Fisheries Centre

The University of British Columbia

Working Paper Series

Working Paper #2015 - 63

Reconstruction of total marine fisheries catches for the Turks and Caicos Islands (1950-2012)

Aylin Ulman, Lily Burke, Edward Hind, Robin Ramdeen and Dirk Zeller

Year: 2015

Email: a.ulman@fisheries.ubc.ca

Reconstruction of total marine fisheries catches for the Turks and Caicos Islands (1950-2012)

Aylin Ulman[a], Lily Burke[b], Edward Hind[c], Robin Ramdeen[a] and Dirk Zeller[a]

[a]*Sea Around Us, Fisheries Centre, University of British Columbia, 2202 Main Mall, Vancouver, BC, V6T 1Z4, Canada*
[b]*Project biologist, Strawberry Isle Marine Research Society, Tofino, B.C.*
[c]*The School for Field Studies, Center for Marine Resource Studies, South Caicos, Turks and Caicos Islands*

a.ulman@fisheries.ubc.ca; lilyaburke@gmail.com; e.hind@outlook.com; r.ramdeen@fisheries.ubc.ca; d.zeller@fisheries.ubc.ca

ABSTRACT

The Turks and Caicos Islands total marine fisheries catches were estimated for the 1950-2012 time period using a catch reconstruction approach, which estimated all fisheries removals, including the reported fish catch destined for export as well as all unreported domestic small-scale commercial (i.e., artisanal) and subsistence catches. All data were reconciled with the data reported by FAO on behalf of the Turks & Caicos Islands for the 1950-2012 period. Here, we present separately the data for the 1950-2010 time period to match the requirements of the *Sea Around Us*. The total reconstructed catch for the 1950-2010 time period is approximately 2.8 times the data reported by FAO on behalf of Turks & Caicos. Reconstructed total catches consisted to 86% of artisanal (i.e., small–scale commercial), 14% subsistence (i.e., small-scale non-commercial) and 0.1% recreational catches. No discards were estimated for these islands since almost all of the fishing is done either by hand collection (i.e., for conch), by trap or hook (for lobster) or by hook and line or Hawaiian sling (for finfish), with all gears being highly selective. Total reconstructed catches declined from around 20,000 t in 1950 to a low of about 5,300 t in 1970 (after Hurricane Camille), and then gradually increased to average about 12,500 t·year^{-1} in the late 2000s. The pattern of reconstructed total catches (substantial decline to 1970, then gradual increase) differed distinctly from the data reported by FAO on behalf of Turks and Caicos, with reported landings showing a steady increase from less than 1,000 t·year^{-1} in the 1950s to around 6,000 t·year^{-1} in the 2000s. Major discrepancies were substantially under-reported artisanal catches in the first few decades, and the absence on subsistence catches from the reported data. Reconstructed total catches were dominated by queen conch (*Strombus gigas*) and Caribbean spiny lobster (*Panulirus argus*), together accounting for 94% of total catches as estimated here.

INTRODUCTION

The Turks and Caicos Islands (TCI) (21.5050° N, 71.7540° W) are a small chain of islands located north of the island Hispaniola (modern day Haiti and Dominican Republic) and southeast of the Bahamas in the Tropical Western Atlantic Ocean, and together with Bahamas are part of the Lucayan Archipelago (Figure 1). They are made up of two distinct groups of islands: the Turks Islands and the Caicos Islands, separated by a 35 km wide and 2,100 m deep channel named the Turks Island Passage. The TCI have an Exclusive Economic Zone (EEZ) of approximately 154,000 km^2 (www.seaaroundus.org). The islands are reported to have received the 'Turks' part of the name from either the indigenous Turk's head cactus, which resembles a Turkish *fez*, or because pirates in the Mediterranean were often of Turkish descent, and European settlers trans-located

the name 'Turks' to the Caribbean, applying it to pirates; the second part of the name is simpler and is named after the Caribbean native islander term "*caya hico*," meaning string of islands. The islands are made-up of low-lying limestone with extensive marshes, mangrove swamps with three distinct platforms of outlying coral reefs: the Caicos, the Turks and Mouchoir Banks and have a total land area of around 430 km^2. The TCI comprises about 40 low-lying islands, only 6 of which are significantly inhabited, with over half of the population inhabiting Providenciales (Halls *et al.* 1999).

Originally settled by Taínos (Amerindians originating from South America) from Hispaniola, and visited by Juan Ponce de Leon in 1512, the islands went back and forth between Spanish, French and British colonial rule until finally becoming a British crown colony in 1962. The current population of the Turks and Caicos Islands is mostly made up of native African descendants, originally brought to work in the saltpans or the cotton plantations, and expatriates, the latter consisting mostly of British, Canadian, US, French, and Bahamians citizens, as well as people from Jamaica and Hispaniola (Haiti and Dominican Republic). The population of the islands was just over 5,000 in 1950 and grew to nearly 46,340 by 2012 (Fig. 2, www.indexmundi.com).

Here, the aim is to reconstruct the total catch of marine fisheries from the Turks and Caicos Islands from 1950-2012 for the *Sea Around Us*, and to help improve the accuracy of the local fisheries data. While data have been reconstructed to 2012, here we focus on reporting data to 2010, in line with all other catch reconstructions conducted by the *Sea Around Us*.

The per capita Gross Domestic Product (GDP) of the TCI in 2007 is about 29,100 USD (indexmundi.com), and the economy of TCI is now predominantly centered on tourism, offshore financial services and fishing, the last of which sustained the island before the growth of tourism. Fisheries play a more dominant role on the lesser inhabited island of South Caicos, where over 75% of the working population is either directly or indirectly linked to the fishing industry (CRFM 2011). The TCI derive an average annual income of approximately 9 million USD through fisheries exports alone, mainly from spiny lobster (*Panulirus argus*) and queen conch (*Strombus gigas*) (Clerveaux and Fisher, 2005; TCI Government, 2004), which equates to 10% of the island's GDP (CRFM 2011). The fishing industry provides direct employment to local fishers, and indirectly to the fish processing industry. The importance of the industry is especially accentuated in the lesser-developed islands such as South Caicos, Middle Caicos and North Caicos, in which there are limited employment alternatives other than fishing, with the exception of farming. The Department of Environment and Marine Affairs (DEMA) is responsible for the coastal zone management of the TCI and is meant to play a major role enforcing the legislation and regulations pertaining to the marine environment.

In the early 1950s, wooden sailing vessel between 10-12 m in length served as mothership for 2-4 wooden, non-motorized dug-out vessels targeting conch and lobster on trips of up to one week duration, using glass buckets to spot queen conch and Caribbean spiny lobster. An 8 m long hook was used to bring conch to the surface, whereas lobsters were 'bullied' with a small net at the end of a pole (Clerveaux and Vaughan 2003). By the end of the 1950s, skin diving gained popularity after masks were introduced. Lobsters were soon caught by the 'toss' method, which had a flexible wire noose at the end of a stick, later replaced by a shark hook attached to a 1.5 long flexible pole. By the mid-1970s, fishing vessels were mostly motorized and the 1980s and 1990s saw the introduction of fishing with noxious chemicals to make lobsters leave their dens. At the turn of the century, fishing provided employment to approximately 8% of the country either in the form of fishing (370 fishers) or processing (Clerveaux *et al.* 2003), and many more part-time fishers.

