Reconstruction of total marine fisheries catches for the Dominican Republic (1950-2010)[1]

Liesbeth van der Meer, Robin Ramdeen, Kyrstn Zylich, and Dirk Zeller

Sea Around Us, Fisheries Centre, University of British Columbia
2202 Main Mall, Vancouver, BC, V6T 1Z4, Canada
l.meer@fisheries.ubc.ca; r.ramdeen@fisheries.ubc.ca; k.zylich@fisheries.ubc.ca; d.zeller@fisheries.ubc.ca

Abstract

The reconstructed total catch for the Dominican Republic for the period 1950-2010 was estimated at almost 2.6 million tonnes, which is approximately 5.1 times the catch presented by the FAO on behalf of the Dominican Republic. Our study includes unreported catch estimates from the recreational and subsistence sectors. It also provides estimates of unreported artisanal catches satisfying tourist markets, such as hotels and restaurants. Better accounting of total fisheries extractions is urgently needed to better understand total resource use.

Introduction

The Dominican Republic shares the island of Hispaniola with Haiti. This popular tourist destination occupies 48,480 km² and lies between 19° 00' N latitude and to 70° 40' W longitude in the Caribbean. The north coast borders the Atlantic Ocean and the south coast borders the Caribbean Sea (Figure 1). It has an Exclusive Economic Zone (EEZ) of 269,285 km² (www.seaaroundus.org).

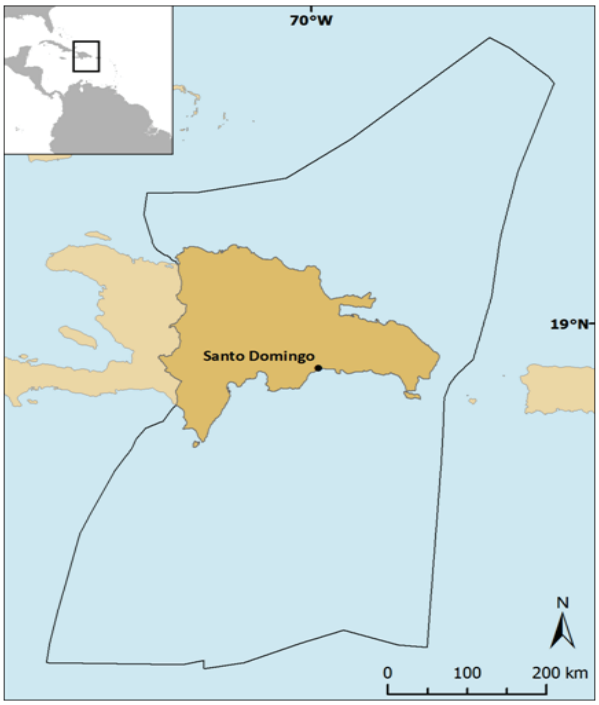

Figure 1. Map of the Dominican Republic with the black line demarcating the Exclusive Economic Zone (EEZ).

The Dominican Republic was first discovered by the Taino Indians, members of the larger Arawak group, who originated in the Orinoco-Amazon basin (Brown 1999). After being sighted in 1492 by Christopher Columbus, the first permanent European settlement was established in Santo Domingo, which is the Dominican Republic's present capital. After 300 years of Spanish, French and Haitian interludes, the country became independent in 1821. However, Dominicans experienced internal strife with American and Spanish interventions, civil wars and dictatorships. The most violent era in the country's history was almost certainly from 1930-1961, when Rafael Trujillo ruled the Dominican Republic with fear and violence. He was responsible for the deaths of thousands of Dominicans as well as Haitians; in the "Parsley Massacre" of 1937 he ordered the execution of all Haitians living along the border of the Dominican Republic. It wasn't until 1978 that the Dominican Republic successfully moved towards representative democracy.

Historically, the Dominican Republic exported sugar, coffee and tobacco. However, in recent years, the service sector has overtaken agriculture as the economy's largest employer, which has been due to growth in telecommunications, tourism and free trade zones (OECD 2010). With a blend of European, African and native Taino cultures, and 1,400 km of coastline bordering the Atlantic Ocean and the Caribbean Sea, millions of tourists are attracted to the Dominican Republic each year. The Dominican tourist industry grew tremendously during the 1970s, thanks to the enactment of the Tourist Incentive Law in 1971, which provided investors a ten-year tax holiday (Malik 2001). Today, tourism accounts for 67% of its total GDP, followed by industry which accounts for 32%, of which agriculture contributes 11%. The Dominican Republic is the second largest country in the Caribbean after Cuba and has a population of 10 million people, with a tourist population that averages 4 million per year. Remittances from the US amount to about a tenth of the GDP, equivalent to almost half of exports and three-quarters of tourism receipts. However, the country suffers from marked income inequality; the poorest half of the population receives less than one-fifth of GDP, while the richest 10% enjoys nearly 40% of GDP (OECD 2010).

Fishing is and has always been important for the people of the Dominican Republic. The fisheries of the Dominican Republic are mainly artisanal and multi-gear. Fishers target more than 300 species of fishes, crustaceans, molluscs and echinoderms. Although fishing accounts for approximately 0.5% of the Dominican Republic's total GDP, fishing culture has a long history that has developed particularly rapidly in the last two decades (Herrera *et al.* 2011).

