Final Technical Report:

Economic Impact Analysis of Commercial and Recreational Billfish Fisheries in the Western Central Atlantic: Grenada and the Dominican Republic

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In support of the business case development efforts in the Caribbean led by the Food and Agriculture Organization (FAO).

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Executive Summary

The main objective of the Economic Impact Analysis was to assess the business case value proposition associated with fishery interventions that reduce billfish mortality in Grenada and in the Dominican Republic (DR). The initial intervention candidates proposed by the CBMC included (1) examining compensation and/or value transfer pathways between the commercial and recreational sectors (2) outlining how such value transfers could be effectively used to finance innovations that improve the sustainability and management of billfish capturing fisheries, and (3) investigate the potential for transitioning low-value commercial artisanal billfish fishers in the pilot countries towards a higher-value recreational fishery. In order to assess the business case value proposition associated with these interventions, a more in-depth economic characterization of these fisheries was carried out, including collecting data on firm-level jobs, revenues, operation costs, profitability, supply chain pathways, supply chain margins and markets. The latter efforts were complementary to the Fishery Performance Indicator (FPI) assessments carried out previously in Grenada and in the DR, enabling the development of fishery supply-chain maps and cash flow models; these models were subsequently used to identify the full extent of potential rent that could be captured under a range of fishery intervention scenarios in Grenada and DR. The main findings from the fishery characterization are summarized in Table A below, with additional details about fishery revenues, operation costs, and recreational expenditures detailed in the Data Collection section beginning on page 18.

***Table A**. Cash Flow characteristics of the recreational and commercial billfish fisheries in Grenada and in the Dominican Republic*

Pilot Country	User Group	Sector	Cash Flow per Year*
Grenada	**Commercial**	FAD	$243,027
		Type I&II Longline	$2,093,727
		Type III Longline	$4,625,084
		Entire Supply Chain	$15,778,628
	Recreational	Total Expenditures	$10,221,579
		For-Hire Business Cash Flow	$5,475,973
Dominican Republic	**Commercial**	FAD	$314,950
		Entire Supply Chain	$424,993
	Recreational	Total Expenditures	$45,116,709
		For-Hire Business Cash Flow	$36,319,120

As illustrated above, the commercial fishing sector in Grenada generates considerably higher cash flows ($22.7 million USD) relative to the recreational fishing sector (15.7 million USD). By contrast, the recreational fishery in the Dominican Republic is much more economically important, generating $36.3 million USD in annual cash flows, compared to the commercial fishing sector, which generates less than $0.75 million USD annually.

Once the above information was collected, cash flow models were developed for the relevant parts of the recreational and commercial fishery supply chains, in order to evaluate the business case value proposition associated with a range of fishery intervention scenarios. Scenario 1, for instance, evaluates the impacts of Blue and White Marlin harvest reductions on food security and revenues, including an assessment of how much fishermen would have to be compensated for lost income associated with those harvest reductions. Scenario 2 examines the cash flow impacts of a 10%, 20% and 30% reduction in sailfish harvests in both pilot countries. Scenario 3 assesses the economic impacts of expanding the recreational fishing sector in each pilot country, including the additional cash flows and employment that would result from several tourism growth scenarios. Finally, scenario 4 assesses the viability of converting commercial fishermen to for-hire charter captains in each pilot country. The findings for each scenario are summarized below. Note that these cash flow models were also used by Wilderness Markets to draft the OPP business cases in the Caribbean (Inamdar *et al.* in-development).

Supply Chain Mapping:

During the FPI assessments in Grenada and in the DR, the team was able to gather some basic data on the harvesters and the supply chain including the basic structure of the supply chains, which was further supplemented through the current Economic Impact Analysis. In both pilot countries, the supply chains are very simple, generally only including a first buyer and, in some cases, a wholesaler or importer. The supply chain is oftentimes vertically-integrated, with the first buying owning the boat and acting as the wholesaler and/or retailer. The FPIs were very important to this project as they leveraged the costs of each stage of this project to avoid duplication of effort and to initiate stakeholder relationships.

Figure A details the Longline (LL) fishery supply chain in Grenada, in which a proportion of the fish landed is retained by the vessel for personal and family consumption. The remaining portion is landed at the first dealer, who then exports all the tuna that grades two or better in terms of quality to the United States, whereas the rest is either sent directly to the local market, or sold to a local distributor.

Figure A. *Grenada Longline Fishery Supply Chain.*

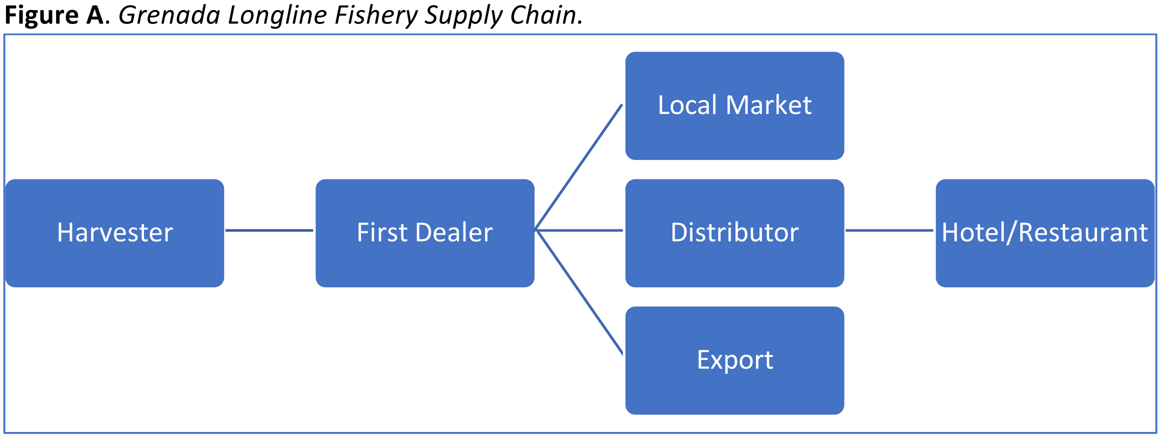


Figure B details the Grenadian Fish Aggregating Device (FAD) fishery supply chain, which consists solely of the harvester and first dealer.

Figure B. *Grenadian FAD Fishery Supply Chain.*

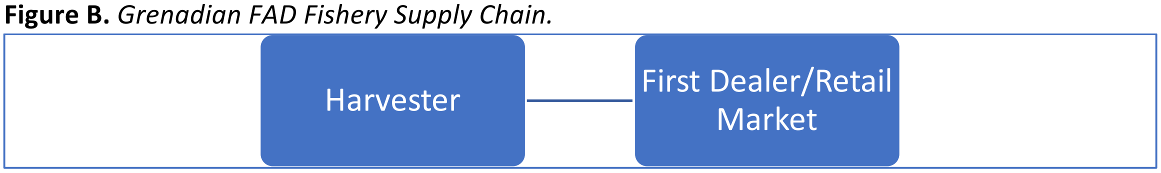
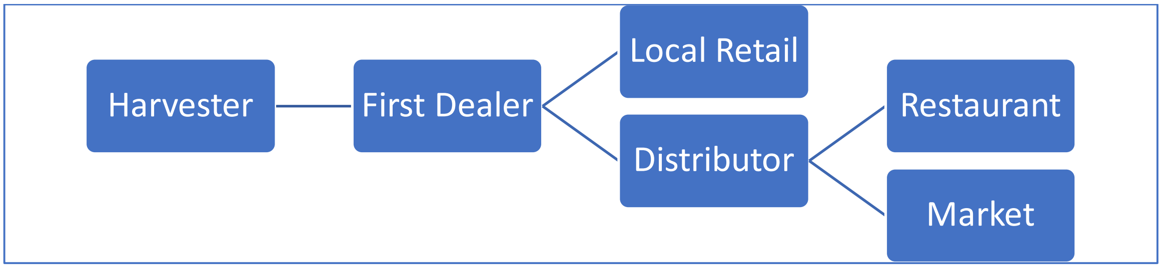


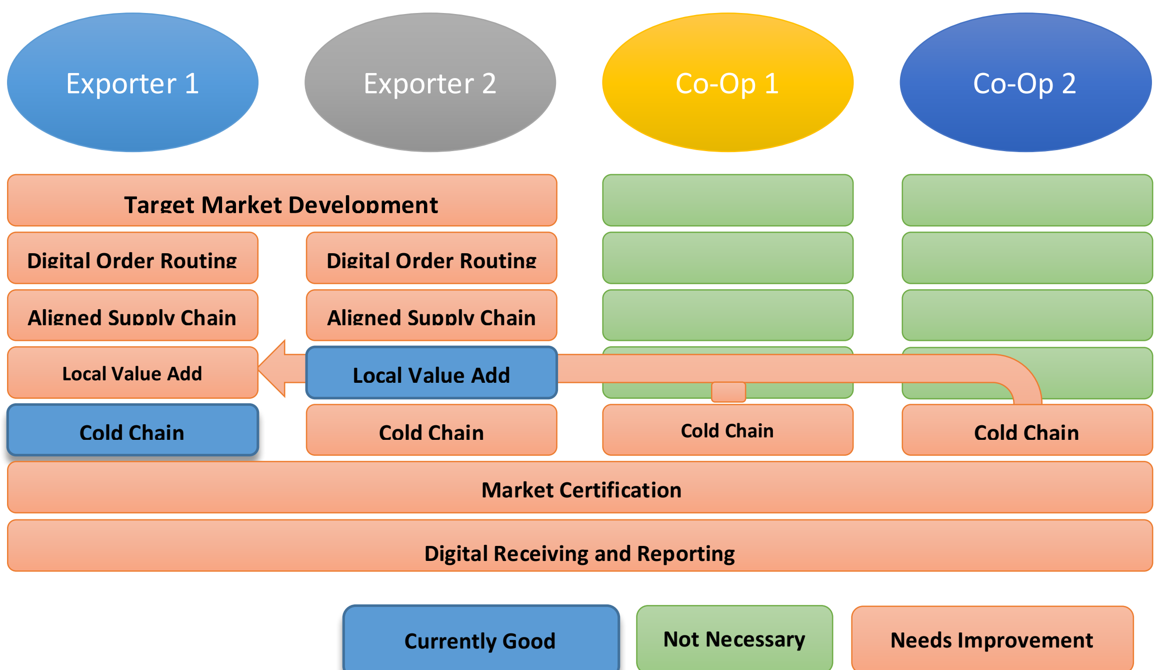
Figure C displays the supply chain for pelagic FAD fisheries in the DR, wherein fish is sold to a first dealer who is often also the local retail market. Alternatively, the fish moves through a distributor to restaurants or markets in the larger cities and resort towns.

Figure C. *Dominican Republic FAD Fishery Supply Chain.*



These basic supply chain maps were used to inform model development and the data collection process going forward. The supply chain maps and cash flow modeling was subsequently used to identify fishery intervention options for the business cases, as well as to assess the cash flow impact of each through the scenario analysis. Figure D outlines the supply-chain intervention recommendations identified for Grenada, which were subsequently used to develop the Grenadian business case.

Figure D. *Supply Chain Business Case Recommendations for Grenada.*[1]



[1] Figure D generated by Wilderness Markets.

Scenario 1: Impacts on Food Security and on Revenues of Blue and White Marlin Harvest Reductions in Grenada

Based on typical actions historically taken with other new members, ICCAT will likely set a 10t blue marlin quota and a 2t white marlin quota for Grenada. The analysis of this reduction revealed that food security would not be significantly impacted by implementing these country level quotas, for a number of reasons. First, blue and white marlin landings combined represent only 1.6% of the total supply of seafood in Grenada. Furthermore, billfish meat is either equivalent ($2.63/lbs. USD) or more expensive than other readily-available protein-rich food sources, such as imported chicken legs ($1.19/lbs. USD), local fresh whole chicken ($2.41/lbs. USD), and other seafood (see Table B).

Table B. *Price comparison of major seafood products and other protein sources in Grenada*

Species	Average Price (USD/lbs.)
Chicken legs (frozen/import)	$1.19
Shark	$1.42
Blackfin tuna	$1.76
Bonito	$1.87
Whole chicken (fresh/local)	$2.41
Flying Fish	$2.46
Skip Jack Tuna	$2.48
Butter fish	$2.50
King Mackerel	$2.53
Albacore	$2.62
Cavalli (*misc. jacks*)	$2.62
Billfish	$2.63
Chicken breast (frozen/import)	$5.49

On the other hand, the above harvest reductions, representing a 75% reduction in marlin harvests for Grenada, would reduce cash flows by $4.7 million over ten years. At the vessel level, the losses would be equivalent to $1,678 per Type III vessel annually, and $2,571 per Type I & II vessels annually, assuming that the remaining quota are allocated toward subsistence fisheries (i.e. "consumed" or "given away").

For the above scenario, it is therefore recommended that additional investments be made to promote adoption of circle hooks by the entire fleet, and to make supply chain improvements, so that fishers can be compensated for billfish harvest reductions through access to higher priced, and less vulnerable species like yellowfin tuna.

Scenario 2: Cash flow impacts of Sailfish Harvest Reduction in Grenada and in the Dominican Republic

Scenario 2 examined the impacts on commercial fishermen cash flows of a hypothetical 10%, 20%, and 30% reduction in sailfish harvest in both countries. The intention here is to anticipate potential future sailfish quota reductions and forecast cash flow changes based on those reductions. Currently the ICCAT sailfish stock assessment is highly uncertain and, while ICCAT has not declared the stock overfished nor that overfishing is occurring, these results are inconclusive for a number of reasons including a lack of good landings data for sailfish. Sailfish is a source of revenue for commercial fishermen in Grenada and in the Dominican Republic, with higher landed value than blue and white marlin combined (Table C).

Table C. *Sailfish Price, Volume and Value by country*

Sailfish	Price Paid to Harvester (USD)	Landed Volume (pounds)	Landed Value (USD)
Grenada	$1.89	211,361	$398,937
Dominican Republic	$1.40	262,350	$367,290

The Net Present Value (NPV) of a 10% reduction in sailfish harvest over ten years would cost fishermen in Grenada a total of $1,882,293 USD, whereas the cash flow losses in the Dominican Republic would reach $743,625 USD over the same time period (Table D):

Table D. *Annual Costs and NPV losses associated with a 10% reduction in sailfish harvests*

Country	Fleet	Annual Cost	NPV Over 10 Years
Grenada	FAD	-$508	-$3,922
	Type I&II	-$66,847	-$516,172
	Type III	-$79,875	-$616,773
	Labor (Captains and Crew)	-$783	-$6,046
	Exporters	-$63,694	-$491,828
	Retail Markets	-$32,059	-$247,551
		Total	-$1,882,293

Country	Fleet	Annual Cost	NPV Over 10 Years
Dominican Republic	FAD	-$53,390	-$412,262
	Labor (Captains and Crew)	-$414	-$3,197
	Retail Markets	-$42,499	-$328,166
	Total		-$743,625

Similarly, a 20% reduction in Sailfish harvest would result in a $3.8 million USD and $1.5 million USD loss for Grenada and DR respectively over a 10-year period. A 30% reduction would similarly result in a $5.6 million loss for Grenada and a $2.2 million loss for the Dominican Republic.

Based on the losses identified above, no sailfish harvest reductions should be undertaken until the stock models support such an action, especially if viable mechanisms to compensate fishermen income losses are not available. In order to demonstrate stock impacts from harvest reductions, better temporal and spatial data on harvests would be needed to improve stock models, highlighting the need to improve the quality and timeliness of fishery data collection in Grenada and DR. Additionally, both countries currently lack Harvest Control Rules (HCRs), and also lack the means to support effective monitoring, control and surveillance. The focus of any investment in the fishery should therefore be on improving these enabling conditions. HCRs should be established according to the findings of robust stock assessments, which are currently unavailable at the Atlantic-wide level by ICCAT. The current stock model is therefore incapable of providing levels of surplus production that could then be assigned to member nations. Currently, only Grenada is a member of ICCAT, and it is making progressive efforts to set a good Caribbean example as the premium sustainable tuna exporter in the Lesser Antilles.

Scenario 3: Economic impacts of increasing tourism growth in Grenada and DR, and options for funding billfish co-management trusts through recreational fishing user fees

Recreational fishing for billfish is an important economic driver for both islands, particularly for the Dominican Republic. The Dominican Republic is one of the most popular and best ranked billfishing destinations in the world, and certainly the top destination in the Caribbean. As a result, user fees from the recreational fishing sector have been highlighted as an important value-driver for some of the OPP business cases. Scenario 4 therefore evaluated the economic impacts that would result from a 3%, 5%, and 10% increase in tourism growth in each pilot country, including the role that user fees could play in funding billfish conservation. For both countries, any increase in tourism yields significant economic returns. Under 3%, 5% and 10% tourism growth scenarios, Grenada could see expenditures increase by $2.6 million, $4.9 million and $30.3 million USD (Table F). In the Dominican Republic, 3%, 5%, and 10% increases in tourism could generate expenditure increases amounting to $7.4 million, $13.5 million and $83.9 million USD.