The three main fisheries on the island are conch (by volume), lobster (by price), and various finfish (Taylor and Medley 2003; Lockhart *et al.* 2007); the first two are of high commercial value and are predominantly exported to the United States; however, all three are also caught for subsistence consumption and local commercial sale. Lobster is the preferred catch, since lobster prices exceed conch prices by a factor of four, but most fishers switch between the two fisheries, either when the lobster fishery is closed, or when conch catches are high, whereas finfish are opportunistically speared by lobster fishers whilst targeting lobster (Medley and Ninnes 1999). Conch is easier to harvest, as they are simply collected, whereas lobster fishing demands more skill and experience. DEMA has been collecting some conch and lobster landings data since 1887 and 1947, respectively.

Lobster (*Panulirus argus*)

The spiny lobster fishery is the most economically important fishery in TCI. Although landings have been recorded since 1947, the fishery did not become profitable until the late 1950s, after snorkeling gear was first introduced, the first processing plant established (CRFM 2011), and especially with the advent of freezing technology in 1966 (Halls *et al.* 1999), which led to a steep-increase of catches. The fishery grew until 1979, after which the fishery began to decline, due to overfishing of the resource. The average lobster size taken by early trap fisheries was around 3 kg, which had declined to 0.7 kg by the 1970s (Rudd 2003).

More recently, three commercial trap boats land between 5-10% of total landings, and operate in deeper fishing grounds, while the remainder are collected by free divers (Tewfik and Béné 2004). Reported catches peaked in 1972 and 1973 with 600 $t \cdot year^{-1}$, and then declined to average just over 300 $t \cdot year^{-1}$ for the 1990s and 2000s (FAO Fishstat). Catch per unit effort (CPUE) appears to have declined for lobster, from approximately 65 $kg \cdot boat^{-1} \cdot day^{-1}$ in the early 1990s to around 20

kg·boat^{-1}·day^{-1} by 2000 (Tewfik and Béné 2004), although other reports suggest that CPUE has remained stable at around 58 kg·boat^{-1}·day^{-1} (Clerveaux *et al.* 2003), which likely did not incorporate the increases in effort, engine power and depth which had occurred, masking the decline by not accounting for technological creep (Dalzell *et al.* 1987; O'Neill and Leigh 2007; Ward 2008). In the early 2000s, there were approximately 130 lobster fishers, most operating from South Caicos (Tewfik and Béné 2004). Lobsters are landed whole, and weighed as such, although only tails are exported. The majority of lobster is landed when the fishery is open from August 15-March 31, although the bulk (over 1/3) is landed immediately following the opening of the fishery, termed the 'Big Grab' each August (Halls *et al.* 1999; Tewfik and Béné 2004). The reported data only includes lobster sent for processing, and hence destined for export. Thus, reported data lack information on domestic consumption and tourist consumption.

Conch (*Strombus gigas*)

In the late 1800s, TCI's largest conch export market was Hispaniola (Haiti and the Dominican Republic) and were sent dried due to the absence of freezing technology (Doran 1958). Conch catches increased substantially from 1937 to 1945 as local labour permanently switched from salt production to conch fishing (Béné and Tewfik 2000). DEMA has been collecting conch landing data since 1887 which shows a peak of 2,619 t in 1943 and a low of 16.4 t after hurricane Camille in 1969. Catches for both spiny lobster and queen conch are recorded daily at each of the handful of processing plants, where they are processed for export. Post WWII, trade with Haiti began to decline (Brownwell and Stevely 1981) and by the mid-1950s, commercial fishing effort shifted towards the higher profit lobster fishery. The conch export industry rapidly developed again in the mid-1970s, when the US began importing frozen conch, as they had newly settled Caribbean immigrants accustomed to conch as a traditional food item (Brownwell and Stevely 1981). Conch were much more abundant in the 1950s, when a crew of two were able to land over 1,000 conch·day^{-1} (Doran 1958). Conch are generally collected by hand from depths under 10 m, as the weight of the shell makes it difficult bringing several conch to the surface from deeper waters (Medley and Ninnes 1999). The late 1970s exhibited the peak of conch processing as each processor on South Caicos Island reached near-capacity by processing 20,000 conch·day^{-1} (Brownwell and Stevely 1981) The queen conch fishery represents a vital source of food and income for the fishers (Chakalall *et al.* 2007).

Queen Conch meat is removed from the shells at sea and then processed, which includes trimming and then freezing for export. The reported data only includes conch sent for processing, and hence destined for export. Thus they lack most information on domestic and tourist consumption. There is currently a MSY catch quota of 700-750 t of conch, which refers to unprocessed meat of wild origin (not farmed) or between 270-290 t of cleaned 'processed' conch

meat for export which equates to about 1,900 t of live (wet) animal weight (Thiele 2001; Turks and Caicos Government 2004; Lockhart *et al.* 2007). The quota was placed to keep the stock at sustainable levels, and does include domestic consumption estimates, which are based on seafood consumption estimates completed once every 5 to 10 years. The export quota for the 2010-2011 season was 4,125 $t \cdot year^{-1}$, but the catch was < 2,800 t. The 2012-2013 season then lowered the quota to 2,540 t, 62.5% of which for export and the remainder for local consumption. The quotas are calculated by a derivative of the previous year's total catch. The Turks and Caicos government is further obligated to report their conch catches if they wish to continue to trade with Convention of International Trade of Endangered Species of Wild Flora and Fauna (CITES) signatory countries such as the U.S., although TCI is not a signatory country itself.[1]

Finfish

In the more recent decades, tourism has surpassed the lobster and conch fisheries as the leading industry, putting additional pressure on local marine resources through increased seafood demand by tourists (Klaus 2001). This local demand of marine resources is exacerbated by a 40% duty on imported fish and seafood. The majority of finish caught in the islands are mainly for domestic consumption (subsistence purposes and localized commercial sales), and very little is exported. Data have only very recently been collected regarding local and tourist seafood consumption via seafood consumption surveys, necessary to estimate local seafood use, especially that of finfish since most of it is consumed locally and hence not recorded at all.

The only finfish reported in the national data is blue marlin *Makaira nigricans* (2 t in 2006), yellowfin tuna *Thunnus albacares* (1 t in 2007), "misc. marlins, sailfishes, etc." (Istiophoridae, 1 t in 2007) and "miscellaneous marine fish", which were reported until the late 1990s, after which they disappeared from the data. Here, we consider all subsistence and local commercial sales to be missing from the catch data. The finfish fishery is likely to expand in upcoming years as two local companies 'Day Boat Seafood' and 'Caicos Pride' are currently experimenting to see if longline fishing could and should be allowed.

The main species traditionally caught were bonefish (*Albula vulpes*) and Nassau groupers (*Epinephelus striatus),* but snappers (Lutjanidae), grunts (Haemulidae), hogfish (*Lachnolaimus maximus*), parrotfish (Scaridae), and triggerfish (Balistidae) are also landed (Klaus 2001). Finfish are mainly opportunistically caught by fishers targeting lobster, since both reef fish and lobster occupy the same habitat (Rudd 2002). A handline fishery also exists for bigeye tuna (*Thunnus obesus*), blackfin tuna (*Thunnus atlanticus*), barracuda (*Sphyraena barracuda*) and other

[1] http://www.tcfreepress.com/index.php?option=com_contentandview=articleandid=3991:conch-quota-lowered-for-exports-local-consumptionandcatid=34:environmentandItemid=75

inshore pelagics (Halls *et al.* 1999). Reef fish fishing has been generally open access on the islands and there are no species prohibitions, seasonal, temporal, or size limits, or quotas (Rudd 2003), with the exception of parrotfishes which became protected in 2012. Nassau grouper will also likely get minimum and maximum size restrictions after the TCI passes new legislation.