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Approximately 8,600 fishers were enumerated to be operating from 3,252 boats in the 1990 census (Anon. 2004). Boats are typically small wooden or fiberglass dinghies with an outboard engine and crews of two (Silva 1994). Fishing is carried out with more than 20 different fishing gear types, such as gillnet, line, longline, nets, and traps. Considered mainly artisanal in nature, fishers have maintained their technologies and knowledge throughout the years with little external intervention (McGoodwin 2001). Fishers land catches at approximately 200 fish landing sites among the 16 different provinces, distributed along over 1,570 km of coastline. Mangroves run along the coast for around 240 km and are considered of great economic importance, as they provide a rich habitat for marine species. Coral reefs cover several hundred square kilometers (Spalding *et al.* 2001) and approximately 48 species have been identified.

Marine species exploited in the Dominican Republic vary greatly within regions. Spiny lobster (*Panulirus argus*) is the most valued marine resource in the Dominican Republic (Anon. 2004). Also highly valuable, the queen conch (*Strombus gigas*) fishery represents 6-16% of the national fisheries value (Anon. 2004). The queen conch is linked to platform sea grass and algae areas located mostly in the south-eastern regions (Delgado *et al.* 1998). Small-scale fisheries also exploit shrimp. The shrimp fishery started in the early 1960s, when locals were forced to find alternative sources of income due to closures in train operations. White shrimp (*Litopenaeus schmitti*) is considered the prevalent species in this area and compromises 86% of total shrimp catch (Sang *et al.* 1997). Other shrimp species include pink shrimp (*Farfatepenaeus durarum*) and the Atlantic seabob (*Xiphopenaeus kroyeri*).

The coastal reef fishery takes place on the entire Dominican Republic shelf up to 30 meters of depth; here, more than 100 species are caught, with the majority being snappers (Lutjanidae) and groupers (Serranidae). This fishery is considered small-scale and is mostly directed to the local market, with a high tourist demand. There is also a semi-industrial fleet that operates year round with longline and handline gears to target snapper. Pelagic fisheries are prevalent on the south coast, and the main species targeted are tunas, mackerel (*Scomberomorus* spp.) and Atlantic sailfish (*Istiophorus albicans*). This is a seasonal small-scale fishery, which has recently developed (Anon. 2004).

Despite productive fishing grounds, and mechanised fishing fleets, fisheries production in the Dominican Republic has not been able to satisfy demand for seafood in the country. Thus, like many other Caribbean countries, the Dominican Republic imports seafood products, averaging 34,000 tonnes per year (Herrera *et al.* 2011). Most of the imported seafood is comprised of shrimp destined for touristic markets (Anon. 2010). The national data collection of the Dominican Republic consists of 282 registered inspectors, who gather data for inland and marine fisheries. Medley (2001) notes several problems in the data gathering process. First, the lack of training of the inspection personnel; second, that catch weight is estimated rather than measured directly; thirdly, that there is no systematic or standard practice implemented for the collection of data and inspection of vessel logbooks; finally, he also notes that statistical errors are not accounted for.

It is widely recognised that catch statistics are fundamental and crucial to fisheries management (Pauly 1998). Fisheries catch data for the Dominican Republic are scattered and scarce. A fishery census conducted in 1990 contains the most updated information available (Medley 2001). This study aims to gather information on fisheries catches and fishing practices to reconstruct the Dominican Republic's total fisheries catches for the period 1950-2010. The catch reconstruction method used here is based on the approach developed by Zeller *et al.* (2007) Using this well established methodology, we aim to improve the catch data both quantitatively and taxonomically.

Methods

Human population and tourist population

Local population statistics for the Dominican Republic were taken from Populstat[2] for 1950-1960 and from the World Bank3 for 1960-2010 (Figure 2). Data on coastal population (Figure 2) with urban and rural distribution were taken from the Word Bank database and were used to calculate subsistence fisheries catches and seafood demand for the period 1950-2010.

Data on the number of stop-over tourists (i.e., travelers who stay on the island for more than a day) were available from the Central Bank of the Dominican Republic.[4] Data were available from 1978-2010, although it was assumed that tourism began in 1961 (the end of the unstable Trujillo era). Setting the tourist population at zero for 1960 and utilizing the data from 1978-2010, we applied direct linear interpolation to derive a time series of the number of stop-over tourists visiting the Dominican Republic from 1961-2010 (Figure 2).

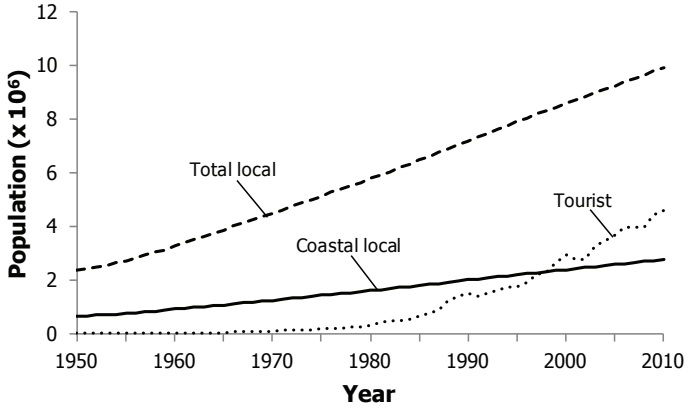

Figure 2. Total local population of the Dominican Republic (Populstat and World Bank statistics), local coastal population (WorldBank), and stop-over tourist population (Central Bank of Dominican Republic).