Table F. *Economic Impacts of 3%, 5%, and 10% tourism growth in Grenada (lower-bound estimates)*

NPV Estimates	3% Growth	5% Growth	10% Growth
Charter Business Cash Flow	$1,437,048	$2,607,606	$16,217,993
Private Stamp Revenue	$13,666	$24,798	$154,231
Government Stamp Revenue	$15,250	$27,671	$172,101
Expenditures	$2,682,427	$4,867,419	$30,272,887
GDP	$6,649,237	$12,065,423	$75,040,842

Note that the modeled increases in tourism growth are consistent with the current growth trajectory in both countries over the last few years, and could be further accelerated through marketing strategies. Since recreational fisheries in both locations practice voluntary catch-and-release for all billfish species, promoting the growth of the recreational fishing sector presents a sustainable way to increase livelihoods in coastal communities, as well as to raise funds for conservation and fisheries management.

Using an average of 200 trips per year for a full-time charter captain, these projected increases would also support the establishment of new charter businesses. In Grenada, a 3%, 5% and 10% increase could support half a full-time charter, slightly less than one full-time charters and three full-time charters respectively. In the Dominican Republic, a 3%, %5 and 10% increase would support up to one new full-time charters, two full-time charters or four full-time charter respectively. All estimates in this scenario are based on uncertain effort and participation estimates resulting in wide confidence intervals. The uncertainty in this effort data highlights the need to more formally collect recreational fisheries data, which is something still being pursued through the Caribbean Billfish Project. Both countries should implement and maintain catch, effort and participation data collection efforts as soon as possible.

Given the lack of recreational data for either pilot country, the project relied on an external effort to collect basic information, including expenditure data, willingness-to-pay for conservation funding and for-hire cost and earnings data (Gentner and Whitehead 2018). Table G below summarizes the current economic impact of recreational fishing in both countries.

Table G. *Economic Summary of the Recreational fisheries in the Dominican Republic and in Grenada*

Metric	Dominican Republic		Grenada	
	Low	High	Low	High
Charter Business Cash Flow	$36,319,120	$43,761,744	$5,475,973	$16,640,454
Private Stamp Revenue	$993,243	$1,251,405	$490,769	$914,498
Government Stamp Revenue	$1,108,328	$1,396,401	$914,498	$1,020,458
Expenditures	$28,328,229	$45,116,709	$10,221,579	$14,340,177

Metric	Dominican Republic		Grenada	
	Low	High	Low	High
GDP	$70,220,399	$111,835,911	$25,337,389	$35,546,625
Employment	2,870	4,571	1,036	1,453

Note that the per-person per-trip fees for the co-management trust were derived using the average number of annual trips taken by billfish anglers from the WTP survey and the estimate of the WTP for a conservation trust estimated as an annual number. The estimates presented above are based on charging both resident and tourist angler that average amount. The per person per trip value, around $30 per person per trip, may be too high for resident anglers, particularly in Grenada. It would likely be preferable to charge resident anglers an annual fee that was less than $30 a fishing trip. If residents were charged a lower fee, the trust would raise less funds. Regardless of the level of fee charged, the opportunity to raise substantial funds is sound, particularly under continued growth in recreational fishing tourism.

Scenario 4: Transitioning the low-value commercial artisanal billfish fishermen towards a higher-value recreational fishery.

In over-exploited fisheries, a strategy to improve stock health while supporting livelihoods, is to support the transition of commercial fishermen to the for-hire recreational fishing sector (i.e. charter captains). One of the initial fishery interventions investigations of the Caribbean Billfish Project, was assessing the feasibility of transitioning the low-value commercial artisanal billfish fishery in the pilot countries towards a higher-value recreational fishery. Scenario 4 therefore assessed the viability of such an option.

With the rise in popularity of the Dominican Republic as a top-rated billfish destination, and given the economic realities of being a FAD fisherman in the nation, many commercial fishermen have already started leading charter recreational fishing trips. In many cases though, these new captains do not practice catch and release fishing. Instead, they harvest all billfish to hang at the dock as a form of advertisement, and then sell that fish to further increase profits. In order to have a sustainability outcome, any increase in charter effort would necessarily need to be coupled with limited entry and mandatory catch and release of billfish. Large fishery management capacity improvements would be required, particularly in the Dominican Republic, before these sustainability ensuring limitations could be effectively enforced. As a result, these enabling factors need to be addressed before this strategy could be responsibly advocated for. Table H below details the economic realities across all sectors in both pilot countries.

Table H. *Average Annual Cash Flows for each fishery in Grenada and in the Dominican Republic*

Country	Fleet	Average Annual Cash Flow
Both	Charter	$17,400
Grenada	FAD	$3,038
	Type I&II	$52,148
	Type III	$54,042
Dominican Republic	FAD	$1,221

From Table H, it is clear that Grenadian Type I, II or III longline captains would not have any incentive to switch to charter fishing, since they earn a considerably higher income from the longline fishery. FAD captains on the other hand earn less than the average annual cash flow of a charter captain, and could therefore be motivated to transition to charter fishing. FAD captains may nonetheless have to overcome the high costs associated with switching from smaller-scale commercial fishing to charter fishing, as illustrated in Table I.

Table I. *Costs for Different Recreational Vessel Types*

Vessel Type	Vessel Cost	Annual Payment at 10% Interest for 15 Years
New Inboard Yacht	$500,000	$64,476
Used Inboard Yacht	$214,258	$27,624
Used Center Console	$50,000	$6,444
New Local Panga (25' 40 hp)	$6,000	$768

Alternatively, captains could offer lower costs trips in open boats as evidenced in Mexico and Central America. Full-day charter prices on the larger trolling yachts cost upwards of $1,500/day whereas open panga trips generally cost $250/day.

At a $250/day charter rate, and with a 200-day fishing season, annual cash flows would be higher than those for current FAD fishers in either country. The costs associated with purchasing a larger trolling yacht on the other hand would be prohibitive for current FAD fishermen.

Under a 3% tourism growth scenario in Grenada, a FAD fisherman could expect to make about twice his current cash flow, if only one fisherman made the switch at the end of 10 years. Under a 10% tourism growth scenario, if two fishermen switched, they would earn slightly more than the basin-wide annual average cash flow in the charter business. The latter findings suggest that the livelihood opportunities from transitioning from commercial to recreational fishing in Grenada are limited, unless there is a more drastic growth in tourism.

The Dominican Republic provides a very different scenario, which also explains why some commercial fishermen have already made the switch in Macau. When the recreational fishery was growing at its fastest rate, 15 commercial fishermen switched to recreational fishing. However, eight of those fishermen have reverted back to commercial fishing. The lowest level of increased tourism from the previous scenario, 3%, generates slightly less cash flow than the average annual cash flow seen for a single charter vessel in DR. However, this represents 13 times more annual cash flow than a FAD fisherman in the Dominican Republic currently makes a year. As a result, even if each boat was not running 180 trips a year, 13 commercial fishermen could convert to recreational fishing and still be better off than fishing FADs commercially. At the highest level of tourism increase, 10%, seven new full-time charter captains could be supported at the basin wide average cash flow, or slightly less than 100 fishermen could convert and make slightly more money than fishing FADs commercially.

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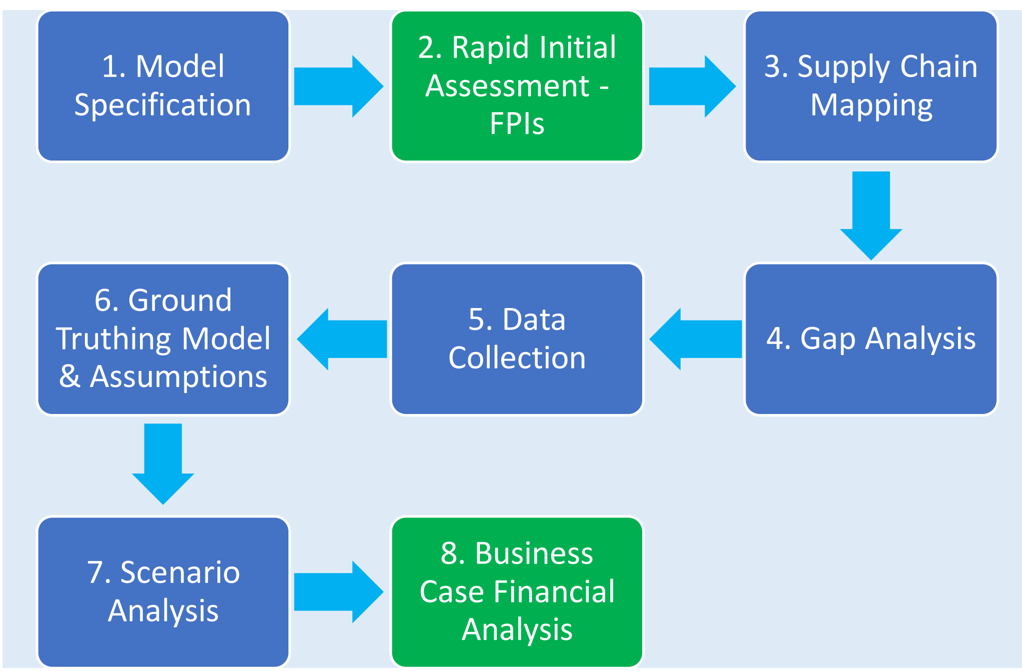
Introduction

Within the context of the Caribbean Billfish Project and the Ocean Partnership Project, the objective of the current activity was to assess the business case value proposition associated with fishery interventions that reduce billfish mortality and to examine compensation and/or value transfer pathways between the commercial and recreational sectors.

In order to develop a fishery development project for investment, there was a need to develop tools that can examine the financial and livelihood implications of interventions used to achieve triple bottom line outcomes. Figure 1 details the steps followed in the CBP project to develop these models. The current Economic Impact Analysis focused on steps 1, and 3-7; step 2 was completed previously, and step 8 is currently being completed by another consultant. A core focus of the current activity was therefore to build on the Fishery Performance Indicator assessment, by collecting data on harvesters and supply chains in order to develop cash flow models of the commercial and recreational fishery supply chains in each pilot country.

Figure 1. *Steps in Quantitative Fisheries Investment Project Development (Steps 2 and 8 were conducted outside this project)*



The research effort took advantage of many data collection synergies and relationships outside this particular project to take advantage of all opportunities and keep costs low.

Data was collected to identify the full extent of potential rent that is not currently captured by local fishing communities. The information collected was used to build cash flow models of all fisheries sectors in Grenada and in the Dominican Republic, providing context about the performance of billfish fisheries in both countries, and highlighting specific issues that needed to be addressed in order to improve their value; both of which are pre-requisites to the development of business cases.

Documenting the value of the billfish recreational and commercial fishery through economic analyses sheds light on the practicality of policy interventions proposed for the business cases. The cash flow models detailed herein were used as the basis of the financial models used to create the business case documents. In addition to the scenarios examined by the business case team, this document contains scenarios to support and add context to that effort. The study results may therefore also motivate investment in enhanced management, and in potential institutional arrangements that provide strong economic incentives for local commercial fishers to abstain from landing billfish.

Rapid recreational and commercial billfish fishery assessments were used by the business case team, consisting of representatives of Conservation International (CI), Food and Agricultural Organization to the UN (FAO), Wilderness Markets (WM) and stakeholders in the pilot countries to identify value-creation opportunities in the respective supply-chains, as well as aspects within countries that can become the focus of the management reforms. The analysis directly helped inform and structure the business cases by helping structure the theory of change. Finally, the economic data collected through this process was complementary and supplementary to that collected through other activities and functioned as a starting point for the drill-down process to inform the value proposition available in the pilot countries and begin to identify ways to transfer that value across sectors. Thus, this work also filled an essential knowledge gap for the larger multi-sector Caribbean Billfish project.

The Economic Impact Analysis extends the knowledge gained during the Fishery Performance Indicator (FPI) process, including through the development of spreadsheet-based cash flow models for the fisheries that target pelagic species in the pilot countries; these models were used to examine the annual profit changes from fishery interventions that reduced billfish mortality. Profit changes were forecasted for the duration of the proposed project, providing financial information that investors and funders want to see in the business cases under development. The financial modeling for the OPP Caribbean business cases was conducted by Wilderness Markets using the data collected, and cash flow models developed under this activity. The overall goal was to build an analysis tool and then use that tool to analyze scenarios generated by the stakeholder-driven business case development process. Note that the analysis did not model any demand changes related to changes in markets nor did it model any potential biological changes in billfish stock.

The models and data collected were grounded and validated during stakeholder outreach meetings conducted by GCG and WM in both pilot countries. Business case ideas were presented and validated in these meetings and any final data gaps were filled.

Work presented here documents all these efforts and distills the models developed into a set of four policy analysis scenarios. The scenarios are in addition to the financial modeling conducted for the formal business case conducted by WM and serve to provide context for those cases and explore ideas that may not rise to the level of a business case. First, the pilot country context is briefly described. Next the methodology is detailed and the data collected is summarized. The final spreadsheet models are described and the report culminates with the analysis for four policy scenarios. the methodology to develop cash flow models of all sectors, commercial and recreational, across both pilot countries, Grenada and the Dominican Republic.

Pilot Country Context

Country context is provided to set the stage for the work completed and provide context for the scenarios analyzed later in this document. The context section begins with Grenada, describing their commercial longline (LL) sector, their fish aggregating device (FAD) sector and their recreational sector that targets pelagic species. Next, the commercial FAD sector and the pelagic recreational sectors in the Dominican Republic are described. The information in this section was derived from desk research, the conduct of the Fishery Performance Indicators (FPI) rapid assessment tool (Gentner et al. 2018), an online survey of recreational anglers (Gentner and Whitehead 2018) and two visits to each pilot country. Rapid assessments, like the FPIs, are the top of the data funnel that led to the specification of the data collection and modeling methodologies.

Grenada

Official landings data of large pelagic fishes in Grenada indicate that yellowfin tuna, the main target species, has maintained an increasing trend in the landings since 2000, reaching its highest record value of 1609 t in 2016, accounting for 68% of the landed catch of the main large pelagic species for the period of 2014-2016. Initially, for the FPIs, disaggregated landings data in Grenada was not available, so the project had to rely on aggregated data as reported to FAO. Through the work on this project, the latter data for Grenada was obtained, which allowed disaggregated analysis of landings by species and gear type for the business case that followed from the work described here.

Grenada has a robust data collection system that is paper based, but there is a data digitalization backlog that dates back to 2013, the last full year of data entry. The Ministry sends a data collector to the first dealer weekly and collects volume and value. While some fish is landed and sold directly to the consumer or consumed by the fishermen without being recorded, official under coverage is only estimated to be between 10-25%.

Generally, recreational harvests that are sold are not captured unless the fish was sold through official channels. The charter boats in the region and the one billfish tournament practice 100% catch and release for billfish. The charter vessels retain dolphinfish, wahoo, king mackerel and yellowfin tuna for client consumption and sale. In this fishery, the fish are the property of the boat. They will give the client a small amount of fish equivalent to one meal's worth, the remainder is typically sold. It is unknown how much of that fish moves through an official dealer.

Longline Fishery

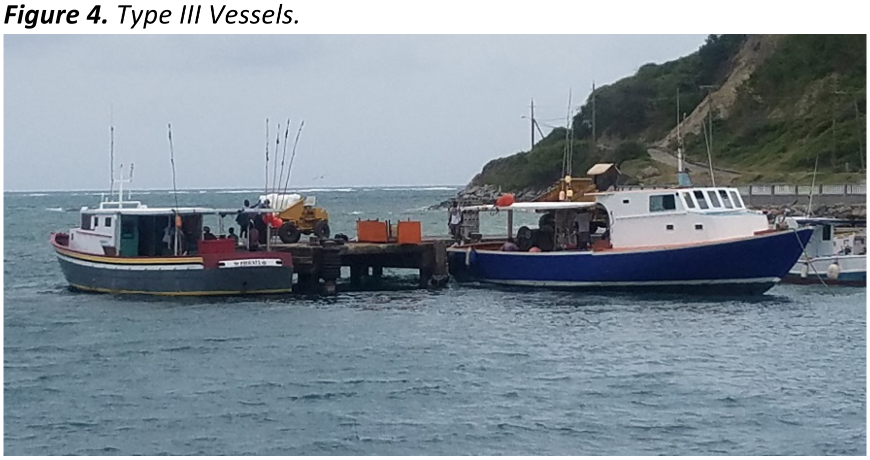
Fishery Details

The Grenadian longline (LL) fishery is prosecuted by three types of fishing vessels. Type 1 boats (Figure 2) are 4.5 – 7m in length single or twin outboard power and set between 100-150 hooks. They typically do not travel more than 10 nautical miles from the coast and return to port every day as they generally have no ice capacity. To be able to sell to the exporter and get export prices, they will run individual fish back to the buyer while leaving the gear fishing. Type II boats, or Trinidadian style fiberglass pirogues, are approximately 9 m in length with a small cabin top, capacity for 3 crew and powered by one or two outboard motors. They tend to include some basic electronic equipment and safety gear. See Figure 3 for a picture of Type II vessels. The Type II boats set 200-300 hooks on overnight trips operating 30-35 nautical miles offshore. They usually have ice capacity. The Type III vessels, Figure 4, are capable of fishing operations of four to six days, deployment of 400-600 hooks and have a single inboard diesel engine. They have significant ice capacity, but no refrigeration. They fish year-round using frozen imported bait to chum for the preferred flying fish bait, while sometimes using locally caught jacks and dead bait when flying fish are scarce.