We attempt here to reconstruct total marine fisheries extractions from the Turks and Caicos EEZ from 1950-2012, using the data reported on behalf of TCI to the FAO as our reported landings baseline, to which other unreported sectors are added. Fisheries catches are estimated to species level, by year and sector, for inclusion in the *Sea Around Us* database (www.seaaroundus.org) on global fisheries extractions. We define the following fishing sectors: industrial (large-scale commercial; deemed absent in TCI); artisanal (small-scale commercial); subsistence (small-scale non-commercial); and recreational (small-scale non-commercial). In order to approximate historic catch time series data when there is a lack of information, we follow the approach used by (Zeller *et al.* 2007) and others (Cisneros-Montemayor *et al.* 2013; Ulman *et al.* 2013; Schiller *et al.* 2014), which use a "re-estimation" approach by incorporating various inferences and interpolations.

METHODS

The fisheries of TCI are defined here as having a small-scale commercial (i.e., artisanal) sector, a subsistence sector (i.e., for the primary purpose to feed one's self or one's family), and a small recreational fishery (i.e., fishing primarily for enjoyment and pleasure).

A review of all available literature (peer-reviewed and grey, online and offline) was undertaken to obtain the information required to reconstruct TCI's total fisheries catches for the period 1950-2012 following the approach of Zeller *et al.* (2007). The primary source of information for this topic was a first attempt at the Turks and Caicos catch reconstruction by Rudd (2003).

The landings data in FAO's Fishstat database, voluntarily reported by member countries (Garibaldi 2012) were used as our reported baseline, to which 'unreported' fishery components were estimated and added. Based on the reporting infrastructure on TCI, the reported data only includes commercial catches destined primarily for export. Thus, any marine catches not sent to one of the five processing plants in either Providenciales or South Caicos are absent from the national catch statistics.

Reported FAO landings

From the FAO Statistical Handbook (FAO 2012) under FAO countries "individual notes", it appears that queen conch from TCI had already been converted to live weight by the FAO using the conversion factor of 7.5. Lobsters are weighed whole before the tails are exported, and thus did not require a conversion factor, unless just tail was reported for export, and then a conversion factor of 2.6 was used (Halls *et al.* 1999).

According to several sources (Rudd 2003; Tewfik and Béné 2004; Lockhart *et al.* 2007), only conch and lobster sent for processing and then exported are included in the national statistics (with the exception of about 1% of locally farmed conch that was also exported for a few years, although currently not operational), and some finfish catches that have only very recently began to be exported and hence reported (i.e., from 2005-2008). Although the conch and lobster data from TCI consists of a long time-series, it is apparent that most reported sources of local landings do not match each other (Rudd 2003).

Working closely with local experts, we realized that the only graph(s) that could reliably be trusted and which did match (after accounting for shell conversion factor to the conch data) were of both conch and lobster landings found in Turks and Caicos Government (2004) and in Clerveaux and Lockhart (2008). At the time the latter was published, Wesley Clerveaux was head of the Department of the Environment and Kathy Lockhart was his main fisheries scientist. These national conch data were much higher than the reported FAO data from 1950 to 1968, but it is trusted and was used to correct our reported baseline sent from Turks and Caicos to the FAO. From 1969-1974, the FAO data seemed to over-report conch catches, which were adjusted, and from 1975, onwards, the data reported to FAO were trusted to be correct and were accepted.

The reported lobster data from 1950-1971 were also adjusted to account for minor over- and under-reporting discrepancies so as to match the national data, but the FAO data were accepted for 1972-2010. All of the reported data (both national and reported to the FAO) were considered here to be caught by the artisanal sector for export, leaving artisanal catches for local sale, subsistence and recreational sectors to be separately estimated.

Local population and tourist numbers

Data on the Turks and Caicos population were available for 1950–1958 from Populstat and for 1959–2010 from World Bank (Figure 2). Data on the number of stop-over tourists (travelers who stay on the island for more than a day) were available for 1962, 1967 and 1968 from Bryden (1973), for 1995-2005 from the TCI Department of Planning and Statistics, and for 2006–2012

from the TCI Tourist Board Statistics (Figure 2). A linear interpolation was used to estimate tourist population in years with missing data.

Subsistence and artisanal catches

Subsistence catches are defined here as fish and invertebrates taken for the primary purposes of self- or family-consumption. It appears that bonefish, Nassau grouper and conch were traditionally the preferred species to consume in the early period (circa 1950). One study stated that over 97% of households in TCI (averaged from the islands of grand Turk, Providenciales and Middle Caicos) ate fish at least once per week, 79% ate conch more than once per week, and 46% of households consumed lobster more than once per week (Maitland 2006).

Domestic consumption

Catches for both local and tourist consumption are missing from the national catch data. Note that imports and exports were not accounted for here since the former are consumed by tourists designed to meet tourist demand and do not generally affect local consumption patterns, and exports were assumed to have been reported, and not used either for domestic consumption.

A national seafood consumption survey was undertaken from 14 October - 26 November 2013, modified from a previous Department for Environment and Marine Affairs (DEMA) study (Lockhart *et al.* 2006). Over 580 residents across the inhabited islands responded, which included representation across all ages (18+), ethnic groups, gender, and islands (Providenciales, Grand Turk, South Caicos, North Caicos, Middle Caicos). The portion sizes used to estimate *per capita* consumption came from Lockhart *et al.* (2006) and can be found in Table (1), and the main results of the survey showing *per capita* domestic consumption are in Table (2). A 1995-1997 average *per capita* seafood consumption rate for TCI was estimated as 40.2 kg·person^{-1}·year^{-1}.

The seafood consumption data in this survey were serving weights which were converted to live animal weight. For conch, an initial conversion factor of 2 was applied to account for the trimmed and unused meat (Thiele 2001) plus a factor of 7.5 to account for the shell (as also used by the FAO) equating to a total conversion factor of 15. For lobster tails with shells, a conversion factor of 2.63 was applied (FAO). For game fish, tuna and sharks, a conversion factor of 1.92 was applied to account for the fillet of meat and likely higher uneaten portions (FAO), but a lower conversion factor of 1.35 was used for the other types of fish such as reef fish and bonefish. There are four types of fish consumed in TCI: reef fish, gamefish, sharks and bonefish. The allocation used for reef fish and gamefish are presented in Table (3), sharks were all categorized as Selachimorpha

since no studies were previously done on local shark taxa, and were estimated using 2013 TCI seafood consumption survey results (Edward Hind, unpubl. data). Fish populations in the islands appear to be in relatively good shape compared to some of the neighboring islands (such as Haiti and Dominican Republic), especially as the traditionally preferred species (i.e., the groupers and hogfish) are still available.

Tourist consumption

To calculate tourist (i.e., stopover tourist) consumption, the following steps were taken:

1) The annual number of tourists from 1967-2012 was established;
2) This was multiplied by the average number of meals (15.2) consumed on the island for an average 6-7 day stay;
3) This was multiplied by tourist seafood consumption rates (see Table 4), and adjusted to mean live weight;
4) This was applied to individual taxonomic groups as for domestic consumption (Table 3);
5) Available information on imported fish was subtracted. Excluding queen conch and lobster, (because conch are not imported and lobster imports are negligible), we assume that 50% of tourist finfish consumption is domestically sourced, the remainder being imported;
6) The remainder was taken as the unreported tourist demand fulfilled by domestic artisanal fisheries.