[2] www.populstat.info [Accessed August 23, 2012]
[3] http://data.worldbank.org/indicator/SP.POP.TOTL [Accessed September 21, 2012]
[4] http://www.bancentral.gov.do/english/index-e.asp [Accessed July 7, 2012]

Artisanal fisheries

Data on artisanal catches in the Dominican Republic were available for several years from various sources (Table 1). The most complete data series reported for artisanal fisheries in the Dominican Republic was found in Herrera *et al.* (2011), this time series included data from 1960 to 2009. Other sources, such as the ones mentioned in Table 1, were used to prove consistency. Using these data as anchor points and applying direct linear interpolation for the years with missing data, we derived a complete time series of artisanal catches for the study time period 1950-2010. The year 1960 was the first year where data were available, and we assumed a 40% increase in artisanal catches from 1950 to 1960. The reason for this is that the tourist boom started in 1960 increasing fish demand and coastal population.

Table 1. Artisanal catch (tonnes) in the Dominican Republic

Year	Artisanal catches (t)	References
1960	1,597	Herrera *et al.* (2011)
1970	4,791	Herrera *et al.* (2011)
1980	11,700	Colom *et al.* (1994)
1991	13,232	Anon. (1995)
2000	13,169	Mateo and Haughton (2004)
2004	11,093	Anon. (2004)

The data used for reconstruction purposes were national data reported by government statistics, and research thesis and NGO reports. The national data collection system captures about 60% of artisanal landings (Jeannette Mateo, pers. comm., Director of Fisheries Ministry of the Dominican Republic). Therefore, considering that 40% of the catches are not fully captured in the data collection system and standard error was not calculated in the weight of recorded catches, we applied a raising factor of 40% to the reported catch from 1950-2010.

Subsistence fisheries

Detailed data regarding subsistence fishers in the Dominican Republic were available for the local community of Buen Hombre. Buen Hombre is a small coastal fishing and farming village of about one thousand people located on the north coast of the Dominican Republic near the Haitian border (Stoffle 2001). The study was conducted in 1989 contained weekly subsistence catch rates and catch distribution information. Stoffle *et al.* (1994) reported an average consumption per household of 2.75 kg per fishing trip. According to Jeannette Mateo (pers. comm., Director of Fisheries Ministry of the Dominican Republic), it would be realistic to assume that a household goes out on one fishing trip per week. Based on government census information,[5] we assumed an average of 5 people per household, meaning each person consumes 0.55 kg·person^{-1}·week^{-1} (i.e., subsistence consumption of 28.6 kg·person^{-1}·year^{-1}). This was applied to the rural coastal population from 1950-1989. For 2010, we assumed that subsistence catch rates were 30% lower (i.e., 20.02 kg·person^{-1}·year^{-1}) and thus interpolated the rate from 28.6 kg·person^{-1}·year^{-1} in 1989 to 20.02 kg·person^{-1}·year^{-1} in 2010 (Table 2).

Table 2. Anchor points for domestic subsistence seafood consumption rates for the urban and rural populations in the Dominican Republic. Interpolation was done between anchor points.

Population	Consumption rate (kg/person/year)		
	1950	1989	2010
Urban	20.02	8.0	5.60
Rural	28.60	28.6	20.02

Urban population was assumed to be the population of Santo Domingo only, the capital of the Dominican Republic.[6] The urban population in general is assumed to consume less seafood than the rural population, as they have more access to other protein sources. For the period 1950-1989, we assumed that the urban population had a seafood consumption rate of 20.02 kg·person^{-1}·year^{-1} (i.e., 30% lower than the rate used for the coastal rural population). For the urban population in 2010, we decreased this subsistence consumption rate by an additional 30% to 14 kg·person^{-1}·year^{-1} (Table 2). In addition, it is known that imported seafood accounts for 60% of total urban consumption (Herrera *et al.* 2011). We assume that imported seafood consumption started to become important in the 1960s after supermarkets became the main source of food distribution in urban Santo Domingo. Thus, we assumed that imported seafood gradually began to constitute a greater proportion of the urban population's seafood consumption over the 1961-1980 time period, and this amount was removed for our calculations in order to establish domestically caught consumption. From 1950-1960, the consumption was stable at 20.02 kg·person^{-1}·year^{-1}. By 1970, 30% of consumption was satisfied by imported seafood, and by 1980, a further 30% came from imports (60% in total). From 1980 to 2010, the 60% of consumption that was attributed to imported seafood was kept constant and therefore our initially estimates were reduced by 60%.

Using the time series of these rural and urban subsistence seafood consumption rates rural and urban population data, we estimated subsistence fisheries catches in the Dominican Republic for the period of 1950-2010.

Industrial catches

The industrial fishery of the Dominican Republic operates year-round and takes place on the ocean banks of La Navidad and La Plata, as well as other small banks in the south. The fleet is composed of boats with decks, diesel engines, and freezing equipment, while using longline and handline as the main fishing gears. These vessels carry between 5 and 25 crew members. The species caught by the industrial fleet were described by Arima (1997, 1999). Amongst the most abundant species reported as caught are *Lutjanus vivanus, L. bucanella* and *Epinephelus mystacinus*. Although this fleet shares taxonomic affinity with parts of the artisanal fisheries, their fishing is

[5] www.one.gob.do [Accessed July 29th, 2012]

[6] Dominican Republic's demographic data. Available at: www.datamonitor.com [Accessed: June 2013]

completely separated since it is undertaken more than 90 miles from land, which makes it inaccessible to most artisanal fishers (Herrera *et al.* 2011). Arima (1999) estimates that 50% of the total catches reported for the species mentioned above are attributed to the industrial fleet. Since this is the only information we could access on industrial fisheries in the Dominican Republic, we assumed that it represented 50% of the commercial catches and that for the period 1950-2010 the total industrial catch was equal to the estimated tonnages of the artisanal catches of the taxonomic groups 'Lutjanidae' and '*Epinephelus* spp.' Herrera *et al.* (2011) estimate that industrial fisheries account for only 1% of total catches in the Dominican Republic.