Figure 2. *Type I Vessels.*

Figure 3. *Type II Vessels.*

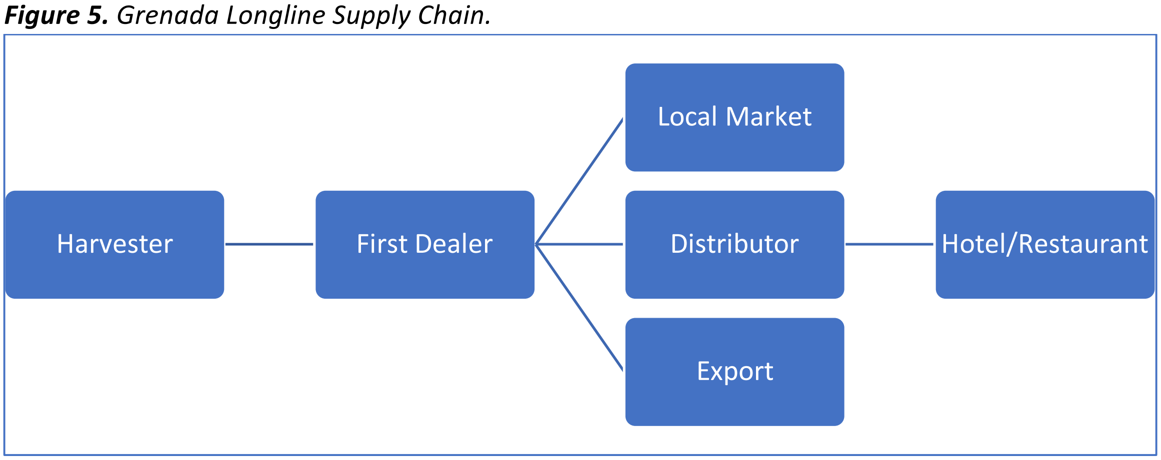
Figure 4. *Type III Vessels.*



The LL supply chain is a very straight forward supply chain (Figure 5). The vast majority of the fish caught are tuna and those fish are exported directly to the US as fresh, never frozen product. There were three exporters in Grenada, but one is functionally out of business and the other handles less than 20% of the market. The first dealer is the exporter in all three cases. In 2016, Grenada exported 1.4 t of yellowfin tuna worth $5.9 million USD. Product is exported fresh via commercial passenger and commercial freight aircraft. The product is minimally processed. It is gilled and gutted while at sea, and for the Type II and III boats, packed in ice. Billfish, dolphinfish and wahoo and tuna not grading out for export are all sold in the local markets. The "bycatch" (the fishers call it bycatch) is economically important and may be sold fresh or frozen for later sale locally. There is limited distribution of fish. The largest buyer is horizontally integrated into general food service supply for the hotels and restaurants. He owns a fleet of trucks for this business and uses those trucks to deliver fish. Generally, however, most seafood is sold at fresh markets at the point of landing.

For this fleet, the key points in the supply chain are the three fish houses built by the Japan International Cooperation Agency (JICA), and two other private facilities. The largest exporter operates out of one of the JICA facilities that has been purchased from the government, renovated with private capital and currently operated as a public private partnership in St. George's. It has been fully modernized with a high capacity ammonia ice plant and is whole fish HAACP compliant. The other two export buyers operate from private docks or take delivery from the public JICA docks and move the product to their facilities. The other exporter in St. Georges also does value added processing smoking some of the billfish they buy. They also loin and vacuum pack snappers for export to the EU when tuna is out of season. The second JICA facility on the west side of the island is in Gouyave. It has an ice plant, a retail market, cold storage and a HACCP room. Currently this facility is not involved in exporting tuna, but there is interest in re-opening it for that purpose.

Figure 5. *Grenada Longline Supply Chain.*



There are a lot of factors at play in the first dealer space. Tuna is graded in the US by the buyer and the price assigned once graded. The importer will not take any of the grading risk, which leaves that risk to be shared between the dealer and the harvester. Tuna grading is not an exact science. Dealers that do predictive grading seem to do better in the US market. Many risk factors could harm the product grade once it leaves the dealer's hands that the dealer has no control over. All dealers try to handle this grading risk in different ways and have tried many ways in the past. Some are selling on consignment, transferring all the risk to the harvester, but generally resulting in higher dockside prices. However, this delays payout and settlement with the dealer. Some offer "standard" prices for tuna transferring all the risk back to the dealer, but not without compensation for that risk. There is grumbling amongst the fishermen that the dealers are taking advantage because pricing isn't always transparent. Pricing transparency is driving interest in two locations to start a cooperative that also does the exporting paying the harvesters either on consignment or via a predicted grade/price with mark ups for ice packs, boxes and shipping costs.

The processing facilities are relatively small, but not much room is needed as fresh fish are boxed and refrigerated for twice weekly flights to the mainland. All processing is done at sea, except for one buyer that has some value added capability with a smoking plant. He used to run sailfish through the smoker for sale to the US until the US banned imports of billfish. The largest exporter's state of the art ammonia ice plant can freeze 20mt of ice a day. All first dealers front the boats fuel, ice, bait, gear and provisions and there is an expectation if the boat took the loan, the boat will land their fish at the same dealer that fronted the supplies.

FAD Fishery

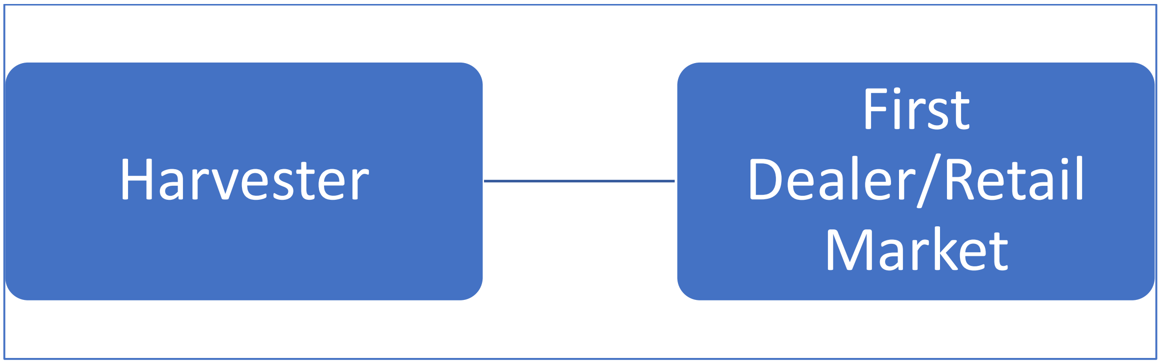
Fishery Details

Figure 6 shows the typical FAD fishing vessel. Generally, they are very similar to the Type I boats above, but without LL reels. Typically, they are 4.5-7 meters long with a single outboard. Most of the Grenville boats have ice capacity and use ice. The vessels may participate in other activities including water taxi (in Carriacou) and other demersal fisheries. The center of the FAD fishery is the port of Grenville but there are active FAD fishers in Carriacou and Petit Martinique. One of the FAD fishers on Carriacou takes a few charter recreational trips each year and was interested in expanding that business. There are no other charter fishing operations on the island of Carriacou. All told, there are probably 120 boats registered that are of a type that fish FADs, but probably 50 or less are active in Grenville, Carriacou and Petit Martinique.

Figure 6. *FAD Fishing Vessel*

The Grenada FAD fishers fish relatively few FADs. They take day trips and will troll plastic squid baits for various pelagic species. They will also catch small pelagics to use as live baits around the FADs. The supply chain, depicted in Figure 7, is very simple. For the Grenville fishery, all the fish are offloaded in Grenville at a JICA facility and are sold directly to customers after a single mark up. There is no distribution. Similarly for the outer islands of Carriacou and Petit Martinique, the harvest goes directly to local consumption. On occasion, the fishers in Petit Martinique will send high quality tuna down to Spice Island Fish House in St. Georges on one of the LL boats. Also on occasion the Petit Martinique FAD fishery will export fish directly to the islands of Martinique.

Figure 7. *Grenada FAD Supply Chain.*



Recreational

Fishery Details

Documenting the recreational sector was much more challenging for a number of reasons. First, the universe of private anglers is unknown and unknowable. If tourist fishers are included, the recreational fishery could have more participants than either commercial fishery. Second, there is absolutely no data available for the fishery. There are no effort estimates nor catch estimates. The tourism ministry, Pure Grenada, conducts an exit survey at their airport and that survey includes a question regarding fishing activity. The responses to that question were used to generate a rough estimate of tourist fishing effort. Regarding local private angling effort, there is no data. It is a 100% release fishery for billfish that targets medium to large blue marlin with large tuna an occasional target. The fleet also catches dolphin, wahoo, barracuda and king mackerel. Fortunately, it seems to be a very small fishery. There may be as many as four charter boats in St. Georges, with only one boat chartering at what would be considered a full-time level.

Dominican Republic

CODOPESCA, collects fisheries landings through a series of enumerators at every landings location. The enumerators use paper notebooks to record landings data. Regarding volume, only recently did CODOPESCA switch from using subjective species groups to individual species for data collection. Additionally, there is currently a backlog on the data entry side that stretches back to 2011, the last year fully entered into an electronic database. CODOPESCA was still using the subjective species groups in 2011. In addition to no actual species information in the pre-2011 data, there is no way to delineate the pelagic fishers in the data set objectively. They do record gear type and fishing location, but there is enough overlap with other gears and locations that it is impossible to identify FAD fishing trips with 100% accuracy. The best thing about their enumerator data collection system for this project is the collection of cost and earnings information for every trip recorded on their forms.

CODOPESCA's official FAO reported landings data on large pelagic fishes in the DR, likely coming from the FAD fishery as described above, indicate that dolphinfish, blackfin tuna, yellowfin tuna, and king mackerel represent the most landed species in that fishery between 2001 and 2016. The landings of the rest of the large pelagic fish species including sailfish, blue marlin, albacore, skipjack, tunas, wahoo and cero mackerel have maintained a relative stable trend through 2014. However, since 2014, landings of dolphinfish, yellowfin tuna, king mackerel, sailfish, and blue marlin have shown noticeable increases. Average landings in recent years (2014-2016) indicate that the group representing all tunas account for almost half (49.4%) of the landings for that period, followed by the group that represents landing of kingfishes; while the billfish group and dolphinfish represent equal proportions of the average landings in 2014-2016.

FAD Fishery

Fishery Details

Overall, the pelagic fishers are much like the Grenada FAD fishers; they will troll small plastic squid skirts for dolphinfish and bait around the FADs and will fish drop lines for billfish and tuna around the FADs. Figure 8 shows the panga style fishing boat which are used for FAD fishing. The boats can be made of wood, fiberglass over wood or all fiberglass. They have a high bow, narrow waterline beam and a flair at the waterline for increase floatation. The boats use various sizes of outboards based on the length of the boat. A general rule of thumb is 15hp for a 5 meter panga, 30hp for a 6-7 meter panga and 40hp or greater for a 7 meter or greater panga.

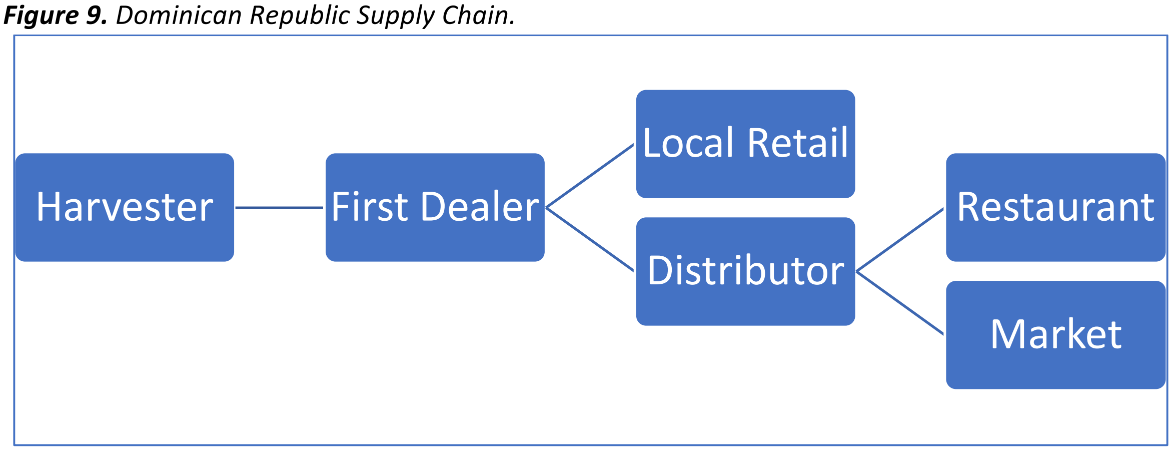
Figure 8. *Panga or Bote style fishing boat.*

Each vessel carries two fishers and each mans two trolling lines. Live bait is caught by trolling small plastic squids or by fishing cut bait. Live baits are used to bait drop lines used around FADs to catch larger pelagics. Droplines consist of a heavy main line with a single hook attached to a plastic jug or float. The hook is set 40 – 50 fathoms deep and is fished weighted or unweighted depending on species targeted. In some locations there have been agreements to fish only a certain number of drop lines, however, those agreements are generally violated. Drop line limit agreements are primarily in place for the sailfish pulse fishery in the area around Barahona. Most FAD fishers elsewhere deploy a small number of drop lines at any one time, generally one or two, around the FAD. In the sailfish pulse fishery, boats will set 20 plus droplines along the coast not associated with FADs. The large amount of floating gear creates severe gear conflicts and also results in lost gear that continues to fish (ghost fishing) which induces mortality for fish that are not landed. Other FAD fishers report seeing dead sailfish with these dropline buoys still attached.

Presently fishers in the FAD fishery prefer pangas of 5-8 m with an outboard engine of 30-40 HP. The cost of the new vessel is around $2300 - $2700 US. FAD construction costs range from $100-$150 US. The most expensive input in FAD construction is the cable/rope that connects the anchor with the buoy, sometimes as much 50% of the total cost. The buoys (bolsa) are usually constructed of recycled plastic jugs or recycled styrofoam insulation tied together or encased in scrap seine net. Most of the cost in the buoy is in the labor. The anchor (or "the doll" or muñeca) is made of concrete poured into large cans with steel reinforcement bar. The anchor requires the purchase of both concrete and steel reinforcing bar along with labor costs. Each boat owner will set and manage between five and 10 FADs. FADs do not last for very long and investment in new FADs is continuous. Some report loosing as many as two thirds of their FADs annually.

Figure 9 displays the very simple supply chain for pelagic species in the DR. DR imports the majority of its seafood and all pelagic production stays in the DR for domestic consumption, except for a small amount of dolphinfish. Many of the first buyers/ dealer are vertically integrated from the boat all the way to the restaurants in Santo Domingo and Punta Cana. At the local level, the first buyer/dealer is also the local retailer. There does seem to be a little independent distribution by small trucks with domestic chest freezers or larger refrigerated trucks that are also hauling other agricultural products. They will buy the fish at the dealer's markup/margin and then distribute those fish to restaurants and sometimes markets to be sold for their markup.

Figure 9. *Dominican Republic Supply Chain.*



Recreational

Fishery Details

The recreational fishery in the DR is substantially larger than Grenada. There are far more private and charter boats involved in the billfish fishery. Most of the billfish effort is clustered on the south side of the DR in the same areas as the FAD fishing. The DR has built a reputation for very high catch rates for small to medium sized blue marlins and the record for the most blue marlin catches in a single day was broken in late 2016. The DR also has excellent white marlin and sailfish fishing. It is possible to catch a billfish slam, sailfish, blue marlin and white marlin, all on the same trip, and although rare, possible to catch a super slam; sailfish, blue marlin, white marlin and spearfish.

The fishery is very seasonal with the different species moving from west to east through the year in different waves. There are essentially four marinas that target billfish from the southern coast. All marinas are 100% billfish catch and release marinas, although the private boats and charters will keep dolphinfish, yellowfin tuna and wahoo for the table and sometimes for sale. From west to east, these marinas are Club Nautico in Santo Domingo, Casa de Campo in La Romana, Cap Cana in Punta Cana and Club Nautico in Cabeza del Toro. The private boat fleet is mostly located at Club Nautico in Santo Domingo. The Club Nautico marina has 100 slips and about 50 private sportfishing boats. It is against their rules to run a for-hire business out of their marina. 20-25 of those boats will follow the fish moving east, first stopping in Casa de Campo, then Cap Cana and finally Club Nautico in Cabeza del Toro. There is one other area with sportfishing boats that may target billfish and that area is Puerto Bahia with approximately 20 boats. The FPI team did not visit this marina, but from all conversations, their operations were very similar to the marinas visited.

Casa de Campo generally has a fishing season that runs from January to May with January being a "pre-season" month with very few boats. The season peaks in March and April with as many as 35 boats participating in the fishery from that marina. Generally, large American and other foreign country boats arrive in March at Casa de Campo. The foreign boats are generally run by a full-time captain and mate and the owner occasionally flies in to fish from his boat. The rest of the time, the captain will charter the vessel. Beginning at the end of April, the local boats that are transient and the foreign boats will begin to move to Cap Cana just outside of Punta Cana. Cap Cana is the largest marina with room for 152 sportfishing boats. It stays at about 80-90% occupancy. Of the 130 or so boats at any one time, 18 are full time charters plus 15-20 boats that will charter seasonally. Most of those seasonal charters are US boats with three from Puerto Rico. The foreign boats generally stay until August. Cap Cana has extremely short runs to the fishing grounds and sometimes, if they are not running to the FADs, they can put lines in for sailfish less than a mile from the marina entrance. While Cap Cana marina promotes year-round fishing, sailfish season is January to April, white marlin peaks from April to August and blue marlin peaks August through October, but lately blue marlin fishing has been very good until January.

