can often be considerable.

## ACKNOWLEDGEMENTS

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