Tourist sector

Investigations were done to assess the seafood sources at hotels in the Dominican Republic, which serve both imported and local seafood products on their menus. It is common for fresh seafood catches to be delivered daily by fishers directly to the hotel. Due to the fact that in these instances, fishers bypass landing sites, seafood catches supplying the tourist markets (such as hotels, guest houses and restaurants) are not accounted for and these catches were reconstructed separately. Annual tourist population data (1961-2010) were combined with data on the average length of stay, which was approximately 8.9 days according to the Caribbean Tourism Organisation. Taken together with inferences about the frequency of fresh seafood consumption (i.e., one serving of fresh seafood per day) and a typical serving proportion of 100 g (round weight), we applied the following equation to estimate tourist seafood demand annually:

Tourist seafood demand = # tourist days x average serving size x # servings/day

In this way, we were able to reconstruct small-scale catches satisfying the tourist market from 1961 to 2010.

Recreational sector

According to a global recreational study (Cisneros-Montemayor 2010), the number of recreational fishers in the Dominican Republic in 2003 was 19,863. Since sport fishing is an activity that is associated with tourism activities (Campos and Munoz-Roure 1987), we assumed all of these fishers were tourists. Therefore, by dividing the number of recreational fishers by the total number of stop-over tourists in 2003, we calculate the proportion of tourists who fish recreationally during their visit. We applied this rate of 0.006% constantly from 2003 to 2010. For the year 1961, we assumed a participation rate of 0.003% (half that of the later time period). Linearly interpolating between these two rates, we derived recreational fishing participation rates of the tourist population for the entire time period, 1961-2010. Assuming tourists are likely to participate in just one fishing tour during their stay of average 8.9 days[7] and assuming a conservative catch of 4.5 kg·tourist^{-1}·year^{-1}, we estimate catches from this sector.

Species composition

Detailed quantitative data for the taxonomic breakdown for all coastal regions of the Dominican Republic were found in PROPESCA reports for the years 1988 to 1990 and in a report by Appledoorn and Meyers (1993). In these sources, total daily catches by species were reported and classified for 12 months starting in November 1988 until November 1989. These catch amounts were turned into percentages. For all those species and families not mentioned in the above reports, but included in the FAO data, average proportions for the 1990-1995 period (the time period in which the FAO data had the greatest taxonomic disaggregation) were calculated and added to the percentage breakdown provided by the independent reports. Catches of Caribbean spiny lobster and queen conch fisheries have been (and continue to be) an important food source for locals but became even more important in the 1960s with the growth of the tourism sector (Melo and Herrera 2002). Taking the average proportional contribution of spiny lobster and queen conch to total catches in SERCM (Secretaria de estado del medio ambiente y recursos naturales [Secretariat of natural resources and environment]) catch data for 2000-2003, we then also added these two commercially important species to the breakdown. Overall proportions were re-scaled to 100% and applied constantly to the domestically consumed artisanal catches from 1950-2010 (Appendix Table A1). A slightly modified version of the artisanal breakdown (i.e., pooled to the family taxonomic level) was applied to the subsistence catches and artisanal catches for tourist consumption.

Information regarding the species composition of the recreational fishery in the Dominican Republic was not available. However, it is known that marlins (Istiophoridae), dolphinfish (*Coryphaena hippurus*), wahoo (*Acanthocybium solandri*), and tunas (Scombridae) are commonly caught species in most marine recreational fisheries. We therefore assumed equal proportionality of 25% for each of these taxonomic groups.

[7] http://www.onecaribbean.org/

RESULTS

Artisanal catches

Reconstructed artisanal catches (including those for tourist consumption) increased steadily from 1,900 t·year^{-1} in 1950 to 6,900 t·year^{-1} in 1964, after which a series of hurricanes devastated coastal villages for 3 years, causing landings to drop slightly. Catches peaked at 40,600 t·year^{-1} in 1993 and then due to a series of unfavorable events (the economic crisis in 1990, tropical storms hitting coastal regions at the end of 1993, hurricane Hortense in 1996 and Hurricane Georges in 1998), there was a decline in catches to almost 17,300 t·year^{-1} in 1998. Another peak was reached in 2002 with just over 32,500 t·year^{-1}. The subsequent decline can be explained by the severe economic crisis that the Dominican Republic faced in 2003 (Figure 3a).[8] Total reconstructed catches from this sector were estimated to be over 1 million tonnes, which accounts for 40.5% of total catches. Of the total artisanal catch, 94% is for domestic consumption, with the other 6% contributing to tourist consumption.