Summers used to be very slow for Cap Cana, but fishing continues to improve drawing more bookings. The blue marlin release record was broken December 11, 2016 with 23 blue marlins released in a single day, and since the marina has been flooded with charter bookings. Numbers for 2017 have surpassed 2016 numbers in May. Marlin magazine covered that record, also increasing demand.[2] Also, the 2016 Billfish Report ranked Cap Cana the #2 Billfishery of the Year for 2016.[3] Finally, Club Nautico Cabeza del Toro is not a full marina, but a series of protected moorings where 11 charter boats work and where there is space for Club Nautico members that move their boats to follow the billfish seasonally. A handful of the Club Nautico boats will finish the season here.

[2] http://www.marlinmag.com/atlantic-blue-marlin-release-record-broken-by-blue-bird-in-cap-cana-dominican-republic

[3] http://billfishreport.com/2017/billfish-report/2016-billfisheries-of-the-year-2-punta-cana/

Overall, all boats utilize a hired captain and a mate, including the private boats. The foreign boats that charter, target a high net worth clientele that is coming to the Dominican Republic specifically to fish. The large foreign boats will charge $3000+ per day and their clients will typically book multiple days. There is one large vessel that charges $5000/day. The expensive foreign charters will often rent a condo at the marina and will offer a condo for their clients as well for an additional fee. The "home port" charters are considerably less expensive. Their fees are around $1500 a day and sometimes will run split charters.[4] Their market is inexperienced big game fishermen who are in Punta Cana for a vacation that includes many activities. The local boats will sell catch if they have a big day for non-billfish species.

Both Cap Cana and Casa de Campo keep detailed catch and effort statistics for all boats in their marina. In 2016, 42 boats from Casa de Campo took 594 trips over 112 fishing days, raising 1025 billfish and releasing 645 billfish. In 2016, 131 boats fishing from Cap Cana took 889 trips releasing 2821 billfish. That is a very impressive average of over three billfish caught and released on every trip. While these estimates cover the two most popular marinas for billfishing, these estimates are lower bounds on the number of boats, effort and releases.

Modeling Methodology

The modeling methodology section describes the process used to produce a model of pelagic supply chain in a quantitative way. Below, the creation of the cash flow models of the supply chains for each sector in each pilot country is detailed. The models track production from the harvester to the consumer, or in the case of exports, when the product leaves the country. For the commercial sectors, commercial harvesters and for-hire recreational providers, cash flows are tracked using margins for each link in the chain forward of the harvester. For both the private recreational sectors, private boaters the more typical margining backward model as private recreational trips are final demand products.

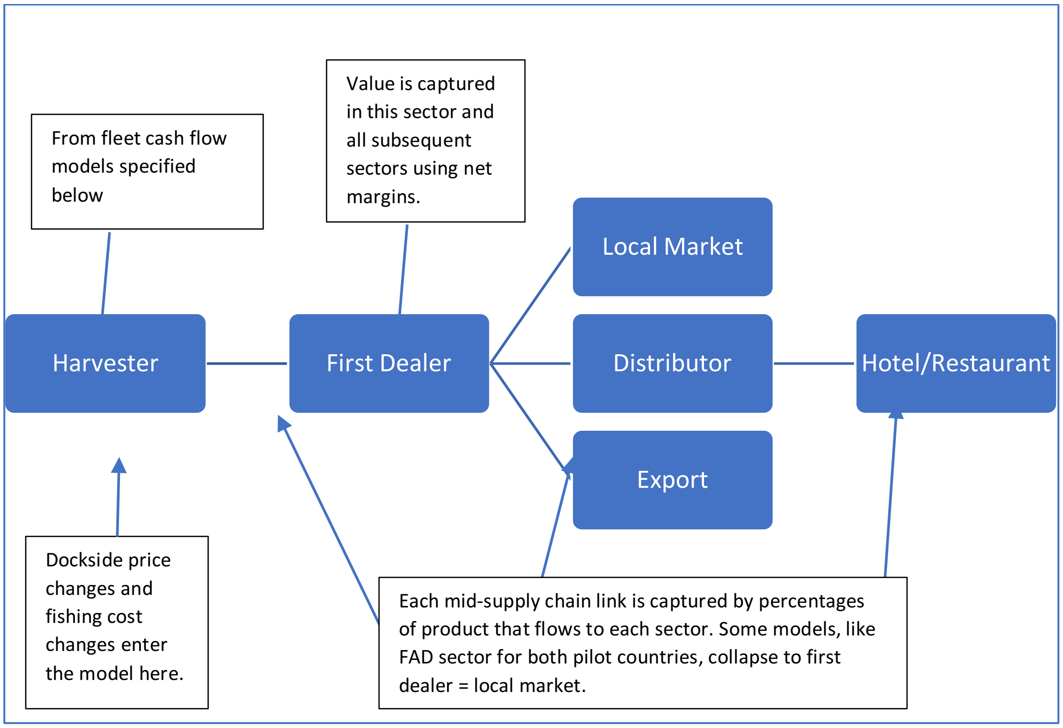
Commercial Cash Flow Models

Figure 10 shows a generic fishery supply chain explaining how the margining forward technique works. Each supply chain detailed above for each sector in each country can be collapsed from this model depending on the percentage distributions from one link to the next. Each link in the chain produces a cash flow generated by that sector, with the sum provided in the spreadsheet models across all sectors equal to the total domestic cash flow in that particular supply chain. Each model includes the cash flow in each link of the chain along with labor returns to the harvesting sector, with labor returns being calculated using the share system in place for each gear type in each fishery.

There may be multiple pathways to the consumer, some more direct than others. In these cases, it is important to map the flows using trade flow percentages. Some fisheries don't have transporters before the first buyer. Some go directly from the first buyer to retail. Some go directly from the first buyer to export. In building these types of models it is important to trace all these pathways. At each link in the chain, it is necessary to establish the profit derived in that link per unit of production.

[4] A split charter is a charter that is operated more like a headboat. That is, each person on the trip pays a set fee that is some portion of the charter fee and the patrons may not know each other.

Figure 10. *Generic Model Schematic.*



At the harvester level, this means building a monetary trip level profit function that takes revenues, subtracts costs and develops profit. Profits for the entire fleet are:

1) $TR_i = \sum_{j=1}^{n} p_j Q_j$
2) $TC_i = \sum_{k=1}^{n} C_k$
3) $\pi_i = TR_i - TC_i$
4) $\Pi_h = \sum_{i=1}^{m} \pi_i$
5) $TR_h = \sum_{i=1}^{m} TR_i$

Where the subscript h represents the harvest sector, i indexes the trip, i = 1 to m for the analysis period, j indexes species over n species and k indexes cost categories over n cost categories. For the harvester link, TR_h is the sum the pounds of fish j times the price of fish j for all j fish caught on the trip. Similarly, for the harvester link, TC_h is the sum of all costs across the fleet such as consumable fishing gear (hooks, line, lights etc.), fuel, food, ice, bait and crew, captain and boat shares. If the equation is denominated in pounds, profit can be estimated by simply applying a new estimate of pounds harvested. If the particular policy intervention changes costs in a significant way, costs can be manipulated to estimate profit changes. If the policy intervention changes prices, the profit changes from that shift can be estimated too.

The modeling effort did not estimate seafood demand models to look at price changes for large changes in harvest levels nor did it estimate potential stock changes that could arise from any change in harvest levels. It also does not estimate how costs might change for changes in stock availability or any other exogenous or regulatory change. It is a static look at cash flows that assumes all other things in the economy stay static. The ceteris paribus assumption works well for marginal changes in harvests.

However, as changes become larger, it is likely that fishers will change their behavior to reduce costs or increase revenues in the face of regulatory changers. It is also likely that for large changes in the harvests or abundance, that prices would change.

The cash flow models also exclude annual costs, depreciation and taxes. That data is not available from the Dominican Republic enumerator data. Also, and described more fully below, annual cost data from the in-person survey of Grenadian captains was plagued by high item non-response. Finally, WM does not use annual costs, only trip costs, in its financial calculations for the business case.

While it is difficult to capture cost and earnings data from commercial fishermen, it is even harder for the other links in the supply chain. The US has had very low response rates to cost and earnings surveys in their commercial fisheries and generally only has good data from programs that require the reporting of cost and earnings data. At least on the commercial side, compared to other links in the supply chain, a universe of participants is generally available through a fishing license or a vessel registry. Additionally, the first buyer generally keeps total revenue records, if the ministry does not. If that first buyer also fronts fishing supplies and fuel to the fishers, that buyer will generally have all the cost and return information for each trip in their settlement sheets for each fisher and trip. Sometimes that can be the most efficient way to collect cost and earnings data.

Unfortunately, all the rest of the links in the supply chain are difficult to track down as they are rarely as well registered as the harvesters. If you can find them, they are also reluctant to share cost information. However, it is often very easy to ask them one simple question; How much did you mark up this pound of fish before you sold it to the next link in the chain? Mark up, also called margin, is the gross profit ratio per pound of product and is often expressed as a percentage. So for this project, profit for the first buyer/dealer will generally be proxied by gross margin and can be expressed as:

6) $\Pi_{dealer} \equiv M_{dealer}(TR_h)$

Or more generically, profits for all links in the supply chain past the harvester are expressed as:

7) $\pi_{i+1} \equiv \eta_{i+1}(M_{i+1}(TR_i))$

where η is the percentage of total product entering that link in the chain, i indexes the supply chain links and M_i is the margin of the ith link expressed in percentage terms. Profit for the entire supply chain is:

8) $\Pi_{total} = \pi_h + \sum_i^n \pi_i$

The series of equations above are sufficiently flexible to handle even a complex supply chain with branches and skips, if each potential pathway is summed to the final consumer. During the course of the FPI effort, the team was able to gather some basic data on the harvesters and the supply chain including the basic structure of the supply chains and the players (Gentner et al. 2018). In both pilot countries, the supply chains are very simple and straight forward, generally only including a first buyer and perhaps a wholesaler or importer but often the first buyer is the entire supply chain. In many cases the entire supply chain is vertically integrated. The boat owner is the first buyer, is the wholesaler and often the retailer. The FPI process was able to collect a lot more data than expected and the rest of the data collection is described in detail below.

Recreational Sector Models

Both recreational sectors are viewed as final demand sectors. As such, all costs incurred are just that, costs and not economic value or benefit. There is no need to estimate values backwards through their input supply chains. For the for-hire sector, equations 1-4 above completely describe the entire profit from this industry. On the private angler side, the equivalent measure to profit as commercial economic value is consumer willingness-to-pay (WTP). The recreational modeling effort will use the results of an external survey funded through FAO to estimate the WTP for access to the billfish resource and the WTP for increases in billfish catch that might result from any proposed intervention (Gentner and Whitehead 2018).

Effort and participation drive these models. It was unknown if effort or participation estimates could be generated for this effort from the WTP survey, but a rough method was developed for the WTP publication and that method was utilized for this effort (Gentner and Whitehead 2018) and described below. It produces wide confidence limits based on assumptions used so upper and low bound values are provided by the models.

The outputs of the recreational models include charter business cash flow, license revenue, for both private and government run license funds, angler expenditures and gross domestic product and employment in both the current base case and the change scenario. The scenario inputs are driven by private and charter effort increases or resident or non-resident participation increases. Any scenario that impacts either effort or participation can be modeled. Multipliers for employment and contribution to gross domestic product were calculated from the World Travel and Tourism Council's report on the impact of Caribbean tourism. [5]

For-Hire Recreational

The for-hire recreational sector is a final demand sector and recreational fishing trips are the driver of any changes in profit and value for the pilot countries from any intervention. To complete this model, cost and earnings data will be collected from the charter vessels on a per trip basis. Estimating current value and any changes in value will require estimates of fishing effort. Estimating fishing effort will be the most challenging aspect of this project. In addition to the profit derived by the business for recreational fishing, the consumers derive value as well. The estimation of that value is detailed in the following section on private angling trips.

Private Recreational

Private recreational trips are an odd form of consumer good. There is no market price, only expenditures required to take the trip. As a result, valuing access and catch cannot be done by simply observing market transactions. Instead, non-market valuation techniques must be used to value recreational trips. The non-market valuation techniques involve either observing behavior or presenting anglers with hypothetical trip scenarios in a survey. The later, called revealed preference techniques, would be impossible to apply in this case as there are no current data collection efforts for the recreational sector in either pilot country. To address these concerns more broadly for the Caribbean,

[5] https://www.wttc.org/-/media/files/reports/economic-impact-research/regions-2017/caribbean2017.pdf

FAO funded a separates survey of angler behavior in the region. The methods and results of that effort are detailed in Gentner and Whitehead (2018).

General Model Assumptions

General assumptions are detailed by model below. Basic economic theory assumptions about proper market function and business and consumer rationality are assumed to hold. That is firms and consumers are assumed to be price takers in a competitive and free market place. Overall, no models contain a dynamic component or behavioral feedback loop. They are assumed to project changes best around marginal changes in market conditions. All values are in 2018 US dollars.

Recreational Models

1. Grenadian model assumes that Caribbean wide expenditures are appropriate for Grenadian billfish anglers.
2. Grenadian and Dominican Republic charter cash flow models assume that the average cash flows for the boats reporting from the entire Caribbean are appropriate for the pilot countries as there was not enough charter response to the WTP online survey to stratify by country. Without any information on this sector in the Caribbean from any source, it is unknown if this is an accurate assumption. From GCG work in this region and with pelagic sportfishing charters globally, the operations in the Dominican Republic and Grenada are similar to pelagic charter operations elsewhere.
3. Assumes Dominican Republic non-resident participation rate is the same as the Grenadian non-resident participation rate.
4. Assumes resident participation rate in all marine fishing activities is same as the Caribbean wide rate produced by Cisneros-Montemayor and Sumaila 2010.
5. Assumes US percentage of all marine recreational fishermen that are fishing for large pelagics applies to the Caribbean and the two pilot countries in particular.
6. Assumes the average participants per boat trip is 4.8 anglers as taken from the US Large Pelagic Survey.
7. Assumes the US effort proportion directed at highly migratory species (HMS) versus all other species applies to the Caribbean.
8. Assumes the HMS effort proportions in the US can be applied in the Caribbean.
9. Assumes all effort increases by mode at the same proportion as current proportions.
10. Assumes that the Caribbean wide multipliers for the impact of tourism expenditures on GDP and employment can be used for Grenada and the Dominican Republic.

Commercial Models

1. All commercial vessels assume that the vessel is not owner operated. Cash flow represents return to the vessel owner. If the owner is also the captain, the cash flow would also include the captain's share. There are percentages of vessel ownership in the inputs page if a further break down of cash flows is necessary or desired.
2. Both models do not contain landed grades and use average dockside prices and therefore revenues for exports and domestic supply chain fish. For the Dominican Republic this has no impact. For Grenada, this masks the tuna grade issues. The model would still allow improved prices for better grades by raising the average tuna price.

3. Grenada model assumes that the trips per vessel per year estimates from the landings data are more accurate than the self-reported totals estimated from the survey.
4. Grenada model assumes that all YFT and BET landed make the grade for export. There are no grades reported in the landings data.
5. Grenada model assumes that the net export margins from the largest exporter fit all Grenadian exporters.
6. Grenadian model assumes that 2013 landings revenue data is suitable for use with 2017 expenses and that there has not been any significant structural change in the industry.
7. Dominican Republic model assumes that 2011 landings revenue and cost data is suitable for use and that there has not been any significant structural change in the industry.

Data Collection

Overall, it was difficult to conduct statistical samples of these fishery sectors in the pilot countries. There was no universal frame for any of these sectors. Both pilot countries have commercial fishing licenses, but neither of them separates out longline or FAD fishing boats directly. Neither license frame contains any contact information either. Similarly, for the recreational sector, there is no fishing license and no data collected on that sector at all. As a result, any surveying will rely on a sample of convenience. Specific sampling regimes will be discussed for each country and sector below.

While the fisheries in each country have their similarities, the cultures and communities are different. The data collection section will cover the recreational data collection, the more complicated data collection first, followed by the commercial data collections in each pilot country.

Recreational Sectors

Both Grenada and the Dominican Republic lack recreational fishing licenses and recreational data collection systems. As a result, there was no frame of saltwater recreational anglers available to use for statistical sampling purposes, nor was there a list of saltwater recreational participants in either pilot country available to establish total participation and therefore total fishing effort.

One way to address the lack of a universe of recreational anglers is to conduct a telephone or mail screening survey that reaches out to local residents to develop a sample frame and to establish a participation rate that can be used to develop resident participation estimates by island. For tourist anglers, in-person exit interviews at airports can be used to screen visitors, establish a participation rate and recruit participants for a more detailed follow-up survey. However, due to time and budget constraints on this project, none of these options were available.