Reported data (i.e., exports) have been excluded here as they do not affect tourist consumption. A similar calculation was done to account for cruise ship tourists who started to arrive in 2006. To estimate the percentage of tourists which consumed a local meal while on an onshore daytrip, a customer service representative from Princess Cruises was contacted who estimated that approximately 30% of the guests would consume a meal on land since the cruise ship is always close by and many guests are frugal (Nikki Beare, Princess Cruises, pers. comm.). To be conservative, we assumed that 30% of cruise ship passengers ate one meal while off the vessel visiting TCI. This does not include crew, who also sometimes dine on land.

The new data from the 2013 survey suggested a tourist seafood consumption rate of 0.56 $kg \cdot person^{-1}$. This consumption rate is used here as the study was thorough and accounted for imports, and is thus more reliable than earlier estimates (Lockhart *et al.* 2006). For specifics for the three main fisheries, and anchor points used, see below.

Conch

For domestic conch consumption, a *per capita* consumption rate of 35.4 kg·person^{-1}·year^{-1} was used from 1950-1985 (Olsen 1985), which was linearly decreased to 10 kg·person^{-1}·year^{-1} by 1990 and held to 1999 (Rudd 2003), and then to 7.5 kg·person^{-1}·year^{-1} by 2012 (Table 1). A conversion factor of 7.5 was applied to determine mean live animal weight (with shell on) which likely did not include the trimmings and the foot. In 1950, conch catches were assumed to have been taken 75% for subsistence purposes and 25% for artisanal purposes. These rates were linearly interpolated to 50% subsistence and 50% artisanal by 2012, as survey results from a 2004 survey indicated that 36% of locals receive conch as gifts from fishers, and 15% personally capture conch (50% subsistence) (Lockhart *et al.* 2006). Thus, it was assumed that the remainder purchase their conch meat. Exported conch meat is referred to as '40% cleaned meat'. The 60% of the live tissue weight not eaten (i.e., the trimmings) are locally used as bait for the lobster trap fishery (Thiele 2001), and are locally used in conch fritters.

Lobster

For lobster domestic consumption of lobster, a *per capita* consumption rate of 25 kg·person^{-1}·year^{-1} was assumed from 1950-1980, since lobster was much more abundant in the past and was a favourite local protein source, while 10 kg·person^{-1}·year^{-1} was used for 1985-1990 (Rudd 2003), and 6.7 kg·person^{-1}·year^{-1} was used from 1995-2012 (Table 2). The rates were interpolated between time periods. A conversion factor of 2.63 (FAO's lobster conversion rate) was then applied to determine mean live animal weight. The *per capita* consumption rates were multiplied each year by the total residents population. In 1950, lobster catches were assumed to have been 75% subsistence and 25% artisanal, which was linearly interpolated to 10% subsistence and 90% artisanal by 2012. This was based on lobster prices having increased, and most fishers selling their catch instead of consuming it.

Finfish

For domestic finfish consumption, a *per capita* consumption rate of 35 kg·person^{-1}·year^{-1} was estimated and applied from 1950-1985 (Olsen 1985), and then linearly decreased to 16.5 kg ·person^{-1}·year^{-1} for 2005-2012 (Table 2). Rudd (2003) assumed that domestic finfish consumption from 1950-1980 was 20 kg·person^{-1}, but this estimate was thought to be too low, as it would only result in about 55 grams·person^{-1}·day^{-1}, as opposed to a much more likely 100 grams·person^{-1}·day^{-1}, which seems a more reasonable estimate since fish are usually eaten whole and TCI is an island country with healthy and abundant fish resources.

The taxonomic breakdown applied for both 1950 and 2012 are displayed in Table (5). This table excludes gamefish in 1950, which we assumed began as a very small target fishery after engines were first introduced in 1965 with 1% of total finfish catch. This was linearly increased to the 2012 levels of 10% of the finfish catch, and all estimates were linearly interpolated for the intervening years. Nassau grouper is and has been the preferred target species for many decades due to their substantial size and ease of catching. They are also known to follow speardivers around for chance feedings opportunities (Rudd 2003) and generally seem unbothered by people. Bonefish (*Albula vulpes*) was also a preferred local species (Olsen 1985), but bonefish consumption rates have decreased in recent decades as older fishers continue to retire, and younger generations regards it as a 'poor man's' food.

For domestic finish consumption, in 1950, 50% was assumed to have been caught as subsistence and 50% as artisanal, which was linearly interpolated to 20% subsistence and 80% artisanal by 2012. Although turtle consumption was also calculated in the 2013 consumption survey, this study only calculated fish and invertebrate catches, excluding turtle, sponges and cetaceans.

Recreational catches

Recreational catches are defined here as caught for the primary purpose of sport or pleasure. A sport fishery was assumed to have begun with the onset of tourism in 1965. In 2002, a tourist survey (TCI Tourist Board 2003) suggested that 0.02% of all tourists come to TCI for the sole purpose of fishing, and in 2004 (TCI Tourist Board 2005), 0.04% of tourists came to TCI primarily to fish. From 1965-1980 (the onset of tourism), 0.01% of tourists were assumed to come to TCI primarily to fish, from 1990 until 2002, 0.02% of tourists were assumed to be fishers and from 2004-2012, 0.04% of tourists were assumed to be fishers. All tourists with focus on fishing were assumed to catch 10 $kg \cdot visit^{-1}$ (which normally averaged 6 days), the percentage of tourists assumed to be fishers was linearly interpolated between the three time-series anchor points. The following species were allocated as 10% each: bonefish (*Albula vulpes*), blue marlin (*Makaira nigricans*), sailfish (*Istiophorus albicans*), wahoo (*Acanthocybium solandri*), bigeye tuna (*Thunnus obesus*), blackfin tuna (*Thunnus atlanticus*), swordfish (*Xiphias gladius*), shark (Elasmobranchii), barracuda (Sphyraenidae), and dolphinfish (*Coryphaena hippurus*).

Foreign fishing

In the past, 24 Taiwanese longline vessels leased to a Japanese company operated in the TCI between 1980-1992 targeting swordfish (*Xiphius gladius*), tuna and some red snappers (*Lutjanus campechanus*) (Halls *et al.* 1999). These foreign catches were not estimated for this study since

no catch amounts were provided, but were mentioned here to assist, if anecdotally, in the accounting of foreign fishing around the TCI.

There have been reports of illegal foreign fishing (i.e., poaching) from neighboring Hispaniola for conch, lobster and finfish (MacAlister Eliot and Partners Ltd. 2003; Rudd 2003). The government also acknowledged the significance of the issue by stating that "these poaching enterprises usually involve a 'mother ship,' with several smaller dingy-type vessels that branch out along the edge of the Turks and Caicos Banks which can carry several t of seafood to their homeland per trip". To combat poaching, in August of 2013, the TCI installed a state-of-the-art radar station, which has resulted in the apprehension of one illegal foreign vessel (TCI Government 2013). Estimates of these foreign catches, using the flowchart about catch origins in Turks and Caicos provided by Halls *et al.* (1999), suggest that the equivalent of less than 1% of total conch catches may have been taken by foreign fishers. Since no specific information could be found regarding any other foreign catches, the above source of 'less than 1% of total conch' was used to create a proxy for foreign (illegal) conch, lobster and finfish catches. Using the total reconstructed catches, 0.5% conch, and 0.3% for both lobster and finish (requiring more skill) were estimated to account for foreign poaching, Dominican Republic was assumed to catch 85% of the catches and the remainder 15% was estimated to have been caught by Haitians (since Dominicans have better access to motorized vessels compared with Haitians).