Industrial catches

Reconstructed industrial catches for the Dominican Republic increased fairly steadily from 300 t·year^{-1} in 1950 to 4,400 t·year^{-1} in 1986, with catches subsequently fluctuating until 1993. After 1993, industrial catches declined to a low of 1,800 t·year^{-1} in 1998. After a short period of increase to 3,500 t·year^{-1} in 2002, catches declined to 2,100 t·year^{-1} in 2003, where they remained relatively stable up to 2010 with 2,300 t·year^{-1} (Figure 3a). Total reconstructed catches for this sector amounted to 124,500 t for the period 1950-2010, accounting for 4.9% of total catches (Figure 3a).

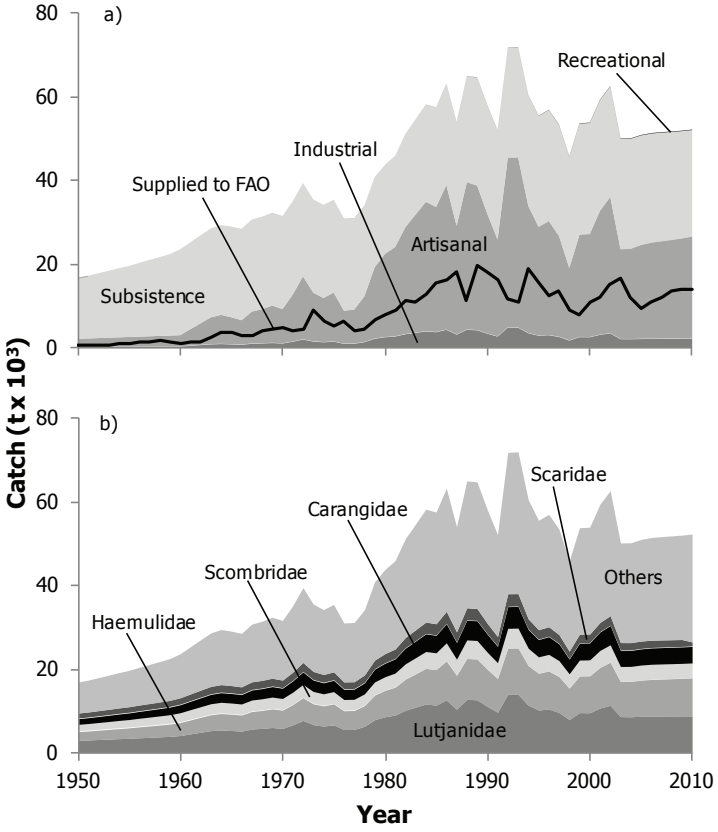

Figure 3. Reconstructed total catch for the Dominican Republic, 1950-2010, a) by sector, compared with data reported to the FAO (overlaid as solid line graph), and b) by major taxonomic categories. The 'others' category includes 100 additional taxonomic groupings.

Subsistence catches

Reconstructed subsistence catches for Dominican Republic increased steadily from 14,600 t·year^{-1} in 1950 to 25,600 t·year^{-1} in 2010 (Figure 3a). Total reconstructed catches for this sector amounted to just under 1.4 million t, which accounts for 55% of total reconstructed catches of the Dominican Republic (Figure 3a).

Tourist seafood consumption

Reconstructed seafood catches supplying tourist markets, such as hotel, guest houses and restaurants were estimated at 60,000 t for the period 1961-2010. This contributed about 2.4% to the total reconstructed catches.

Recreational catches

Reconstructed recreational catches for Dominican Republic were approximately 1,700 t from 1961-2010, accounting for only 0.07% of the total reconstructed catch (Figure 3a).

Reconstructed total catch

Total landings as presented by FAO for the Dominican Republic were 600 t·year^{-1} in 1950, steadily increasing to a maximum of 19,058 t·year^{-1} in 1994 (Figure 3a). FAO reported landings for the period 1950-2010 amounted to 503,655 t. The reconstructed total catch for the Dominican Republic for the period 1950-2010 was estimated at just under 2.6 million t, which is approximately 5.1 times that supplied to FAO on behalf of the Dominican Republic.

[8] The Dominican Republic resolving the banking crisis and restoring growth, July 20, 2004. Cato Institute Foreign Policy Briefing visited on March, 2013 http://www.cato.org/sites/cato.org/files/pubs/pdf/fpb83.pdf

Catch composition

Fisheries catches of Dominican Republic were dominated by reef and demersal species such as grey and silk snapper (Lutjanidae, 18.4%) and caesar and small grunt (Haemulidae, 14.9%; Figure 3b). Queen conch and lobster increase their importance throughout time, due to expansion of export markets and tourism. Since fishers do not discard any of their catch the species composition presents a large pool of taxa, and thus the 'others' category in Figure 3b consists of 93 additional taxonomic groups, accounting for 46.5% of the catch.

Discussion

The Dominican Republic's total catches from 1950-2010, as estimated in our reconstruction, were approximately 2.6 million t. Over the same period, FAO reported landings of only 503,656 tonnes on behalf of the Dominican Republic. Our reconstruction includes fisheries sectors that have been overlooked in other estimations, including catches from the subsistence fisheries in coastal regions and those from a popular recreational sector. Our reconstruction also improves what has been reported by the artisanal fisheries sector by filling in catches of several species that were previously recorded as zero; for instance, queen conch and Caribbean spiny lobster in the early time periods.