Instead, this project used a sample of convenience to contact recreational billfish anglers through an online survey using Survey Monkey. The data elements needed for this effort were added to a larger survey of marlin anglers' willingness-to-pay (WTP) for increases in catch quality and WTP for conservation trusts. The WTP survey was funded through the International Game Fish Association (IGFA) and the full methodology and results are detailed by Gentner and Whitehead (2018).

IGFA was a collaborator on this study, volunteering the use of their email list and posts on their social media pages. Marlin Magazine offered to feature the survey in their November conservation column and post the survey online on the web site and social media sites. Additionally, the owner of a large Caribbean tournament series volunteered the use of their tournament registration lists from last year. Additionally, angling clubs in both pilot countries, Grenada and the Dominican Republic, provided their membership lists. Finally, two popular marinas in the Dominican Republic agreed to send the survey link around to boat owners that had rented boat slips.

All email lists were sent a link to the survey instrument and the source of the sample was tracked. All email lists were reminded to participate three times over about a 30-day period. Incentives were offered to encourage participation. The incentive was an entry to win one of 10 Yeti Ramblers engraved with the IGFA logo. The survey went live on October 4th and the drawing was held December 1st. All winners were notified immediately and their prizes shipped within the week. The survey instrument was available in English and Spanish. The Spanish translation was done by a native Spanish speaker, Dr. Freddy Arocha, who is a billfish stock expert in the Caribbean and very familiar with the idiomatic nature of Spanish relating to recreational fishing. Overall, 1,101 anglers visited the survey link with 56% completing the survey once they initiated the survey. Table 1 contains the visitation statistics by sample source.

The IGFA mailing went out to 61,000 emails. The email indicated the survey was for anglers that participated in Caribbean billfish fisheries. There was no good way to screen this worldwide list in advance, so the invitation was sent to everyone. The IGFA list generated the most visits to the survey at 859. Their completion rate was also the highest at 68%. Eleven IGFA members chose to take the Spanish version of the survey. The email lists, which contained regional tournament participants and fishing club members, contained 1,442 email addresses. 1,235 of those emails came from billfish tournament registration lists and 191 people responded to either the initial invitation or one of three follow-up emails. The tournament registration list sub-group had a 50.8% survey completion rate. The second group of emails came from the Grenadian Game Fishing Association who supplied 207 email addresses. Only 21 anglers responded to this invitation.

***Table 1**. Survey Initiation by Sample Source.*

Sample Source	Language	COUNT	PERCENT
IGFA	English	859	73.04%
IGFA	Spanish	11	0.94%
Email List	English	249	21.17%
Email List	Spanish	34	2.89%
Marlin Magazine	English	23	1.96%

The same web link was sent to a Dominican Republic sportfishing organization, Club Nautico, and the marina managers at Casa de Campo and Punta Cana. As displayed in Table 1, 34 of those respondents chose to respond to the Spanish version of the survey. Finally, while Marlin Magazine went above and beyond to help this survey effort, very little response came from the mention in the magazine, from subsequent posting of the column online or through cross posting on social media pages.[6] The poor response from the magazine was surprising to the research team, who collectively expected this avenue to yield more response. While it is understood that few respondents will take the time to type in the

[6] https://www.marlinmag.com/caribbean-billfish-project-conservation-plan

URL to a survey found on a post card or a magazine page, it was hoped that the web version of the article or the social media posts would have driven more traffic.

The survey screened for 12-month fishing activity in the Caribbean. The demographics of these two samples are presented in Table 2. Somewhat surprisingly, demographics of these two samples are very similar, although no tests for statistical difference were conducted. The average years of fishing experience is 35 for both samples. The average age is in the mid-50s. Eighty-seven percent of those who did not target billfish are white/Caucasian while 72% of the sample who had taken a Caribbean billfishing trip in the previous 12 months are white/Caucasian. The average household size is three and males represented 86%-88% of the samples. The average years schooling is between 15 and 16 for both samples. The average household income (in US$) is $161,000 for those who did not target billfish and $241,000 for those who did target billfish.

Table 3 contains the results of the ethnicity question expanded to include all ethnicity categories included in the survey. Again, it is a predominantly white/Caucasian sample. In both samples, the second most represented ethnicity represented was Hispanic at 5.0% and 12.0% for the anglers with no 12-month fishing experience and those with 12-month fishing experience, respectively.

For those who targeted billfish during the 12 months prior to the survey, the survey asked questions about their billfishing avidity (Table 4). Respondents took an average of nine billfishing trips and fished an average of 16 days on each of these trips. Thirteen of these days were typically spent on a private boat, while three days were on a charter boat. To label these respondents, most are what would be considered to be high income, highly experience anglers with fishing as highly central in their life that take multi-day fishing trips to the Caribbean and not the all-inclusive resort patron who takes a single day fishing trip as part of many recreational activities. The demographics in the survey results is an artifact of the sample sources used.

Table 2. *Sample Summary.*

Variable	0 days for billfish in past 12 months					1+ days for billfish in past 12 months				
	n	Mean	SD	Min	Max	n	Mean	StdDev	Min	Max
experience	222	34.55	17.08	1	71	230	34.80	16.00	2	70
age	217	55.19	13.46	20	80	227	53.29	13.76	18	83
white	228	0.87	0.34	0	1	239	0.72	0.45	0	1
house	218	2.61	1.27	1	8	229	2.74	1.30	1	7
male	228	0.86	0.34	0	1	239	0.88	0.33	0	1
school	219	15.38	2.17	10	18	227	15.63	2.18	10	18
Income ($1000)	180	$161.25	$135.89	0.05	$800	198	$241.19	$372.25	0.05	$3,000

Table 3. *Ethnicity Expanded.*

Race	0 days for billfish in past 12 months		1+ days for billfish in past 12 months	
	Frequency	Percent	Frequency	Percent
Multiple	3	1.36%	12	5.53%

Race	0 days for billfish in past 12 months		1+ days for billfish in past 12 months	
	Frequency	Percent	Frequency	Percent
American Indian or Alaskan Native	1	0.45%	1	0.46%
Asian/Pacific Islander	6	2.73%	3	1.38%
Black or African American	1	0.45%	3	1.38%
Hispanic	11	5.00%	26	11.98%
White/Caucasian	198	90.00%	172	79.26%

Table 4. *Billfishing Avidity.*

Variable	1+ days for billfish in past 12 months				
	n	Mean	StdDev	Min	Max
trips	239	8.67	14.27	1	100
days	239	16.44	19.66	1	100
private	239	13.18	17.70	0	99
charter	239	2.62	7.02	0	60

Private Recreational Anglers

Expenditure estimates were calculated as simple means as detailed in Gentner and Steinback (2008). If a respondent completed any expenditure category in the expenditure table, all missing responses were re-coded as zeros. The survey collected information on fishing mode of their last Caribbean fishing trip and the country of their last trip. The country of their last trip was compared to their country of residence to develop whether the respondent was a resident of the country where they took their last trip. Resident status and fishing mode were used to post stratify the expenditure means. Initial means were run on those strata and outliers were eliminated by strata and expenditure category. Outliers were removed by calculating the percent standard error (PSE) for each mean. Any mean with higher than a 20% PSE had the upper 5% of its distribution truncated at the 95% value (Gentner and Steinback 2008). Fishing days were collected in the survey and total trip expenditures were calculated and then divided by total fishing days to derive an estimate of expenditure per fishing day.

Tables 5 and 6 display expenditures for private boat angler and charter boat anglers, respectively, after outliers were removed. With outliers removed, the total spending by private boat anglers was $1,583 for residents and $7,055 for non-residents. Fishermen utilizing the charter mode spent $1,863 and $6,807 for residents and non-residents, respectively. It is interesting to note that residents and non-residents, whether they are fishing on private boats or charter boats, spend very nearly the same amount per trip in total and per fishing day. As is typical for angler surveys, the single biggest expenditure items for non-residents in either mode are charter fees, airfare and lodging. For residents, the single biggest expenditure items are fuel for private boat anglers and charter fees for the charter angler.

Table 5. Private Boat Expenditures by Resident Status with Outliers Removed.

Private Boat		Mean Expenditure	N	Standard Error	95% Lower Bound	95% Upper Bound
Expenditure Category	Resident Status					
Airfare	non-resident	$1,202.83	112	$276.73	$654.48	$1,751.18
	resident	$9.30	43	$6.50	($3.81)	$22.42
Bait and Tackle	non-resident	$537.03	112	$80.73	$377.06	$697.00
	resident	$246.42	43	$59.35	$126.64	$366.20
Car Rental	non-resident	$48.79	112	$12.02	$24.97	$72.62
	resident	$9.30	43	$6.50	($3.81)	$22.42
Charter Fees	non-resident	$0.00	112	$0.00	$0.00	$0.00
	resident	$0.00	43	$0.00	$0.00	$0.00
Food and Beverage	non-resident	$1,191.77	112	$238.76	$718.64	$1,664.89
	resident	$316.05	43	$63.75	$187.39	$444.71
Fuel (Vehicle and Boat)	non-resident	$2,540.58	112	$329.66	$1,887.33	$3,193.83
	resident	$792.00	43	$151.38	$486.51	$1,097.49
Lodging	non-resident	$960.54	112	$183.16	$597.59	$1,323.50
	resident	$77.33	43	$33.22	$10.28	$144.37
Miscellaneous Costs	non-resident	$455.09	112	$88.86	$279.00	$631.17
	resident	$106.05	43	$24.40	$56.81	$155.28
Other Recreational Activities	non-resident	$119.21	112	$25.96	$67.78	$170.65
	resident	$26.74	43	$11.57	$3.40	$50.09
Total Daily Expenditures	non-resident	$2,767.35	112	$570.66	$1,636.56	$3,898.14
	resident	$1,036.55	43	$206.40	$620.03	$1,453.07
Total Trip Expenditures	non-resident	$7,055.85	112	$930.17	$5,212.65	$8,899.05
	resident	$1,583.19	43	$247.46	$1,083.79	$2,082.58

Table 6. Charter Patron Expenditures by Resident Status with Outliers Removed.

Charter		Mean Expenditure	N	Standard Error	95% Lower Bound	95% Upper Bound
Expenditure Category	Resident Status					
Airfare	non-resident	$999.00	105	$103.94	$792.89	$1,205.11
	resident	$25.00	8	$25.00	($34.12)	$84.12
Bait and Tackle	non-resident	$140.33	105	$29.31	$82.21	$198.46
	resident	$271.25	8	$181.97	($159.04)	$701.54
Car Rental	non-resident	$68.48	105	$11.83	$45.03	$91.93
	resident	$46.88	8	$26.07	($14.76)	$108.51
Charter Fees	non-resident	$2,811.52	105	$268.68	$2,278.72	$3,344.32
	resident	$706.25	8	$113.56	$437.72	$974.78

Charter		Mean Expenditure	N	Standard Error	95% Lower Bound	95% Upper Bound
Food and Beverage	non-resident	$644.86	105	$71.36	$503.35	$786.37
	resident	$188.13	8	$40.84	$91.56	$284.69
Fuel (Vehicle and Boat)	non-resident	$230.00	105	$85.52	$60.41	$399.59
	resident	$175.00	8	$121.74	($112.88)	$462.88
Lodging	non-resident	$1,404.00	105	$149.96	$1,106.62	$1,701.38
	resident	$375.00	8	$154.69	$9.22	$740.78
Miscellaneous Costs	non-resident	$298.04	105	$50.80	$197.30	$398.78
	resident	$37.50	8	$24.55	($20.55)	$95.55
Other Recreational Activities	non-resident	$210.89	105	$31.56	$148.31	$273.47
	resident	$37.50	8	$24.55	($20.55)	$95.55
Total Daily Expenditures	non-resident	$2,970.79	105	$231.77	$2,511.19	$3,430.40
	resident	$819.94	8	$152.89	$458.40	$1,181.48
Total Trip Expenditures	non-resident	$6,807.11	105	$452.06	$5,910.66	$7,703.56
	resident	$1,862.50	8	$395.36	$927.62	$2,797.38

All attempts were made to stratify the expenditure estimates by Caribbean country. Most countries did not contain enough response to report estimates. Table 7 contains the expenditure estimates for the Dominican Republic. Even though GCG obtained a Grenada specific email list with over 200 email addresses, only four responses were filled with all missing values from this second pilot country, so its figures are not reported.

Referring to the DR estimates in Table 7, 19 non-resident charter mode anglers, 24 non-resident private boat anglers, one resident charter angler and 10 resident private boat anglers responded to the survey. Non-resident charter anglers spent the most on charter fees ($3,251) and non-resident private boat anglers spent the most on fuel ($3,683). Resident private boat anglers spent the most on fuel ($1,325) and resident charter anglers spent the most on lodging ($1,367). However, resident charter angler estimates should be taken with a grain of salt as they are based on a single observation that did not indicate any charter fee expenditures. Overall, DR charter boat expenditures are very similar to those presented in Tables 5 and 6 with the DR charter expenditure being slightly higher. For anglers on private boats, the DR resident expenditures are nearly identical but the non-resident expenditures are nearly $4,000 less.

Table 7. Trip Expenditure Estimates for the Dominican Republic.

Dominican Republic			Mean Expenditure	N	Standard Error	95% Lower Bound	95% Upper Bound
Expenditure Category	Resident Status	Fishing Mode					
Airfare	non-resident	Charter	$1,604.21	19	$403.77	$755.92	$2,452.50
		Private Boat	$1,354.00	24	$382.34	$563.06	$2,144.94
	resident	Charter	$0.00	1	.	.	.
		Private Boat	$20.00	10	$20.00	($25.24)	$65.24
Bait and Tackle	non-resident	Charter	$69.21	19	$33.67	($1.53)	$139.95
		Private Boat	$893.75	24	$231.38	$415.11	$1,372.39
	resident	Charter	$1,500.00	1	.	.	.
		Private Boat	$176.10	10	$72.36	$12.41	$339.79
Car Rental	non-resident	Charter	$55.26	19	$23.85	$5.16	$105.36
		Private Boat	$82.29	24	$34.82	$10.26	$154.33
	resident	Charter	$200.00	1	.	.	.
		Private Boat	$40.00	10	$26.67	($20.32)	$100.32
Charter Fees	non-resident	Charter	$3,251.05	19	$672.10	$1,839.02	$4,663.09
		Private Boat	$0.00	24	$0.00	$0.00	$0.00
	resident	Charter	$1,000.00	1	.	.	.
		Private Boat	$0.00	10	$0.00	$0.00	$0.00
Food and Beverage	non-resident	Charter	$652.63	19	$186.71	$260.37	$1,044.90
		Private Boat	$1,847.08	24	$825.15	$140.13	$3,554.03
	resident	Charter	$275.00	1	.	.	.
		Private Boat	$385.00	10	$141.63	$64.62	$705.38
Fuel (Vehicle and Boat)	non-resident	Charter	$42.11	19	$39.42	($40.70)	$124.91
		Private Boat	$3,683.33	24	$882.80	$1,857.12	$5,509.54
	resident	Charter	$0.00	1	.	.	.
		Private Boat	$1,325.00	10	$546.97	$87.66	$2,562.34
Lodging	non-resident	Charter	$1,367.11	19	$260.43	$819.97	$1,914.24

Dominican Republic			Mean Expenditure	N	Standard Error	95% Lower Bound	95% Upper Bound
Expenditure Category	**Resident Status**	**Fishing Mode**					
Airfare	**non-resident**	**Charter**	$1,604.21	19	$403.77	$755.92	$2,452.50
		Private Boat	$1,354.00	24	$382.34	$563.06	$2,144.94
	resident	**Charter**	$0.00	1	.	.	.
		Private Boat	$20.00	10	$20.00	($25.24)	$65.24
		Private Boat	$1,765.63	24	$519.84	$690.26	$2,840.99
	resident	**Charter**	$1,000.00	1	.	.	.
		Private Boat	$125.00	10	$100.35	($102.00)	$352.00
Miscellaneous Costs	**non-resident**	**Charter**	$61.84	19	$32.58	($6.60)	$130.28
		Private Boat	$677.08	24	$296.20	$64.34	$1,289.82
	resident	**Charter**	$0.00	1	.	.	.
		Private Boat	$215.00	10	$59.18	$81.12	$348.88
Other Recreational Activities	**non-resident**	**Charter**	$332.63	19	$96.00	$130.93	$534.33
		Private Boat	$106.25	24	$50.03	$2.76	$209.74
	resident	**Charter**	$0.00	1	.	.	.
		Private Boat	$65.00	10	$34.20	($12.36)	$142.36
Total Daily Expenditures	**non-resident**	**Charter**	$3,486.22	19	$608.33	$2,208.17	$4,764.28
		Private Boat	$5,311.99	24	$2,363.41	$422.90	$10,201.07
	resident	**Charter**	$567.86	1	.	.	.
		Private Boat	$2,018.30	10	$686.42	$465.50	$3,571.10
Total Trip Expenditures	**non-resident**	**Charter**	$7,436.05	19	$971.78	$5,394.41	$9,477.70
		Private Boat	$10,409.42	24	$2,675.59	$4,874.54	$15,944.29
	resident	**Charter**	$3,975.00	1	.	.	.
		Private Boat	$2,351.10	10	$643.56	$895.26	$3,806.94

Charter Cost and Earnings

While the focus of this survey was on anglers and not charter businesses, the research team realized early in the survey development that all of the sample sources would reach charter boat captains and charter boat owners. Instead of screening those individuals out of the survey, the research team developed a charter module. Early in the survey, participants were asked if they owned a boat, and, if yes, the survey asked if they ever chartered that boat. If their answer to that questions was yes, they were administered the charter module. Once that module was complete, their survey was complete.