While the vessel from the Dominican Republic and Haiti are likely relatively small vessels, and hence locally thought of as artisanal, for the purposes of the *Sea Around Us*, we consider this foreign fleet fishing in another country's EEZ as 'industrial'.

RESULTS

Adjusted national catches

The uncorrected FAO landings data, which are our reported baseline, amounted to 230,679 t for the 1950-2010 period (1950-2012: 238,236 t). Our reconstruction of TCI adjusted the reported data for mis-reported landings, which were all deemed to be artisanal catches, and destined for export.

Reconstructed total catch

The reconstructed total catch for Turks and Caicos peaked in the early 1950s at around 20,000 $t \cdot year^{-1}$, after which it declined to a low of around 5,300 t in 1970, and gradually increased

thereafter to average about 11,500 t·year^{-1} in the 2000s (Figure 3a, Appendix Table 1). The reconstructed total catch was 2.8 times the than the reported catch baseline from 1950-2010.

The major taxonomic contributors to the total catch were conch (88%) and lobster (7%), while bonefish, snapper, grunts, grouper, wrasses, sharks, grouper, and 18 other taxa contributed considerably smaller amounts to the total catch (Figure 3b, Appendix Table 2).

Artisanal sector

For the 1950-2010 time period, artisanal catches contributed 86% of the catches to the reconstructed total catch (Figure 3a). The artisanal sector had the following taxonomic composition: conch (89%), lobster (6%), with bonefish, snapper, grunts, grouper, wrasses, sharks and 18 other taxa each making minor contributions.

Subsistence sector

For the 1950-2010 time-series, subsistence catches contributed 14% of the catches to the reconstructed total catch (Figure 3a). The reconstructed subsistence sector had the following taxonomic composition: conch (85%), lobster (11%), with snapper, grunts, grouper, wrasses, sharks, triggerfish, and 10 other taxa each making minor contributions.

Recreational sector

From the beginning of recreational fishing in the TCI in 1965 to 2010, recreational catches contributed only around 0.1% or about 800 t in total to the reconstructed catch. It is highly likely, though, that the economic value of recreational fishing far outweighs the tonnage taken.

Foreign catches

The Dominican Republic was estimated to catch a total of approximately 2,700 t for the entire 1950-2010 period, averaging about 44 t·year^{-1}. Haiti, on the other hand, was estimated to catch just over 500 t in total, i.e., 9 t·year^{-1} on average. Both their catches were assumed to have consisted of conch (88%), finfish (8%), and lobster (4%).

DISCUSSION

The TCI are undergoing rapid tourist development due to their relatively pristine environment and favorable Caribbean geographical location. For example, in the first quarter of 2014, tourist

numbers were up by over 40% from the previous year and TCI reported a 30% increase in stopover guests.[2] Three large new hotels are also due to open in the next years to help facilitate the rising demand. This increasing development could lead to environmental problems such as habitat loss, biodiversity loss and overexploitation of resources, which threaten the integrity of coastal and marine ecosystems, the prime reason for the country's popularity. Although the development of the Turks and Caicos Islands are directly linked to the health of its marine ecosystem, environmental problems generated by development, the spatial concentration of human and commercial activities, and changes in production and consumption in the islands are generally not well documented (Clerveaux and Fisher 2005; Lockhart *et al.* 2007). A lack of data on fisheries, especially for the domestic, non-export sectors (e.g., domestic artisanal, subsistence and recreational), have led to an underestimation of marine resource use and potentially erroneous catch quotas.

The queen conch population in TCI is one of the last remaining healthy conch populations in the greater Caribbean, which should alone justify protecting their status and ensuring their sustainability. Considering marine resources contribute to over 10% of the county's GDP, and also benefits residents by providing a cheap and readily available local protein source and employment opportunities, it seems that the government's recent decision to cut funding and hence enforcement capabilities as well as scientific output to the Department of Environment and Marine Affairs[3] is ill-advised. Protecting existing and rebuilding depleted local stocks, through well-enforced and precautionary catch quotas, and effective and patrolled 'no take' Marine Protected Areas is imperative to the sustainability of the marine resources of the TCI.

An additional recommendation is that the minimum size for landing conch, which currently is 7 inch (17.8 cm) shell length (Medley and Ninnes 1995) should be changed to include conch shell lip thickness, which is the only way to tell that a conch is mature and hence avoid stock depletion.

Tourist consumption should be sampled and estimated regularly, and incorporated into the stock assessment models, which already incorporate domestic consumption (Lockhart *et al.* 2006), thus ensuring that catch quotas are more robust.

[2] http://tcweeklynews.com/huge-increase-in-tourist-arrivals-so-far-this-year-p5091-1.htm

[3] http://www.publications.parliament.uk/pa/cm201314/cmselect/cmenvaud/332/332we06.htm

ACKNOWLEDGEMENTS

This work was completed as part of the *Sea Around Us*, a scientific collaboration between the University of British Columbia and The Pew Charitable Trusts. Edward Hind gratefully acknowledges the key financial and logistical support provided by The School for Field Studies (SFS) Center for Marine Resource Studies and the Turks and Caicos Department of Environment and Marine Affairs (DEMA). He is also extremely thankful to the staff and students of The SFS Center for Marine Resources Studies Fall '13 Program, as well as Kathleen Wood, Luc Clerveaux and Maggie Wisniewski of DEMA for their assistance with collecting the data for the 2013 tourist and domestic seafood consumption study.

REFERENCES

Béné C and Tewfik A (2000) Analysis of fishing effort allocation and fishermen behaviour through a system approach. CEMARE Research Paper 155, University of Portsmouth. 30 p. Available at: http://www.port.ac.uk/research/cemare/publications/pdffiles/researchpaperspdf/filetodownload,71361,en.pdf [Accessed:

Brownwell W and Stevely J (1981) The biology, fisheries, and management of the Queen Conch, *Strombus gigas*. 43(7): 12.

Bryden J (1973) Tourism and Development: A Case Study of the Commonwealth Caribbean. Cambridge University Press, Cambridge. 236 p.

Chakalall B, Crispoldi A, Garibaldi L, Lupin L, Mateo J and Medley P (2007) World markets and industry of selected commercially-exploited aquatic species Caribbean queen conch (Strombus gigas), Food and Agriculture Organization of the United Nations, Rome, Italy.

Cisneros-Montemayor AM, Cisneros-Mata MA, Harper S. and Pauly D. (2013) Extent and implications of IUU catch in Mexico's marine fisheries. Marine Policy 39: 283-288.

Clerveaux W and Fisher T (2005) Socio – Economic and Demographic Concerns in Fisheries and Coastal Area Management, Turks and Caicos Islands Case Study. Caribbean Regional Fisheries Mechanism Secretariat. Available at: http://www.fao.org/docrep/006/y4931b/y4931b0j.htm [Accessed:

Clerveaux W and Lockhart K (2008) Fisheries of the Turks and Caicos Islands. pp. 68-78 *In* Mills C (ed.) A history of the Turks and Caicos Islands. Macmillan, Oxford, UK.