The difficulty of estimating total catch in the Dominican Republic is due to the dispersed nature of landing sites, as well as the multitude of gear-types employed and taxa fished. The artisanal sector in the Dominican Republic has not changed its structure since the Taino Indians; in fact, historians have found little change in the gear used by today's fishers (Chiappone 2001), although modern materials for lines and nets are being used. Thus, despite technological advances, the Dominican Republic's artisanal and subsistence fishing sectors remain relatively traditional.

In the Dominican Republic, fishes and invertebrates (lobster, conch) are critical marine resources, particularly for local communities. The most economically valuable species, specifically for tourist and export markets, are spiny lobster and queen conch. Thus, the importance of coral reef fisheries may not be so much in terms of absolute catch but in their contribution to the local income of fishers, who have few alternative opportunities for employment (Russ 1991).

Queen conch has been a principal source of food for the inhabitants of the Caribbean since at least the Taino Indians (Brownell and Stevely 1981; Appledoorn and Meyers 1993). Conch was valued as a protein source, second only to finfish in native diets during the past century. Queen conch is heavily fished throughout much of the Dominican Republic and represents the second most valuable fishery after the spiny lobster (Richards and Bohnsack 1990). In addition to the meat, the colorful shell is often sold for ornamental purposes and was once used in the manufacture of lime and porcelain (Randall 1964). Fishers in the Dominican Republic use free diving for collection of conch, and is therefore performed by artisanal and subsistence fisheries. Snappers (Lutjanidae) are also important top level predators in coral reef ecosystems and are among the most important food fishes in the tropics and subtropics (Chiappone 2001).

Catches from the subsistence sector contribute to the largest difference found in our reconstructed estimates, accounting for 55% of total catches in the period 1950-2010. Low level of development, widespread poverty, lack of basic services and infrastructure, and environmental degradation characterize the situation of many coastal communities. In these areas, large numbers of people depend on exploitation and commercialization of fisheries. In many cases, fisheries are their only source of livelihood (Mateo and Haughton 2004). Furthermore, a growing local and tourist population has increased the pressure on Dominican Republic's fisheries resources to an unsustainable level. Despite bringing much needed foreign currency to the island, the tourism sector is impacting marine resources, both through seafood consumption as well as recreational fishing. Reconstructed seafood catches supplying tourist markets such as hotel, guest houses and restaurants were estimated at 60,000 t for the period 1961-2010. This made up about 2.4% of the total reconstructed catches and should not be overlooked.

Recreational fishing is largely unreported globally. We estimated an average annual recreational fishing rate for tourists in the Dominican Republic of 35 $t \cdot year^{-1}$ since 1961. However, it was not possible to estimate recreational catches made by locals, though we know such a sector exists. Thus, it is mainly catches from the artisanal and industrial sectors that are being reported and even then only a few censuses have been conducted to determine the number of fishers. It is plainly evident that catches are missing from official reports, leaving fisheries managers with an incomplete picture of resource extraction, which can result in an overly optimistic analysis of fisheries' status.

Although assumptions were used to interpolate and infer fisheries catches, we believe that our estimate reflects more realistic levels of total catches than reported data alone (Zeller *et al.* 2007). Better accounting of total fisheries extractions is urgently needed to better understand total resource use. Given the difficulties in fisheries monitoring, especially subsistence fisheries, this can be best achieved through regular, albeit non-annual, surveys (Zeller *et al.* 2007).

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Appendix Table A1. Taxonomic breakdown for the artisanal sector in the Dominican Republic. The breakdown was based on PRODESUR (South Branch of PRODEPESCA) and Appledoorn and Meyers (1993)