Tables 8 and 9 display the basic sample characteristics of the charter captains in this sample. Looking at Table 9, it is clear that country level stratification will be impossible except for Barbados, the DR and Puerto Rico for both sample size reasons and confidentiality reasons. Take for instance, Grenada, where there are really only two full time charter captains and perhaps another two part time charter captains. It would not be ethical to present confidential business information that could be easily deduced presenting estimates from those two vessels.

Table 8. *Charter Characteristics (Means).*

Detail	N	Mean	Standard Error	95% Lower Bound	95% Upper Bound
Boat Length	52	37.70	1.86	33.97	41.43
Fuel Capacity	48	551.21	74.86	400.61	701.80
Total HP	49	984.14	125.01	732.79	1,235.50
Boat Value	46	$556,775	$165,498	$223,445	$890,105

Overall, charters in the Caribbean use "Sportfisher" type boats that average 37.7 feet long with full cabins (59.6%) and 551 gallons of fuel capacity, followed by center console boats at 34.6%. The majority of those boats are diesel-operated with 984 total horsepower on average. Average current, fair market value of the vessels used for chartering is just over a half-million US dollars. Only 43.1% of respondents keep their boat year-round in the Caribbean. When doing the FPI studies in the DR, GCG found that many of the charters are owned by boat owners that may or may not have a permanent residence in the Caribbean but move their boats to follow the fish around the Caribbean (Gentner et al 2017).

For most, only a portion of their trips are charter trips. 46% report taking only 25% or less of their trips for-hire and, on the other side of that coin, only 6% report taking all of their trips as for-hire trips. The part time nature of some of the charter captains is borne out by the question about the type of for-hire business they are, with 21.9% saying they are full time charters, 31.3% self-identifying as part-time charters, 15.6% identifying as cost recovery charters and 31.3% indicating "other" as their type. Remaining respondents seemed to have misunderstood the question, indicating they were a "fun" charter or some variation of a cost recovery charter.

Finally, 39.4% responded that they sell fish and, of those, the majority does not sell fish every trip with 60.7% saying they don't sell fish on 75-99% of their trips. The fish sales question was asked of all respondents and it was found that 8.3% of the private anglers sold fish.

Table 9. Charter Characteristics (Frequencies)

Detail	Response	Frequency Count	Percent Frequency
Charter Country	Bahamas	1	4.76%
	Barbados	4	19.05%
	Dominican Republic	4	19.05%
	Grenada	2	9.52%
	Mexico (Caribbean coast)	2	9.52%
	Puerto Rico	4	19.05%
	Trinidad and Tobago	3	14.29%
	Venezuela	1	4.76%
Boat Type	Center console	18	34.62%
	Cuddy cabin	3	5.77%
	Sportfisher	31	59.62%
Fuel Type	Diesel	30	60.00%
	Gasoline	20	40.00%
Keep a Boat in the Caribbean?	No	29	56.86%
	Yes	22	43.14%
Percent For-Hire Trips	0% (none)	8	16.00%
	100% (all of them)	3	6.00%
	Between 1% and 25%	23	46.00%
	Between 25% and 50%	11	22.00%
	Between 75% and 99%	5	10.00%
Type of Charter	Cost recovery	5	15.63%
	Full-time charter	7	21.88%
	Other (please specify)	10	31.25%
	Part-time charter	10	31.25%
Do You Ever Sell Fish	No	20	60.61%
	Yes	13	39.39%
Percent Trips with No Fish Sales	0% (none)	1	3.57%
	Between 1% and 25%	7	25.00%
	Between 25% and 50%	3	10.71%
	Between 75% and 99%	17	60.71%

Table 10 contains the results for the charter cost and earnings questions, aggregated across all countries. Means were calculated as above with the outliers removed using the same previously described outlier rule. Total revenue appears to be quite low at $21,796 per year. Fortunately, the survey asked half and full day prices and the total number of half and full day trips. On average, using this total revenue figure, these businesses lose money as total annual costs are higher than revenues. That is to be expected if the majority of these boats are part-time charters or cost recovery charters. The highest annual cost was annual repair and maintenance at $12,459. The second highest was annual boat insurance at $3,123 per year. While only 39% responded they sold fish, average annual fish sales were $2,623. In total, their average half day trip costs are $492/trip and full day trip costs are $761/trip. With half day prices averaging $578 and half day tips averaging $81, margins are therefore very tight for the half day trips. On the other hand, with full day prices averaging $1,344/trip and tips averaging $181, margins are much better on full day trips. On average, each vessel is taking 22 half day trips and 19 full day trips, which is indicative of a part-time charter. It is not unusual, for a charter captain in a warm weather location, to average over 200 trips a year.

Table 10. *Aggregate Charter Costs and Earnings.*

Estimate Type	Expenditure Category	Mean Expenditure	N	Standard Error	95% Lower Bound	95% Upper Bound
Annual Estimates	Annual Boat Insurance	$3,123.29	28	$624.02	$1,842.91	$4,403.66
	Annual Gear and Tackle	$2,657.21	28	$591.89	$1,442.75	$3,871.67
	Annual Interest	$0.16	25	$0.11	($0.07)	$0.39
	Annual Licensing	$403.46	28	$92.16	$214.37	$592.55
	Annual Mooring Fees	$4,225.07	28	$1,083.86	$2,001.17	$6,448.97
	Annual Other	$2,653.78	27	$772.64	$1,065.59	$4,241.96
	Annual Repair and Maintenance	$12,459.00	28	$2,877.53	$6,554.80	$18,363.20
	Fish Sale Revenue	$2,622.71	24	$585.84	$1,410.80	$3,834.62
	Total Annual Cost	$25,427.18	28	$4,870.19	$15,434.37	$35,419.98
	Total Revenue	$21,796.19	36	$4,542.62	$12,574.19	$31,018.20
Full Day Trip Estimates (Per Trip Except for Total Full Day Trips)	Full Day Bait Cost	$54.78	27	$10.20	$33.82	$75.74
	Full Day Boat Share	$143.67	27	$40.09	$61.26	$226.07
	Full Day Captain Share	$95.70	27	$26.28	$41.69	$149.72
	Full Day Food and Beverages	$66.07	27	$12.40	$40.58	$91.57
	Full Day Fuel	$270.93	27	$52.71	$162.59	$379.26
	Full Day Gear Used on Trip	$35.30	27	$6.91	$21.10	$49.50
	Full Day Ice	$15.37	27	$2.77	$9.67	$21.07
	Full Day Mate Share	$50.70	27	$12.71	$24.59	$76.82
	Full Day Oil and Lube	$28.70	27	$6.24	$15.88	$41.53
	Full Day Price	$1,343.84	38	$160.62	$1,018.39	$1,669.30
	Full Day Tips	$180.60	35	$30.45	$118.72	$242.48
	Total Full Day Cost per Trip	$761.22	27	$113.57	$527.77	$994.67

Estimate Type	Expenditure Category	Mean Expenditure	N	Standard Error	95% Lower Bound	95% Upper Bound
	Total Full Day Trips	19.28	47	3.46	12.31	26.24
Half Day Trip Estimates (Per Trip Except for Total Full Day Trips)	Half Day Bait	$39.97	29	$7.13	$25.37	$54.56
	Half Day Boat Share	$68.44	27	$18.06	$31.33	$105.56
	Half Day Captain Share	$70.85	27	$18.08	$33.70	$108.01
	Half Day Food and Beverages	$52.86	29	$9.31	$33.79	$71.93
	Half Day Fuel	$171.47	30	$31.10	$107.85	$235.08
	Half Day Gear Used on Trip	$31.61	28	$5.59	$20.14	$43.07
	Half Day Ice	$12.28	29	$1.75	$8.69	$15.87
	Half Day Mate Share	$51.41	27	$11.57	$27.62	$75.19
	Half Day Oil and Lube	$18.79	28	$3.28	$12.05	$25.52
	Half Day Price	$577.94	31	$91.92	$390.21	$765.66
	Half Day Tips	$81.53	30	$15.98	$48.86	$114.21
	Total Half Day Cost per Trip	$491.73	30	$68.79	$351.04	$632.42
	Total Half Day Trips	21.74	27	6.38	8.63	34.85

Table 11 takes the data above, removes the missing data, takes out the part time and cost recovery operators and calculates annual mean cash flow. Overall, after taxes and depreciation, charter boats earn about $17,400, before depreciation and taxes. The means are across vessels self-selecting as full-time charters.

Table 11. *Annual Cash Flow Summary Means.*

Annual Estimate	N	Mean
Gross Revenue	17	$57,919
Variable Costs	17	$12,751
Fixed Costs	17	$30,400
Cash Flow	17	$17,400
Depreciation	17	$21,426
Tax	17	-$1,664

Effort Estimates

Again, there are no data collection efforts in either pilot country directed at recreational anglers. As a result, we have no complete participation, effort or catch estimates from either country. However, we do have some estimates in both countries.

Grenada

The Grenada Ministry of Tourism released some statistics from their airport intercept survey. One question on that survey asked what activities the visitor participated in while they were in Grenada. Table 12 contains the summary of the fishing response to that question. From their data, it shows that 4.9% of visitors indicated they had gone fishing on their trip. With 146,899 visitors in 2017, that means there were 7225 trips taken by visitors. Dividing that number by 4.8 persons per boat trip yields 1,500 vessel trips by tourists. That number would not include resident fishing trips and assumes all visitors indicating they had fished on their visit fished for just one day. The estimates seem slightly high as there are between two and four active charter boats in Grenada. Only one is full time charter running approximately 200 trips a year. If all four were full time charters running 200 trips a year, the total charter effort would be 800 trips. If each vessel had a full family of four on the vessel, that is still only 3840 person trips. It is also hard to believe that Grenada would have nearly the same number of boat trips as the two very busy marinas reporting from the DR. It is possible that tourists are responding yes to the exit survey question when they do any sort of fishing while participating in sailing or other boat related recreation.

Table 12. *Grenada Airport Survey Results.*

Response	Frequency	Percent
Yes	27	4.92%
No	516	93.99%
Not Stated	6	1.09%
Total Interviews	549	100.00%
Total Visitors in 2017		146,899
Total Tourist Fishing Trips		7,225

On the resident side, it was determined through the FPI visits and subsequent visits that there were 15 vessels that were rigged for offshore fishing that participated actively. The estimate of 15 boats was used to estimate the lower bound estimate on total resident effort. The upper bound on resident effort was generated by multiplying the Grenadian population times the percentage of the population that participates in recreational fishing from Cisneros-Montemayor and Sumaila (2010) of 22.79%. That number was further reduced by the percentage of US anglers that participate in large pelagic fishing, 0.33%, from the Large Pelagic Survey.[7] Using these two methodologies, total pelagic fishing effort in Grenada was estimated between 1954 and 3641 trips in 2017.

[7] MRIP Online Queries: https://www.st.nmfs.noaa.gov/st1/recreational/queries/index.html

Dominican Republic

From the FPI report, we know that most effort is confined to a small number of marinas. Two of those marinas log every trip taken by every boat and keep catch and release statistics on billfish. Both Marina Cap Cana and Casa de Campo Marina keep detailed catch and effort statistics for all boats in their marina. In 2016, 42 boats from Casa de Campo took 594 trips over 112 fishing days, raising 1025 billfish and releasing 645 billfish. In 2016, 131 boats fishing from Cap Cana took 889 trips releasing 2821 billfish. That is a very impressive average of over three billfish caught and released on every trip. While these estimates cover the two most popular marinas for billfishing, these estimates are lower bounds on the for-hire number of boats, effort and releases.

For the private recreational sector, Club Nautico representatives estimate the number of private recreational boats that target pelagics at 200. Using average annual avidity estimates from the survey for resident private boate avidity rates, lower bound total private boat effort was estimated. Combined with the total number of charter trips taken from the marina, the lower bound effort estimate was estimated at 7143 boat trips. In conversations with Club Nautico, they estimated a few years ago that there were 9000 total boat trips taken for billfish fishing. That estimate was assumed to be the upper bound on effort. It is possible that there are far more recreational fishing trips being taken in the region. There were over 6.1 million visitors to the Dominican Republic in 2017. [8] Even if all 9000 trips estimated above were charter trips by tourists, that represents a tourist participation rate of 0.14%, which seems low for a destination known for its high quality billfish fishing and certainly when compared to the tourist fishing participation rate of 4.9% found for Grenada above.

Commercial Data Collection

Grenada

Local fisheries governance is entrusted to a fisheries division, the FMU, as the lead agency responsible for management and development of fisheries. The functions entrusted to the FMU include extension, fishing technology, data management, marine protected area management, resource assessment and fisheries management. The head of the FMU is the Chief Fishery Officer, whom is appointed by the Minister under advisement of the FAC. Fisheries Officers are based at each of the seven District Fishery Centers around the islands and are responsible of monitoring and controlling the aspects stipulated in the current regulations. Monitoring is currently conducted on site by Fishery Officers at local fish markets and processing plants. Generally, they don't gather data from the fishermen, but instead gather it from the first dealer. After a long waiting period, the team was able to obtain disaggregated landings data, which does contain species volume, price and value. It took our second visit to the country to present the FPI results and business case concepts before the landings data would be shared. However, the agency does not collect cost data on any trips so a separate data collection effort was launched to collect cost and earnings data.

There are 2,028 licensed vessels from the boat registry list provided by the FMU. All fisheries are completely open access and every fisherman needs a license, the boat needs a registration and the first dealer needs a license. The first dealer is required to report all landings, volume and value, by species.

[8] https://globenewswire.com/news-release/2017/05/05/979728/0/en/Dominican-Republic-Announces-2017-Developments-and-Boasts-Strong-Tourism-Statistics.html

Unfortunately, there is no clear delineation in the registration list regarding gear types or fisheries in which the boat lands fish. Additionally, the registration list does not use the same nomenclature (Type I – III) that the Fisheries Ministry has adopted. There are 336 open pirogues in the list (Type I), 278 pirogue (Type II) and 81 "LLNF" (Type III). If those naïve classifications are correct that means that there are 695 vessels that are capable of deploying LL gear. However, in talking to the main export buyer who appears to handle 80-90% of all export tuna, he says there are 60-80 Type II and mostly Type III boats in the fishery. If you include the Type I vessels, that may add another 40 vessels. While all these boats have sold fish to him in the past, he regularly works with the same 60 vessels. For a 10% sample of all three vessel types using the naïve classification from the fisheries registration list, target sampling rates for the cost and earnings data collection was 33 Type I boats, 28 Type II boats and eight Type III.

In Grenville, the major focus of the FAD fishery, there are 60-100 boats registered but only 40-45 active vessels. There are only a handful of FAD fishers in Carriacou and really only two in Petit Martinique. It will be important to collect data in each location, but most of the sampling will be carried out in Grenville. Following the 10% sampling rule above, GCG attempted to conduct as many as six interviews in Grenville, two or three in Carriacou and at least one in Petit Martinique.

It was decided that the overall data collection be conducted by the Fisheries Officers as the FMU deemed the financial information sensitive and only fisheries officers should be privy to it. There was considerable suspicion and concern about how this data will be used and what the conclusions will be, mainly from the FMU and not the fishers. Some of the caution was being driven by their recent joining of ICCAT and the political uncertainty in the country surrounding a local election and the potential for a change in leadership within the FMU.

The final data sheets were delivered to GCG during the March 2018 CBMC meeting. The forms were reviewed and the data entered during the meeting so any questions could be addressed. Monetary survey responses were converted to USD using an exchange rate of 0.37 USD to ECD. [9] Cash flow estimated in the tables below is net of captain and crew share. Basically, cash flow is the cash flow for the boat owner. If the captain is the vessel owner, cash flows would be higher by the amount of the captain's share.

LL Fishery

Looking at Table 13, seven Type I and II boats were sampled and 22 Type III boats were sampled. There was no delineation during the survey between Type I and II vessels. Most of the Type I and II boats were from the port of Gouyave (57%). All of them used outboard motors and self-classified as full-time fishermen. Most, 50%, were between 35 and 44 years old and 60% obtained less than a 9th grade education. Finally, 80% earned less than $10,000 ECD per year. For the Type III vessels, 46% were from St. Georges. All of their vessels were inboard diesels and 91% considered themselves full time fishermen. 52% were in the same 35-44 year old age group as the Type I boats. They were more educated with 59% finishing high school, however there was a high degree of item non-response to this question. There was even more item non-response to the income question with only 13 captains giving their income. It also appears that there were some protest responses given as 46% responding said their income was less than $5,000 ECD (or $1,850 USD). In speaking with the interviewers, income and trip revenue were not answered by the majority of the LL vessel captains.