Clerveaux W, Puga R and Medley P (2003) National report on the spiny lobster fishery of the Turks & Caicos Islands. pp. 162-174 *In* Report of the second workshop on the management of Caribbean spiny lobster fisheries in the WECAFC area, Havana, Cuba, 30 September – 4 October 2002. Food and Agriculture Organization, Rome, Italy.

Clerveaux W and Vaughan V (2003) An investigation on the effects of increasing fishing efficiency on the productivity of the queen conch (Strombus gigas) and Caribbean Spiny lobster (panilurus argus) fisheries within the Turks and Caicos Islands.54, GCFI. 36 p.

CRFM (2011) Baseline review of the status and management of the Caribbean spiny lobster fisheries in the Caricom region. CRFM Technical & Advisory Document - Number 2011 / 5 Belize. 70 p.

Dalzell P, Corpuz P, Ganadan R and Pauly D (1987) Estimation of Maximum Sustainable Yield ad Maximum Economic Rent from the Philippine small pelagic fisheries. Bureau of Fisheries and Aquatic Resources X(3): 23.

Doran EJ (1958) The Caicos Conch Trade. Geographical Review 48(3): 388-401.

FAO (2012) 2010 Fishery and Aquaculture Statistics Capture Production. FAO, Rome, Italy. 609 p.

Garibaldi L (2012) The FAO global capture production database: a six-decade effort to catch the trend. Marine Policy 36: 760-768.

Halls AS, Lewins R and Farmer N (1999) Information systems for the co-management of Artisanal fisheries. Field Study 2- Turks & Caicos. MRAG Ltd., London. 214 p.

Klaus D (2001) Baseline assessment of commercially viable finfish for future management in the Turks and Caicos Islands. Thesis, BA, Claremont Colleges. 39 p.

Lockhart K, De Fontaubert C and Clerveaux W (2007) Fisheries of the Turks and Caicos Islands: Status and Threats. Proceedings of the Gulf and Caribbean Fisheries Institute 58. 66-71 p.

Lockhart K, Magnusson G and Clerveaux W (2006) Consumption of Local Conch by Resident of the TCI. Proceedings of the Gulf and Caribbean Fisheries Institue 57. 791-802 p.

MacAlister Eliot and Partners Ltd. (2003) Impact of fisheries bycatch on endangered migratory species. Convention on the Conservation of Migratory Species of Wild Animals (CMS). Twelfth Meeting of the CMS Scientific Council. Glasgow, Scotland, United Kingdom, 31 March-3 April 2004 Lymington, England. 96 p.

Maitland T (2006) Dietary Habits, Diversity and the Indigenous Diet of The Turks and Caicos Islands. Implications For Island-specific Nutrition Intervention. West Indian Medical Journal 55(6): 1-13.

Medley P and Ninnes C (1995) Fisheries management inthe Turks and Caicos Islands. Joint FFA/SPC workshop on the management of South Pacific inshore fisheries, South Pacific

Commission, Noumea, new Caledonia, 26 June-7July 1995. 10 p. Available at: http://www.spc.int/DigitalLibrary/Doc/FAME/Meetings/SPC_FFA_Workshop_1995/BP33.pdf [Accessed:

Medley P and Ninnes C (1999) A stock assessment for the conch (*Strombus gigas L.*) fishery in the Turks and Caicos islands. Bulletin of Marine Science 64(3): 399-406.

O'Neill MF and Leigh GM (2007) Fishing power increases continue in Queensland's east coast trawl fishery, Australia. Fisheries Research 85: 84-92.

Olsen DA (1985) Fishery Resource Assessment of the Turks and Caicos Islands. Final Report on FAO Project TCI/83/002 Rome, Italy. 94 p.

Rudd M (2002) A comment on fishing effort allocation in the Turks and Caicos Islands. Department of Fisheries and Oceans, Canada, Nova Scotia. 8 p.

Rudd M (2003) Fisheries landings and trade of the Turks and Caicos Islands. pp. 149-161 *In* Fisheries Centre Research Reports. Fisheries Centre, University of British Columbia, Vancouver, B.C.

Schiller L, Alava J, Grove J, Reck G and Pauly D (2014) The Demise of Darwin's Fishes: Evidence of fishing down and illegal shark finning in the Galápagos Islands. Aquatic Conservation: Marine and Freshwater Ecosystems.

Taylor O and Medley P (2003) Turks and Caicos Islands Field Report. Participatory Fisheries Stock Assessment project R7947. Marine Resource Assessment Group's (MRAG) Fisheries Management Science Programme (FMSP). 56 p.

TCI Government (2013) Turks and Caicos Islands National Report on the Queen Conch Fishery 2012/2013. Department of Environment and Maritime Affairs, Ministry of Environment and Home Affairs, Lower Bight Road, Providenciales. 1 p.

TCI Tourist Board (2003) Survey of Departing Visitors Report– 2002. Statistical Office Department of Economic Planning and Statistics. 66 p.

TCI Tourist Board (2005) Survey of Departing Visitors Report June– 2004. Statistical Office Department of Economic Planning and Statistics. 43 p.

Tewfik A and Béné C (2004) "The Big Grab": non-compliance with regulations, skewed fishing effort allocation and implications for a spiny lobster fishery. Fisheries Research 69: 21-33.

Thiele S (2001) Queen Conch fisheries and their management in the Caribbean. TRAFFIC Europe, WWF and IUCN. 96 p.

Turks and Caicos Government (2004) Plan for managing the marine fisheries of the Turks and Caicos Islands 2005-2010.

Ulman A, Bekişoğlu Ş, Zengin M, Knudsen S, Ünal V, Mathews C, Harper S, Zeller D and Pauly D (2013) From bonito to anchovy: a reconstruction of Turkey's marine fisheries catches (1950-2010). Mediterranean Marine Science 14(2): 309-342.

Ward P (2008) Empirical estimates of historical variations in the catchability and fishing power of pelagic longline fishing gear. Reviews in Fish Biology and Fisheries 18: 409-426.

Zeller D, Booth S, Davis G and Pauly D (2007) Re-estimation of small-scale fisheries catches for U.S. flag island areas in the Western Pacific: The last 50 years. Fishery Bulletin 105: 266-277.

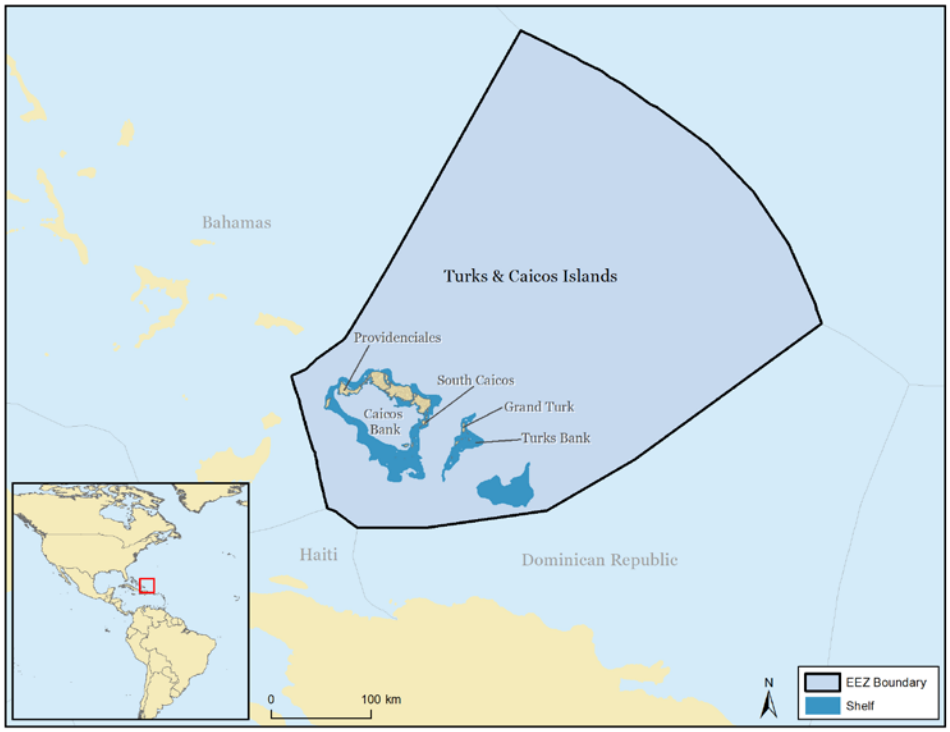

Figure 1. The Exclusive Economic Zone (EEZ) and continental shelf (to 200 m depth) of the Turks and Caicos islands.