	Percentage composition			Percentage composition	
Taxon name	**1950**	**2010**	**Taxon name**	**1950**	**2010**
Albula vulpes	0.37	0.37	*Agonostomus monticola*	0.01	0.01
Anguilla rostrata	0.01	0.01	Mugilidae	0.23	0.23
Anomura	0.01	0.01	Mullidae	3.96	1.00
Aulostomidae	0.06	0.06	Muraenidae	0.56	0.56
Balistidae	1.42	1.42	*Mobula* spp.	0.01	0.01
Belonidae	0.41	0.41	Myliobatidae	0.13	0.13
Brachyura	0.25	0.25	*Octopus vulgaris*	0.09	0.09
Calappidae	0.08	0.08	Octopodidae	0.08	0.08
Majidae	0.48	0.48	Ostraciidae	1.32	2.32
Caranx crysos	0.31	0.31	*Crassostrea rhizophorae*	0.06	0.06
Caranx spp.	0.31	0.31	*Panulirus argus*	1.26	1.26
Seriola spp.	0.17	0.17	Palinuridae	1.91	1.91
Trachinotus spp.	0.16	0.16	Pempheridae	0.37	0.37
Carangidae	7.36	7.36	Penaeidae	0.31	0.31
Carcharhinidae	2.02	2.02	Polynemidae	0.32	0.32
Cassidae	0.20	0.20	Pomacanthidae	0.37	0.37
Centropomus spp.	0.17	0.17	Pomacentridae	0.42	0.42
Chaetodontidae	0.30	0.30	Priacanthidae	0.42	0.42
Harengula spp.	0.18	0.18	Rajiformes	0.12	0.12
Opisthonema oglinum	0.31	0.31	Scaridae	7.28	3.28
Clupeidae	0.57	0.57	*Cynoscion* spp.	0.13	0.13
Coryphaena hippurus	0.79	0.79	*Acanthocybium solandri*	0.99	0.99
Crustacea	0.03	0.03	*Katsuwonus pelamis*	0.28	0.28
Cyprinus carpio carpio	0.63	0.63	*Scomberomorus cavalla*	1.57	1.57
Dasyatidae	0.39	0.39	*Scomberomorus regalis*	0.19	0.19
Diodontidae	1.89	2.89	*Thunnus alalunga*	0.01	0.01
Echeneidae	0.07	0.07	*Thunnus albacares*	0.11	0.11
Exocoetidae	0.01	0.01	*Thunnus atlanticus*	0.31	0.31
Fistulariidae	0.03	0.03	*Thunnus thynnus*	0.11	0.11
Gempylidae	0.02	0.02	Scombridae	7.46	5.42
Gerreidae	0.36	0.36	Scorpaenidae	0.06	0.06
Ginglymostoma cirratum	0.07	0.07	Scyllaridae	0.16	0.16
Ginglymostomatidae	3.81	3.81	*Epinephelus morio*	0.35	0.35
Haemulidae	12.32	18.00	*Epinephelus* spp.	0.19	0.19
Hemiramphidae	0.10	0.10	Serranidae	2.07	2.07
Holocentridae	1.66	1.66	*Archosargus rhomboidalis*	0.01	0.01
Istiophorus albicans	0.27	0.27	*Calamus* spp.	0.63	0.63
Makaira nigricans	0.03	0.03	Sparidae	3.58	3.58
Labridae	0.45	0.45	*Sphyraena* spp.	1.54	1.54
Loligo spp.	0.07	0.07	Sphyraenidae	0.85	0.85
Lutjanus purpureus	0.60	3.00	Sphyrnidae	0.64	0.64
Ocyurus chrysurus	0.47	0.47	*Strombus* spp.	0.17	2.01
Lutjanidae	15.57	11.00	Synodontidae	0.06	0.06
Branchiostegus spp.	0.02	0.02	Triakidae	0.11	0.11
Malacanthidae	0.02	0.02	Triglidae	0.02	0.02
Mollusca	0.04	0.04	Urolophidae	0.15	0.15
Monacanthidae	0.65	0.65	Xanthidae	0.34	0.34
			Miscellaneous marine fishes	3.16	4.81

Appendix Table A2. FAO landings vs. reconstructed total catch (in tonnes), and catch by sector, for the Dominican Republic, 1950-2010.

Year	FAO landings	Reconstructed total catch	Industrial	Artisanal	Subsistence	Recreational
1950	600	16,800	300	1,900	14,600	-
1951	600	17,300	310	1,980	15,000	-
1952	600	17,900	321	2,050	15,500	-
1953	600	18,500	331	2,130	16,000	-
1954	900	19,100	341	2,210	16,500	-
1955	1,100	19,600	351	2,280	17,000	-
1956	1,300	20,400	361	2,360	17,700	-
1957	1,400	21,100	371	2,430	18,200	-
1958	1,700	21,800	380	2,510	18,900	-
1959	1,400	22,500	390	2,590	19,500	-
1960	1,100	23,600	399	2,660	20,500	-
1961	1,400	25,300	580	3,900	20,800	0.25
1962	1,400	27,000	759	5,140	21,100	0.52
1963	2,700	28,600	935	6,380	21,300	0.79
1964	3,702	29,400	1,006	6,910	21,500	1.08
1965	3,601	29,100	926	6,420	21,700	1.38
1966	2,901	28,500	829	5,800	21,900	1.70
1967	2,804	30,700	1,085	7,620	22,000	2.02
1968	4,202	31,400	1,149	8,120	22,100	2.36
1969	4,502	32,400	1,252	8,890	22,200	2.71
1970	5,002	31,600	1,137	8,150	22,300	3.07
1971	4,103	35,100	1,561	11,210	22,300	3.44
1972	4,602	39,500	2,088	15,030	22,400	3.83
1973	8,901	35,600	1,598	11,620	22,300	4.22
1974	6,448	34,200	1,430	10,500	22,300	4.63
1975	5,243	35,400	1,580	11,650	22,200	5.05
1976	6,390	31,000	1,048	7,860	22,100	5.31
1977	4,187	31,100	1,073	8,100	21,900	5.57
1978	4,431	34,100	1,451	10,920	21,800	5.83
1979	6,729	40,900	2,267	17,030	21,600	6.67
1980	8,032	43,800	2,628	19,840	21,300	7.59
1981	8,981	46,000	2,802	21,310	21,800	9.08
1982	11,391	51,200	3,343	25,520	22,300	9.82
1983	10,803	54,700	3,677	28,200	22,800	10.44
1984	12,783	58,300	4,006	30,920	23,400	11.87
1985	15,631	57,600	3,834	29,870	23,900	14.15
1986	16,087	63,300	4,405	34,500	24,400	16.25
1987	18,231	54,100	3,248	25,900	24,900	19.92
1988	11,421	65,100	4,403	35,210	25,400	25.01
1989	19,772	64,800	4,279	34,550	26,000	27.71
1990	18,189	58,200	3,480	28,540	26,100	30.09
1991	16,106	52,200	2,787	23,100	26,300	27.53
1992	11,816	71,900	4,934	40,540	26,400	33.54
1993	10,820	72,100	4,904	40,620	26,500	36.26
1994	19,058	60,600	3,586	30,330	26,600	39.33
1995	15,768	55,600	3,001	25,920	26,700	43.82
1996	12,606	57,100	3,122	27,190	26,700	48.14
1997	13,468	53,500	2,686	24,020	26,700	56.00
1998	9,076	45,900	1,841	17,260	26,700	59.23
1999	7,804	53,800	2,653	24,420	26,700	68.97
2000	10,828	54,000	2,623	24,600	26,700	78.32
2001	12,059	59,500	3,206	29,560	26,600	76.73
2002	15,159	62,700	3,544	32,540	26,600	75.75
2003	16,591	50,200	2,169	21,430	26,500	89.51
2004	12,243	50,200	2,153	21,560	26,400	94.10
2005	9,499	51,000	2,211	22,400	26,300	100.66
2006	11,045	51,500	2,232	22,940	26,200	108.14
2007	12,228	51,700	2,252	23,260	26,100	108.53
2008	13,674	51,900	2,271	23,560	25,900	108.54
2009	13,801	52,100	2,291	23,890	25,800	108.88
2010	14,140	52,300	2,310	24,320	25,600	112.49