[9] http://www.xe.com/currencyconverter/convert/?Amount=1&From=XCD&To=USD

Table 13. *Frequencies for Categorical Variables in the Survey of LL Vessels.*

Vessel Type	Table	Variable	Frequency	Percent
I	Port	Gouyave	4	57.14%
		Grenville	1	14.29%
		Victoria	2	28.57%
	Engine Type	outboard	7	100.00%
	Fisherman Type	full-time	6	100.00%
	Age	25-34	2	33.33%
		35-44	3	50.00%
		45-54	1	16.67%
	Education	Less than 9th grade	3	60.00%
		High school graduate	1	20.00%
		Some college	1	20.00%
	Income	$10,0001-$25,000	1	20.00%
		$5,001-$10,000	2	40.00%
		Less than $5,000	2	40.00%
III	Port	Carenage	6	27.27%
		Gouyave	1	4.55%
		Grand Mal	5	22.73%
		St. Georges	10	45.45%
	Engine Type	inboard	22	100.00%
	Fisherman Type	full-time	19	90.48%
		part-time	2	9.52%
	Age	25-34	6	28.57%
		35-44	11	52.38%
		45-54	2	9.52%
		55-64	1	4.76%
		less than 25	1	4.76%
	Education	Less than 9th grade	1	5.88%
		Some high school	4	23.53%
		High school graduate	10	58.82%
		Some college	1	5.88%
		Bachelor's degree	1	5.88%
	Income	$10,0001-$25,000	3	23.08%
		$5,001-$10,000	4	30.77%
		Less than $5,000	6	46.15%

Table 14 contains more descriptive statistics of the two vessel types. CI was very interested in how much of these vessels catch was going to home consumption and not entering the market for food security reasons. For the Type I vessels, 9.2% was being consumed and 10.5% was being shared with friends or 19.7% was being used for local food security. For the Type III vessels, 6.3% was consumed and 6.9% was given away or 13.2% was contributing to local food security.

Table 14. *LL Fleet Characteristics by Vessel Type.*

Vessel Type	Variable	N	Mean	Standard Error	Lower 95% Confidence Interval	Upper 95% Confidence Interval
I	Percent sold	6	79.17%	3.00%	71.44%	86.89%
	Percent consumed	6	9.17%	2.39%	3.03%	15.30%
	Percent given away	6	10.50%	2.43%	4.25%	16.75%
	Percent tuna	4	61.25%	18.75%	1.58%	120.92%
	Percent billfish	3	29.17%	15.57%	-37.82%	96.15%
	Percent other	3	12.50%	6.29%	-14.57%	39.57%
	Vessel owner?	7	71.43%	18.44%	26.30%	116.56%
	Market value of vessel	7	$11,972.14	$1,417.40	$8,503.88	$15,440.40
	Horsepower	7	48.57	4.04	38.68	58.46
	Fuel capacity	6	17	2.236068	11.252004	22.747996
	Vessel length	6	18.17	0.31	17.38	18.96
	Captain share	5	26.27%	0.79%	24.08%	28.46%
	Crew share	5	27.38%	1.64%	22.82%	31.94%
	Boat share	5	46.35%	2.32%	39.90%	52.80%
	Total annual trips	6	185.00	22.78	126.45	243.55
III	Percent sold	21	87.05%	1.97%	82.94%	91.16%
	Percent consumed	20	6.25%	1.07%	4.02%	8.48%
	Percent given away	20	6.85%	1.23%	4.27%	9.43%
	Percent tuna	21	68.10%	1.67%	64.61%	71.58%
	Percent billfish	21	21.31%	1.63%	17.90%	24.72%
	Percent other	21	12.74%	2.13%	8.30%	17.17%
	Vessel owner?	20	50.00%	11.47%	25.99%	74.01%
	Market value of vessel	22	$48,537.27	$3,378.38	$41,511.55	$55,563.00
	Horsepower	22	195.77	17.41	159.57	231.97
	Fuel capacity	21	340.47619	38.671241	259.8094	421.14298
	Vessel length	22	38.73	1.24	36.15	41.30
	Captain share	3	12.74%	8.50%	-23.85%	49.33%
	Crew share	3	43.24%	6.76%	14.17%	72.32%
	Boat share	3	44.01%	1.79%	36.31%	51.71%
	Total annual trips	21	34.29	1.50	31.15	37.42

71% for the Type I and II fleet own their own vessels while only 50% of the Type III captains own their own vessel. For the Type I fleet, their vessels are 18 feet long, powered by 49 horsepower motors that have 17 gallons of fuel capacity and are currently worth $11,972. They take 185 trips per year and the captain earns 26.5% of the net revenues while the crew earns 27% and the vessel earns 46%. The Type III vessels are 39 feet in length, powered by 196 horsepower that have 340 gallons of fuel capacity and are currently worth $48,537. They take 21 trips a year. Item non-response was a huge problem for the share system questions with only three captains responding to the question. There were many comments written in the margins calling this question too personal or discriminatory. The same captains had no issue telling the FPI time their share arrangements. Across these three captains, crew receive 43%, captain receives 13% and the boat receives 44%.

Due to the level of item non-response across trip revenue described above, trip ticket data was combined with the cost data to produce cash flows by vessel type. Caution is warranted with the small sample sizes used for the trip cost information. Trip revenue data represents a complete census of trip ticket data. Table 15 summarizes the costs and earnings of these two vessel types. For both types of vessels, fuel was the single highest cost category.

Table 15. *LL Trip Costs and Earnings by Vessel Type.*

Type III	Trip ticket	Self-Reported
Trip revenue	$7,507.67	$9,435.00
Trip cost		$1,653.73
Net revenue	$5,853.94	$8,213.08
Return to the vessel	$2,576.32	$669.05
Captain share	$745.79	
Crew share	$2,531.24	
Vessel market value		$48,537.27
annual costs		$8,716.95
Type I&II	**Trip ticket**	**Self-Reported**
Trip revenue	$2,403.80	$1,822.87
Trip cost		$552.90
net revenue	$1,850.90	$931.78
return to the vessel	$857.89	$252.99
Captain share	$486.23	
Crew share	$506.78	
vessel market value		$11,972.14
annual costs		$1,767.83

For the Type III boats, that is followed by ice expenditures and for the Type I boats by oil. Total trip costs for the Type I and II boats was $552.90 and for the Type III boats $1,654 per trip. Net revenue then for the Type I and II boats was $932 from the self-reported data only and $1,851 using the trip ticket revenue. For the Type III boats, net revenue using only the self-reported data was $8,213/trip, but that is based on only two observations. When using the trip ticket data, the net revenue figure was $5,854/trip. Trip cash flow, which for this work is the return to the vessel, is $858/trip for the Type I and II boats and $2,576 for the Type III boats, based on trip ticket revenue. To estimate the return to an owner operator, the captain's share would need to be summed with the return to the vessel. For example, an owner operator of a Type III vessel would bring home $3,322/trip. The modeling effort will use the trip ticket revenue cash flow projections as those are more robust. Annual cost estimates were not deemed reliable due to low response and all modeling will be based on trip cash flow only.

FAD Fishery

In Grenville, the major focus of the FAD fishery, there are 60-100 boats registered but only 40-45 active vessels. There are only a handful of FAD fishers in Carriacou and really only two in Petit Martinique. Most of the sampling was carried out in Grenville. Looking at Table 16, 23 FAD fishers, all from Grenville, were sampled. Overall, this fleet responded to this survey with less item non-response. 83% consider themselves full-time fishermen. They are predominantly 35-44 (45%) and have less than a 9th grade education (50%) and report making $50,001-$100,000 (55%).

Table 16. *Frequencies for Categorical Variables in the Survey of FAD Vessels.*

Variable	PORT	Frequency	Percent
Port	Grenville	23	100.00%
Engine Type	outboard	23	100.00%
Fisherman Type	full time	19	86.36%
	part time	3	13.64%
Age	25-34	8	36.36%
	35-44	10	45.45%
	45-54	2	9.09%
	less than 25	2	9.09%
Education	Less than 9th grade	11	50.00%
	Some high school	7	31.82%
	High school grad	3	13.64%
	Associates degree	1	4.55%
Income	$10,001-$25,000	4	18.18%
	$25,001 -$50,000	2	9.09%
	$50,001-$100,000	12	54.55%
	Over $100,000	2	9.09%
	Less than $5,000	2	9.09%

Table 17 summarizes the FAD fleet vessel characteristics. For this fleet, and of concern for CI regarding food security, 13.1% of harvest is kept for home consumption and 11.6% is given away, for 30% of their catch going to support local food security. Applying that figure to billfish catch, which is 15.6% of their catch, 4.7% of their billfish harvest is supporting local food security. Only 48% of these captains are vessel owners. They fish 19 foot boats with 57 horsepower and 30 gallon fuel capacity. The vessels are currently worth approximately $9,172. They fish 212 trips a year and split their shares in three equal portions.

Table 17. *FAD Fleet Characteristics.*

Variable	N	Mean	Standard Error	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Percent sold	15	70.20%	4.12%	61.37%	79.03%
Percent consumed	14	13.07%	3.54%	5.43%	20.71%
Percent given away	14	11.57%	2.03%	7.19%	15.96%
Percent tuna	18	47.78%	5.60%	35.95%	59.60%
Percent billfish	18	15.56%	3.26%	8.69%	22.43%
Percent kingfish	18	11.11%	2.27%	6.32%	15.90%
Percent dolphin	18	19.33%	3.84%	11.24%	27.43%
Percent other	19	7.11%	2.14%	2.61%	11.60%
Vessel owner?	23	47.83%	10.65%	25.74%	69.91%
Market value of vessel	20	$9,172.30	$765.36	$7,570.39	$10,774.21
Horsepower	23	57.17	1.80	53.44	60.91
Fuel capacity	22	30.27	2.61	24.85	35.69
Vessel length	23	18.91	0.16	18.59	19.24
Captain share	18	33.33%	0.00%	33.33%	33.33%
Crew share	18	33.33%	0.00%	33.33%	33.33%
Boat share	18	33.33%	0.00%	33.33%	33.33%
Total annual trips	18	212.39	16.60	177.36	247.42

Table 18 contains the summary of trip costs and earnings. Overall, this fleet makes $230/trip based on the self-reported data and $525 based on the trip ticket data. While there was much less item non-response to this question than the Type III boats, the trip ticket based calculation, using self-reported costs, will be used for the modeling to remain consistent. It is interesting to note that this fleet had much less of a problem responding to the trip revenue question than the LL vessels did. The single biggest trip expense for this fleet is also fuel with gear second. Total trip costs were $144 resulting in a net revenue of $76 using the self-reported data and $381 using the trip ticket data. The resulting cash flow for the boat is $22 using the self-reported data and $127 using the trip ticket data. If the boat is owned by the captain, the cash flow would be $254/trip using the trip ticket revenue.

Table 18. *FAD Trip Cost and Earnings.*

FAD	Trip ticket	Self-Reported
Trip revenue	$524.86	$230.30
Trip cost		$143.93
net revenue	$380.93	$75.69
return to the vessel	$126.96	$21.58
Captain share	$126.96	$21.58

FAD	Trip ticket	Self-Reported
Crew share	$126.96	$21.58
vessel market value		$9,172.30
annual costs		$2,633.17

Dominican Republic

CODOPESCA, collects fisheries landings through a series of enumerators at every landings location. The enumerators use paper notebooks to record landings data. Purportedly, the enumerators profile every fishing trip taken in the country. CODOPESCA makes no attempt to estimate their undercount and generally assumes they are obtaining a census of fishing trips. There are many strengths and weakness of the DR sampling program. The program is extensive and the data collected includes costs and earnings for every trip profiled. Unfortunately, they lack the human resources to data enter paper forms in a timely fashion and have a data backlog stretching back to 2011. The project opted to use the 2011 data because this project did not have the budget for the kind of sample that is freely available in this data set. All attempts are being made to nudge DR to increase their capacity to analyze this data.

Two of the largest drawbacks in the DR enumerator program are their use of arbitrary species groups in their data collection process, at least in 2011, and data collection consistency. While they collect volume, price and total value data, these arbitrary groupings make it impossible to separate out pelagic species. The inability to separate out species also factors into our difficulty defining what constitutes a FAD fishing trip. The DR has changed its data collection protocol to include individual species since 2011, but that data was not made available to the team due to data entry backlogs. The second large drawback is data collection consistency. There is high turnover in the enumerator staff and, often, the jobs are handed out as political favors and not necessarily to those with fishery experience. The high turnover shows in the way some of the data is recorded. For instance, they don't record vessel registration numbers for each trip but instead use the vessel name. Some boats aren't named so the number categorized "Sin Nombre" or recorded as by boat color make parsing out the total number of annual trips per vessel very difficult, as will be seen below. Additionally, there are obvious coding errors across some variables. For instance, shares are recorded in percentage form sometimes and in monetary term by other interviewers. As mentioned in the FPI report, CODOPESCA would be well served to develop a data collection protocol and training manual and require regular training across all enumerators.

Table 19 details some of the basic statistics for the 2011 enumerator data set. There were 33,436 trips profiled in 2011 countrywide. However, trips are not fully categorized as pelagic trips or FAD trips in the data set. The data set does include fishing location and fishing gear, however and various combinations of those variables were used to identify FAD trips. Regarding fishing site, if it was coded as FAD (bolsa), and indicator variable was created, pelagic site, and the value of that variable set to one. In this data set, 1,253, or 3.75%, of all trips were trips to fish a "bolsa". Most of the codes in the fishing location variable refer to specific locations like "Frente al Belance" which does not help determine if it was a FAD trip or not. Gear type in the data contains codes for trolling handline (LCU = linear cullican) and hook and line (LCO = linear cordell). If either of these types of gears were indicated, an indicator variable was created, pelagic gear, indicating the gear was consistent with FAD fishing. There is no gear code for fishing with jugs/drop lines.

Table 19. *DR FAD Fishing Trip Profiles, 2011.*

Sample Characteristic	Count	Percent
Total Trips in 2011	33,436	100.00%
Pelagic Site	1,253	3.75%
Pelagic Gear	866	2.59%
FAD	1,498	4.48%
FAD2	11,074	33.12%

From Table 19, 866 trips used pelagic gear. If both pelagic site and pelagic gear indicator variables equaled one, the indicator FAD was set equal to one and otherwise zero. 1,498 trips, or 4.48% of all trips, met this definition. The method used is the most conservative way to define FAD trips. In order to explore the sensitivity of this assumption, a more expansive definition of what constitutes a FAD trip was constructed. As mentioned above, there are many coding errors in the data. For the gear variable, there are many misspelling and miscoding of LCO and LCU that include terms like "cullican" and "cordell" as well as shortening of both abbreviations. FAD2 was coded as a one if there was any chance there was a misspelling of either gear type or its acronym.

Regarding volume, only recently did CODOPESCA switch from using subjective species groups to individual species for data collection. As a result, pelagic prices cannot be tracked directly or modeled directly. The inability to track species price should be fine for this project as revenue increases can still be modeled and we found during the FPIs that there was little price variation during the year or across species.

Table 20 contains the means and descriptive statistics for all of the trips profiled (33,436) in the 2011 data. The values in all the cost and earnings estimates here are in 2016 US dollars. The values were first inflated to 2016 Dominican Pesos (DOP) using the World Bank's CPI figures (only available through 2016).[10] Next, DOPs were converted to US dollars using exchange rates by month for 2016.[11] Across all types of trips for all types of species, gross revenue per trip averaged $317.31 and net revenue averaged $262.55. Crew share averaged $28.53, captain's share averaged $35.07 and the boat share averaged $21.78. The estimates are very consistent with low standard errors and tight confidence intervals. As a result, outliers did not have to be addressed because percent standard errors were all below 20%. The tight variances are why GCG chose to use the enumerator data. The sheer number of observations will greatly improve the cash flow models used for the business cases. Cash flow, as calculated as net revenue minus crew share, or the boat share plus the captain's share, was $41.40. The cash flow value seems lower than the table would suggest as there are 12,054 observations on net revenue that are missing share proportions. There were 356 (1.1%) trips with negative cash flow and another 1,868 trips with less than $5 of cash flow. There were 1,283 trips with negative net revenue, before even paying the crew.

[10] https://data.worldbank.org/indicator/FP.CPI.TOTL?locations=DO
[11] https://www.exchange-rates.org

Table 20. Means Across All DR Trips (2016 US Dollars).

Variable	N	Mean	StdErr	95% Lower Bound	95% Upper Bound
Fuel	24,719	$67.84	$5.17	$57.71	$77.98
Oil	13,789	$7.52	$0.92	$5.72	$9.32
Ice	8,087	$11.60	$0.89	$9.85	$13.34
Gross Revenue	32,887	$317.31	$43.96	$231.14	$403.48
Total Cost	26,450	$72.98	$5.42	$62.36	$83.61
Net Revenue	32,570	$262.55	$42.42	$179.40	$345.69
Boat Share	7,738	$21.78	$1.30	$19.23	$24.34
Captain's Share	26,988	$35.07	$0.93	$33.25	$36.88
Crew Share	21,383	$28.53	$0.54	$27.47	$29.59
Cash Flow	21,382	$41.40	$1.15	$39.14	$43.67

Table 21 displays the same means using the conservative definition of a FAD trip. Net revenues on these trips are lower ($93.68), but cash flow is higher ($63.38). The most striking thing is the small amount of ice used per trip. All shares are higher for these types of trips as well. 3.4% of these trips had negative cash flow (50 trips) which is three times higher than the sample overall. Another 51 trips (3.4%) had less than $5 of cash flow. 98 trips had negative net revenue. Standard errors are still small and confidence intervals are still tight. The cash flow estimates in Table 21 are the ones used for the modeling exercise described below.