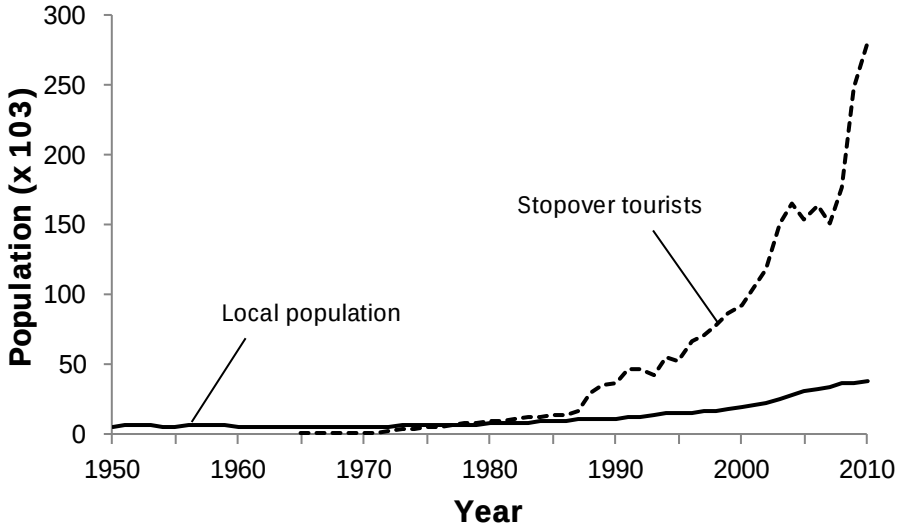

Figure 2. Local and tourist population of TCI, 1950-2010. Sources: Bryden (1973), 1962 anchor point; Caribbean Tourism Organization, 1980-2006 data; TCI Tour board Statistics, 2007-2010 data. Note: stopover tourists average between 6-7 days each, and tourist days were used to calculate consumption.

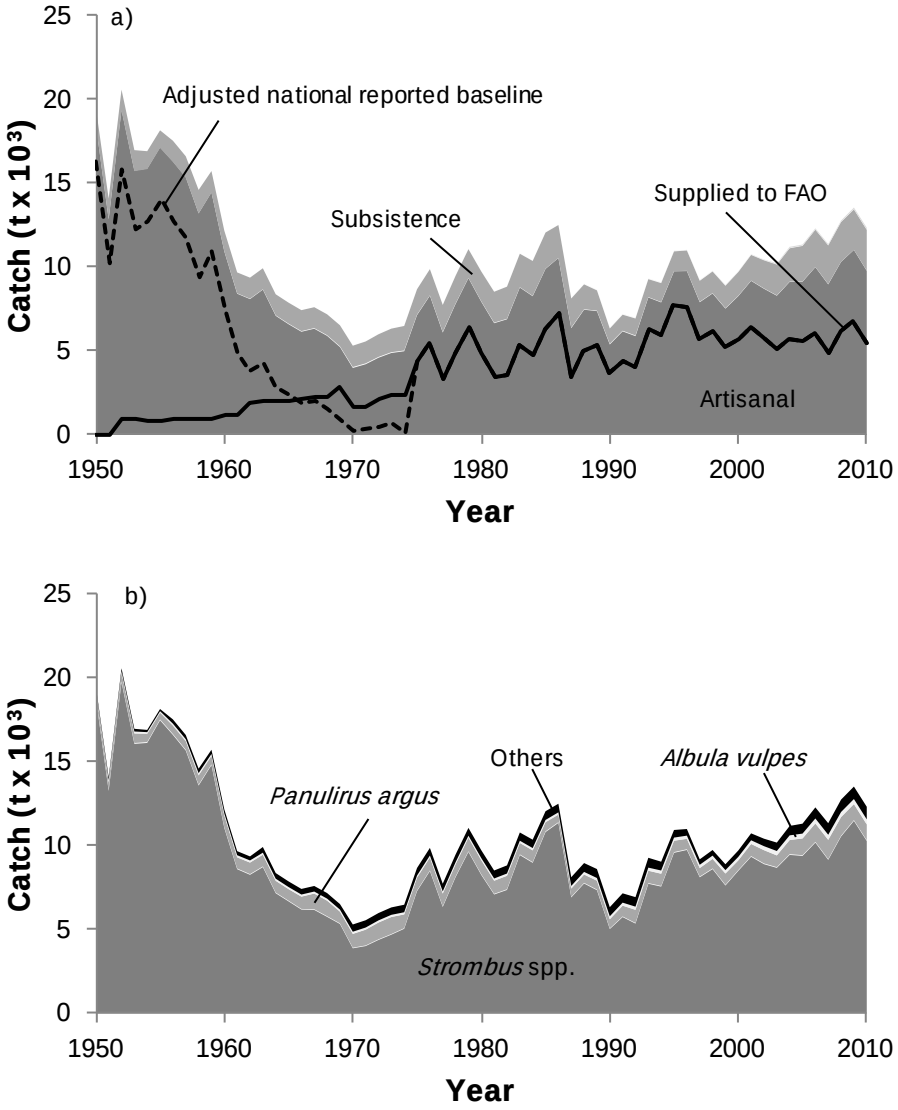

Figure 3. Time-series of marine catches for Turks and Caicos Islands for 1950-2010 by (a) fishing sector, with data reported by FAO on behalf of Turks and Caicos, as well as adjusted national reported data, overlaid as solid and dashed lines, respectively (note that recreational catches are included but are too small to be visible); and (b) by major taxa, with the 'others' grouping consisting of 24 additional taxa.

Appendix Table A1. Total reconstructed catch (t) by sector, compared to data supplied to FAO and adjusted national baseline, 1950-2010.