Appendix Table A3. Reconstructed total catch (in tonnes) by major taxa for the Dominican Republic, 1950-2010. 'Others' contain 93 additional taxonomic categories.

Year	Lutjanidae	Haemulidae	Scombridae	Carangidae	Scaridae	Others
1950	3,020	2,030	1,750	1,350	1,200	7,440
1951	3,100	2,110	1,800	1,390	1,220	7,660
1952	3,200	2,200	1,850	1,440	1,250	7,930
1953	3,300	2,290	1,910	1,490	1,280	8,200
1954	3,400	2,380	1,960	1,540	1,310	8,490
1955	3,490	2,470	2,010	1,580	1,340	8,740
1956	3,610	2,580	2,080	1,640	1,380	9,080
1957	3,720	2,680	2,140	1,700	1,410	9,390
1958	3,830	2,790	2,210	1,750	1,440	9,720
1959	3,950	2,910	2,280	1,810	1,470	10,050
1960	4,130	3,080	2,380	1,900	1,530	10,570
1961	4,530	3,300	2,490	2,020	1,620	11,330
1962	4,920	3,530	2,600	2,130	1,700	12,090
1963	5,300	3,750	2,700	2,240	1,770	12,850
1964	5,470	3,880	2,760	2,300	1,800	13,230
1965	5,340	3,860	2,730	2,280	1,770	13,080
1966	5,170	3,830	2,700	2,250	1,720	12,850
1967	5,690	4,130	2,830	2,390	1,820	13,870
1968	5,830	4,240	2,870	2,440	1,840	14,190
1969	6,040	4,400	2,920	2,500	1,870	14,650
1970	5,820	4,330	2,870	2,460	1,810	14,310
1971	6,660	4,800	3,070	2,680	1,970	15,940
1972	7,690	5,380	3,320	2,970	2,170	17,940
1973	6,720	4,920	3,070	2,710	1,950	16,180
1974	6,370	4,780	2,980	2,630	1,860	15,590
1975	6,650	4,970	3,040	2,710	1,900	16,170
1976	5,580	4,430	2,770	2,420	1,660	14,160
1977	5,600	4,470	2,760	2,420	1,650	14,230
1978	6,310	4,890	2,920	2,620	1,770	15,650
1979	7,880	5,820	3,280	3,050	2,060	18,790
1980	8,550	6,240	3,430	3,240	2,170	20,180
1981	8,980	6,580	3,560	3,390	2,250	21,210
1982	10,120	7,350	3,870	3,740	2,460	23,690
1983	10,850	7,880	4,070	3,980	2,590	25,370
1984	11,570	8,430	4,280	4,220	2,720	27,070
1985	11,320	8,400	4,250	4,190	2,660	26,780
1986	12,530	9,260	4,570	4,570	2,870	29,510
1987	10,340	8,040	4,070	3,980	2,450	25,200
1988	12,710	9,660	4,690	4,720	2,880	30,430
1989	12,550	9,690	4,680	4,710	2,830	30,350
1990	11,000	8,800	4,320	4,280	2,520	27,250
1991	9,630	8,000	3,980	3,890	2,240	24,440
1992	13,900	10,910	5,030	5,190	3,000	33,870
1993	13,860	11,000	5,030	5,200	2,960	34,010
1994	11,280	9,380	4,410	4,460	2,470	28,550
1995	10,150	8,720	4,140	4,140	2,250	26,230
1996	10,400	8,990	4,200	4,240	2,270	26,960
1997	9,580	8,510	4,010	4,010	2,100	25,280
1998	7,910	7,420	3,610	3,510	1,790	21,640
1999	9,540	8,670	4,020	4,040	2,050	25,520
2000	9,510	8,740	4,020	4,050	2,020	25,620
2001	10,630	9,640	4,280	4,410	2,180	28,340
2002	11,270	10,190	4,420	4,630	2,250	29,970
2003	8,600	8,310	3,790	3,810	1,800	23,890
2004	8,570	8,360	3,780	3,810	1,770	23,950
2005	8,690	8,540	3,810	3,870	1,760	24,370
2006	8,740	8,660	3,820	3,900	1,740	24,630
2007	8,750	8,740	3,810	3,910	1,720	24,780
2008	8,750	8,820	3,800	3,920	1,690	24,900
2009	8,760	8,890	3,780	3,930	1,660	25,030
2010	8,780	8,980	3,780	3,950	960	25,880