Year	FAO landings	Adjusted national baseline	Total reconstructed catch	Artisanal	Subsistence	Recreational
1950	0.50	16,261	19,520	18,490	1,030	
1951	0.50	10,160	14,070	12,830	1,250	
1952	892.25	15,845	20,600	19,350	1,250	
1953	942.25	12,224	16,980	15,720	1,260	
1954	850.25	12,748	16,910	15,840	1,070	
1955	850.25	14,067	18,170	17,110	1,060	
1956	950.00	12,698	17,540	16,270	1,280	
1957	950.00	11,769	16,610	15,330	1,280	
1958	950.00	9,366	14,590	13,180	1,420	
1959	950.00	10,889	15,720	14,430	1,290	
1960	1,190.00	7,399	12,150	10,910	1,240	
1961	1,137.00	4,877	9,650	8,400	1,250	
1962	1,908.00	3,814	9,340	8,080	1,260	
1963	2,021.00	4,294	9,900	8,640	1,260	
1964	2,023.00	2,761	8,340	7,080	1,260	
1965	2,015.00	2,286	7,840	6,580	1,260	0
1966	2,059.00	1,863	7,390	6,130	1,250	0
1967	2,263.00	1,967	7,570	6,310	1,250	0
1968	2,257.00	1,560	7,140	5,890	1,250	0
1969	2,868.00	892	6,480	5,220	1,260	0
1970	1,583.00	176	5,260	3,980	1,280	0
1971	1,650.00	350	5,510	4,200	1,310	0
1972	2,117.00	467	5,940	4,590	1,360	0
1973	2,317.00	667	6,280	4,870	1,410	0
1974	2,336.00	133	6,440	4,970	1,470	0
1975	4,408.00	4,408	8,640	7,120	1,520	0
1976	5,494.00	5,494	9,850	8,280	1,570	1
1977	3,241.00	3,241	7,700	6,090	1,610	1
1978	4,879.00	4,879	9,450	7,790	1,660	1
1979	6,338.00	6,338	11,040	9,330	1,720	1
1980	4,830.00	4,830	9,710	7,920	1,790	1
1981	3,466.00	3,466	8,490	6,640	1,850	1
1982	3,590.00	3,590	8,800	6,870	1,920	1
1983	5,364.00	5,364	10,770	8,760	2,010	2
1984	4,742.00	4,742	10,340	8,250	2,090	2
1985	6,276.00	6,276	12,040	9,870	2,170	2
1986	7,255.00	7,255	12,490	10,520	1,970	2
1987	3,449.00	3,449	8,090	6,350	1,740	3
1988	4,940.00	4,940	8,940	7,450	1,490	5
1989	5,263.00	5,263	8,580	7,360	1,210	7
1990	3,705.00	3,705	6,300	5,370	910	7
1991	4,414.00	4,414	7,130	6,160	960	9
1992	4,045.00	4,045	6,900	5,870	1,020	9
1993	6,255.00	6,255	9,250	8,170	1,080	8
1994	5,883.00	5,883	9,020	7,880	1,130	11
1995	7,674.00	7,674	10,920	9,730	1,180	10
1996	7,613.00	7,613	10,980	9,740	1,220	13
1997	5,709.00	5,709	9,160	7,890	1,260	14
1998	6,138.00	6,138	9,720	8,410	1,300	16
1999	5,156.00	5,156	8,870	7,510	1,340	17
2000	5,713.00	5,713	9,690	8,250	1,420	18
2001	6,419.00	6,419	10,720	9,160	1,540	21
2002	5,767.00	5,767	10,400	8,690	1,680	24
2003	5,100.00	5,100	10,160	8,280	1,840	45
2004	5,685.50	5,686	11,160	9,100	2,000	66
2005	5,505.00	5,505	11,300	9,110	2,130	61
2006	6,040.25	6,040	12,270	9,980	2,230	66
2007	4,860.00	4,860	11,330	8,950	2,310	60
2008	6,133.50	6,134	12,740	10,290	2,380	70
2009	6,803.00	6,803	13,520	11,000	2,420	99
2010	5,446.00	5,446	12,310	9,760	2,440	112

Appendix Table A2. Total reconstructed catch by taxon (t), from 1950-2010. Others category comprises 24 additional taxa.

Year	*Strombus* spp.	*Panulirus argus*	*Albula vulpes*	Others
1950	18,810	438	142	137
1951	13,260	477	169	163
1952	19,740	537	167	161
1953	16,070	587	165	160
1954	16,120	517	139	135
1955	17,470	429	135	131
1956	16,600	527	160	255
1957	15,670	533	158	254
1958	13,580	572	172	268
1959	14,800	520	154	251
1960	11,050	716	145	243
1961	8,600	666	144	242
1962	8,270	687	143	241
1963	8,720	698	140	339
1964	7,170	698	138	337
1965	6,680	688	133	337
1966	6,190	729	130	336
1967	6,170	931	128	334
1968	5,760	923	125	332
1969	5,330	692	124	333
1970	3,890	816	123	434
1971	4,020	932	124	436
1972	4,380	995	126	440
1973	4,700	1,010	128	445
1974	5,050	813	131	449
1975	7,290	767	133	453
1976	8,480	771	134	457
1977	6,350	757	135	460
1978	8,120	727	136	463
1979	9,620	814	138	467
1980	8,250	839	140	472
1981	7,090	778	144	479
1982	7,360	801	148	486
1983	9,440	684	153	494
1984	8,980	699	157	502
1985	10,810	549	161	521
1986	11,360	456	164	515
1987	6,920	486	167	521
1988	7,750	495	169	529
1989	7,350	523	173	537
1990	5,030	540	177	546
1991	5,750	639	183	558
1992	5,360	778	191	571
1993	7,730	735	198	590
1994	7,560	725	205	527
1995	9,580	679	209	456
1996	9,740	625	211	398
1997	8,120	506	211	326
1998	8,600	571	211	336
1999	7,630	674	215	351
2000	8,500	582	225	382
2001	9,340	724	240	416
2002	8,900	793	259	447
2003	8,680	701	280	504
2004	9,450	846	300	564
2005	9,390	998	313	595
2006	10,180	1,103	323	663
2007	9,160	1,151	328	692
2008	10,550	1,120	330	741
2009	11,480	964	332	746
2010	10,280	949	329	754

Table 1. Portion sizes used	kg
20 conch fritters	0.1130
1 fillet of fish	0.1130
1 portion lobster salad	0.0567
1 cleaned conch	0.1130
1 lobster tail	0.1500
1 whole bonefish	1.8100

Source: Lockhart (2006).

Table 2. Per capita seafood consumption 2013 ($kg \cdot year^{-1}$)

Fish type	Adult	Child
Conch	7.5	11.0
Lobster	6.7	9.8
Reeffish	12.6	18.6
Gamefish	1.6	2.4
Shark/ray	0.5	0.6
Bonefish	1.8	2.5
Total	33.4	22.0

Source: Edd Hind (unpublished data).

Table 3. Taxonomic allocation used for reef-fish and gamefish for both domestic and tourist consumption.

Reef fish	%	Gamefish	%
Lutjanidae	33.0	Scombridae	45
Pomadasys spp.	30.0	*Coryphaena hippurus*	40
Epinephelus spp.	17.0	Xiphiidae	10
Labridae	10.0	*Acanthocybium solandri*	5
Balistidae	2.5		
Scarus spp.	2.0		
Carangidae	1.5		
Acanthuridae	1.0		
Calamus calamus	1.0		
Gerreidae	1.0		
Pomacanthidae	1.0		

Table 4. Tourist (*per capit*a) consumption per meal (kg).

Fish type	**kg·meal^{-1}**
Conch	0.0071
Lobster	0.0102
Reef fish	0.0163
Game fish	0.0026
Game fish for breakfast	0.0006

Source: 2013 National seafood consumption survey, unpublished results.

Table 5. Fish allocation (%) for 1950 and 2012 for subsistence and artisanal catches.

Year	**Reef- fish**	**Bonefish**	**Sharks**	**Gamefish**
1950	0.60	0.350	0.050	0.0
2012	0.77	0.105	0.025	0.1