Table 21. Means Across Conservative FAD Trip Definition (2016 US Dollars).

Variable	N	Mean	StdErr	95% Lower Bound	95% Upper Bound
Fuel	1,447	$57.34	$0.82	$55.74	$58.94
Oil	1,127	$4.27	$0.09	$4.09	$4.44
Ice	113	$1.19	$0.05	$1.09	$1.30
Gross Revenue	1,455	$147.56	$3.27	$141.15	$153.98
Total Cost	1,454	$60.52	$0.85	$58.85	$62.18
Net Revenue	1,389	$93.68	$3.05	$87.69	$99.67
Boat Share	673	$33.67	$1.54	$30.64	$36.70
Captain's Share	1,124	$42.74	$1.43	$39.93	$45.56
Crew Share	1,065	$41.11	$1.34	$38.48	$43.74
cash_flow	1,065	$63.58	$2.31	$59.05	$68.11

Table 22 contains the means across the expansive definition of a FAD trip. Cash flow estimates are lower as are net revenues. Shares are lower and ice usage is higher than the conservative FAD definition. The next question is which designation we use to build the cash flow models for the business cases. Both sub sets have very good statistical properties.

Table 22. *Means Across Expansive FAD Trip Definition (2016 US Dollars).*

Variable	N	Mean	StdErr	95% Lower Bound	95% Upper Bound
Fuel	8,079	$45.41	$0.64	$44.15	$46.67
Oil	5,015	$4.72	$0.20	$4.34	$5.11
Ice	2,946	$7.16	$1.16	$4.89	$9.44
Gross Revenue	10,852	$98.00	$3.00	$92.11	$103.89
Total Cost	8,463	$48.96	$1.05	$46.91	$51.01
Net Revenue	10,828	$59.33	$2.18	$55.06	$63.60
Boat Share	2,408	$21.14	$0.70	$19.77	$22.52
Captain's Share	9,300	$35.57	$1.68	$32.28	$38.86
Crew Share	7,059	$32.71	$0.56	$31.62	$33.80
cash_flow	7,059	$44.19	$0.78	$42.66	$45.73

Generally, the fish buyers finance the trip costs. They will loan the boats fishing line, hooks, squid skirts, fuel and food, payable upon settlement of the fish ticket. From the FPIs, CODOPESCA officers and fishermen related that it is not uncommon for the fishers to be in debt to the fish house. The buyer will often still pay the fishers some cash on a money losing trip so they can cover living expenses, but this puts the fishermen in further debt to the buyer. While that does appear to be happening, it is happening across a relatively small number of trips in this data set. Fuel costs are, by far, their single biggest trip costs. The enumerators do not collect annual costs, but from the FPIs we know that annual costs for this fleet are very low.

The other main drawback to estimating an annual cash flow figure is an estimate of the average number of trips per boat. The data on vessels in the enumerator data is very rough as described above. There is no unique identifier used in the data set and subjective boat names and/or colors are used to delineate boats. Even after consolidating duplicates vessel names and similar spellings by hand, the average number of trips per vessel per year is low. Across the FAD2 definition of trips, each vessel took 10 trips per year with a lower bound of 8.6 trips and an upper bound of 11. 5 trips per year. After many queries to CODOPESCA we were unable to improve upon this estimate.

Scenario Analysis

The scenario analysis section showcases the capability of the models designed to analyze policy scenarios. The scenario analysis section was included to provide support to the larger business case development by Wilderness Markets (WM). The models described here were provided to WM and underpin their investment models. The scenarios provided here were developed in consultation with FAO, CI and WM to provide context to the business cases and to backstop assumptions and examine paths not taken in the actual, brief business case documents.

Scenario 1 looks at the food security and revenue implications of reducing blue and white marlin harvests. The current levels of harvest being kept for family and friend consumption by the commercial sector is compared to the ICCAT quotas of blue marlin and white marlin and the financial implications of those harvest reductions are estimated. Scenario 2 examines sailfish harvest reductions. While the stock status for sailfish is not overfished and overfishing is not occurring, the assessment itself is highly uncertain. So, while ICCAT has not set a sailfish quota and is not currently advocating for sailfish harvest reductions, this scenario examines the impact of those reductions.

The second group of scenarios pertain to the recreational sectors in both pilot countries. Initially, although not a part of current business cases, the CBP suggested that there may be room for a Coasian bargain between the recreational sector that would benefit from commercial harvest reductions and the commercial sector. As a result, the potential funding for such a mechanism was explored and projected through a series of recreational fishing tourism growth scenarios. The final group of scenarios examines the possibility of converting commercial fishermen into charter captains.

Scenario 1: Impacts on Food Security and on Revenues of Blue and White Marlin Harvest Reductions in Grenada

Grenada is in the process of joining ICCAT. ICCAT stock assessments have shown both blue marlin and white marlin stocks to be overfished and has set country level quotas for both species to recover both stocks. It recommends all member nations use circle hooks and release all billfish to stay under these quotas. It has set quotas low in hopes that all harvest will be either bycatch or used to support local food security. In discussion with US ICCAT experts, Grenada will likely be assigned a 10mt quota for blue marlin and a 2mt quota for white marlin. The scenarios look at the impact of reducing harvests of billfish on local food security and revenues.

Current State – Summary of Current Billfish Landed Volume

Based on landings data collected by the Fisheries Ministry from the first dealer provided for the FPI, Table 22 displays the total harvest of all billfish species in Grenada for 2013, the last year of disaggregated landings data available from the Ministry. All weights are headed and gutted weights (Gentner et al. 2018).

Table 22. *Total Grenadian Harvests of Billfish Species.*

Species	Pounds	Metric Tons
Blue Marlin (blue marlin)	90,279	40.95
White Marlin (white marlin)	15,860	7.19
Sailfish	211,361	95.87

Below are tables on the retail prices of other protein sources in the supermarket in Grenada. Table 23 shows frozen imported chicken legs are nearly half the price of fresh local chicken which is 20 cents a pound less than the average of all fish from the 2013 landings data summarized above. As shown in the table, billfish is only 2 cents a pound higher priced than all other fish.

Table 23. *Prices for Substitute Proteins in Grenada.*

Product	Fresh/Frozen	Local/Import	Price USD
Chicken legs	Frozen	Import	$1.19
Whole chicken	Fresh	Local	$2.41
All fish	Fresh	Local	$2.61
Billfish	Fresh	Local	$2.63
Boneless skinless chicken breasts	Frozen	Import	$5.49
Tilapia	Frozen	Import	$6.85

Regarding fish prices the table below contains prices for other fresh fish in Grenada with prices cheaper than marlins. As stated in the FPI reports, generally all fish besides export fish receive on average the same price at the dock and generally have the same price in the market regardless of species. As the table shows, only shark, blackfin tuna and bonito are significantly less expensive than the average fish price.

Table 24. *Prices for Substitute Fish Species in Grenada.*

Species	Average Price USD
Shark	$1.42
Blackfin tuna	$1.76
Bonito	$1.87
Flying Fish	$2.46
Skip Jack Tuna	$2.48
Butter fish	$2.50
King Mackerel	$2.53
Albacore	$2.62
Cavalli (miscellaneous jacks)	$2.62

From the FAO Food Balance query tool, the total supply of seafood products consumed in Grenada in 2013 was 2,920 metric tons, including imports and net of exports.[12] Blue and white marlin landings represent only 1.6% of the total supply of seafood in Grenada.

Proposed Scenario

From the table above, it is clear both the blue marlin and white marlin quotas would be exceeded without reductions in harvests. However, Conservation International was concerned that reducing billfish harvest would impact food security. As a result, GCG added questions to the survey of fishing vessels regarding the amount of billfish being retained for personal consumption and for trade or gifting to friends or relatives.

The objective here is to anticipate the impact of possible ICCAT country level quotas for blue marlin and white marlin (i.e. harvest reductions) on income and on food security.

ICCAT Country Level Quota Scenario

Current uses of billfish caught in Grenada by species and fleet are as follows (Table 25).

Table 25. *Current Disposition of Billfish Species by Vessel Type.*

Fleet	Billfish Disposition	Percent	Blue Marlin Volume (mt)	White Marlin Volume (mt)	Sailfsh Volume (mt)
Type III	Sold	87.05%	29.9	5.8	46.4
	Consumed	6.25%	2.1	0.4	3.3
	Given Away	6.85%	2.4	0.5	3.7
Type I & II	Sold	79.17%	4.6	0.4	33.4
	Consumed	9.17%	0.5	0.0	3.9
	Given Away	10.50%	0.6	0.1	4.4
FAD	Sold	70.20%	0.6	0.0	0.2
	Consumed	13.07%	0.1	0.0	0.0
	Given Away	11.57%	0.1	0.0	0.0
Total	Sold		35.0	6.2	80.1
	Consumed		2.8	0.5	7.2
	Given Away		3.1	0.5	8.1

Based on the survey data and the 2013 landings data, reducing blue marlin and white marlin quotas to 10 and 2 mt respectively will have no impact on food security, assuming that the blue marlin and white

[12] http://www.fao.org/faostat/en/#data/FBS

marlin harvest quotas are allocated first for food security purposes (i.e. "consumed" or "given away" in table above). Currently, all vessels retain 5.9 mt of blue marlin for home consumption or to give away and only retain 1 mt of white marlin for home consumption or to give away. However, there will have to be reductions in blue marlin and white marlin harvests that are currently "sold".

To meet the possible ICCAT quotas, blue marlin harvest will have to be reduced from 41 mt to 10 mt or a reduction of 31 mt and white marlin harvests will have to be reduced from 7 mt to 2 mt. As a percentage of total billfish harvest, this amounts to a 25.1% reduction in billfish landings. The cash flow impacts of that level of reduction in billfish landings are presented in Table 26. The reduction in blue and white marlin harvest represents only a 1.4% reduction in total fish supply in the country.

Table 26. *Cash Flow Impacts of Meeting Potential ICCAT Quotas.*

Country	Fleet	Annual Cost	NPV Over 10 Years
Grenada	FAD	-$1,270	-$9,807
	Type I&II	-$167,117	-$1,290,433
	Type III	-$199,687	-$1,541,930
	Labor (Captains and Crew)	-$5,142	-$39,705
	Exporters	-$159,236	-$1,229,578
	Retail Markets	-$80,149	-$618,889
		Total	-$4,730,343

Based on the cash flow models and the existing prices for billfish, the net effect of this scenario is a loss. A 25% reduction in blue and white marlin harvests reduce cash flows in Grenada by $4.7 million over ten years. Most of those losses are borne out by Type III vessels, assuming that the blue marlin and white marlin harvest quotas are allocated first for food security purposes (i.e. "consumed" or "given away" in table above).

Prices cannot be projected because no demand models were estimated. As volumes drop, all other conditions equal, prices should rise, reducing these impacts. The level of billfish harvest reductions translates into a 1.4% reduction in total seafood supply in Grenada, which is a small portion of total fish supply. Additionally, from the FPIs and an examination of the landings data, there is very little market differentiation in price across all fish species. As a result of a small drop in volume in an essentially undifferentiated market, it is expected that prices for billfish will increase only slightly. Also, if harvesters could change targets or make up for the difference in the harvest of other species, the impact of reductions would be less. If more billfish are released, it will make more hold space for more valuable tunas. If they change their baits or fishing depth it might bring in more higher value tunas as well. Without detailed behavioral data, it is not possible to project those gains. Complementary scenario analyses (i.e. compensating lost income from billfish harvest reduction, with higher quality and better priced tuna, particularly yellowfin) are being modelled through a separate study led by Wilderness

Markets in collaboration with GCG, CI, and FAO. Finally, if harvesters could otherwise reduce costs or change production practices, the impact of reductions could be less as well. As a result, these costs represent upper bounds on the true cost of these reductions.

Key Assumptions

The net present value of the stream of costs from blue marlin and white marlin harvest reductions are calculated using a 5% discount rate, the same discount rate used in the business cases.

The current scenarios account for potential cash flow changes due to sailfish landing reductions, but do not model subsequent behavioral change by fishers, such as exiting the fishery or compensating for lost income by landing other species. The latter scenario (i.e. compensating lost income from billfish harvest reduction, with higher quality and better priced tuna, particularly yellowfin) is being modelled through a separate study led by Wilderness Markets in collaboration with GCG, CI, and FAO.

Harvest reductions are shared equally, according to current landing proportions, across all gear types.

It is assumed that the reductions in harvest come from the use of circle hooks and live release of caught billfish. Otherwise the harvesters cannot change their production technology.

It is assumed that prices remain static for billfish, regardless of supply levels, landed and sold domestically or exported. Modelling seafood supply and demand relationships was beyond the scope of this project.

There are no assumptions made regarding any stock changes. There could be additional costs in monitoring, control and enforcement in order to make these cuts, but those costs are not considered here.

Recommendations

Based on the analysis above, adopting the ICCAT country level quotas for billfish would not significantly impact food security, assuming that the blue marlin and white marlin harvest quotas are allocated first for food security purposes (i.e. “consumed” or “given away” in table above). The lost cash flow associated with those harvest reductions each year is substantial, as evidenced by the NPV of those loses. At the vessel level, the losses are more moderate at $1,678 per Type III vessel annually and $2,571 per Type I & II vessels annually. Grenada lacks a history of harvest control rules and it is recommended that investments be made in monitoring, control and enforcement. It is also recommended that external funds be used to convert the fleet to circle hooks and make supply chain improvements so that fishers can be incentivized to reduce billfish harvest by switching to higher valued products. Finally, it is recommended that gear trials continue to further explore technological changes to reduce billfish harvest.

Scenario 2: Cash flow impacts of Sailfish Harvest Reduction in Grenada and in the DR

Context – Activity Objectives

One of the objectives of the current activity is to assess the business case value proposition associated with policy interventions that reduce billfish mortality in Grenada and in the Dominican Republic, and to examine possible value transfer pathways between the commercial and recreational sectors. The current scenario analyses focus on reductions in sailfish harvest. While sailfish is not subject to ICCAT country level quotas because it has not been declared overfished nor is overfishing occurring, Conservation International desired an analysis of the reduction in sailfish harvest in addition to the examination of the harvest reductions ICCAT will require for blue and white marlin as Grenada and the Dominican Republic harvest more sailfish than blue or white marlin (Gentner et al. 2018).

Current State – Summary of Current Landings, Volume and Value, in Both Grenada and the Dominican Republic

Based on data provided by the Fisheries Performance Indicators (FPI), Table 27 contains the estimated landed volume and value of sailfish (sailfish) (Gentner et al. 2018). Please note, all prices are in USD. All weights are headed and gutted weights, as landed, in each country.

Table 27. *Volume and Value of Sailfish Landings by Pilot Country*

Sailfish	Price Paid to Harvester (USD)	Landed Volume (pounds)	Landed Value (USD)
Grenada	$1.89	211,361	$398,937
Dominican Republic	$1.40	262,350	$367,290

- Grenada landings data from 2013, the last year disaggregated landings are available for Grenada.
- Dominican Republic data from FPIs, which is what the country reported to FAO for 2016[13]

Proposed Harvest Reductions

The following three harvest reductions are considered for the purposes of decision making:

- 10% reduction in sailfish landings over ten years
- 20% reduction in sailfish landings over ten years
- 30% reduction in sailfish landings over ten years

The intention here is to anticipate potential future sailfish quota reductions and forecast cash flow changes based on those reductions. Currently the ICCAT sailfish stock assessment is highly uncertain and, while ICCAT has not declared the stock overfished nor that overfishing is occurring, these results are inconclusive due to the lack of exploitation data from coastal small-scale fisheries.[14] As a result, it is not possible to estimate surplus yield and therefore a potential Atlantic wide TAC.[15] Without a total TAC, it would not be possible to speculate what country level quotas might look like or whether current harvest rates in either country are sustainable or not.[16] Additionally, not enough information exists regarding the spatial-temporal distribution of sailfish to determine if reduction in hypothetical partial national quotas would have any impact on the Atlantic wide stock of sailfish.[17] Nevertheless, fairly substantial reductions are examined here. Grenada is currently in negotiations to join ICCAT and would

[13] Dominican Republic enumerator data does not contain species information.
[14] Dr. Nelson Ehrhardt, personal communication.
[15] Ibid.
[16] Ibid.
[17] Ibid.

therefore be subject to any sailfish TAC that ICCAT would set if they chose to set a country level TAC in the future. The Dominican Republic is not a member of ICCAT nor is it considering membership.

Case 1 – 10% Harvest Reduction

Current payments to harvesters are $1.89 per lb in Grenada and $1.40 per lb in the Dominican Republic. Table 28 contains the cash flow impacts of this scenario.

Table 28. *10% Sailfish Harvest Reduction Cash Flow Impact.*

Country	Fleet	Annual Cost	NPV Over 10 Years
Grenada	FAD	-$508	-$3,922
	Type I&II	-$66,847	-$516,172
	Type III	-$79,875	-$616,773
	Labor (Captains and Crew)	-$783	-$6,046
	Exporters	-$63,694	-$491,828
	Retail Markets	-$32,059	-$247,551
		Total	-$1,882,293
Dominican Republic	FAD	-$53,390	-$412,262
	Labor (Captains and Crew)	-$414	-$3,197
	Retail Markets	-$42,499	-$328,166
	Total		-$743,625

Based on the cash flow models and the existing prices for sailfish, the net effect of this scenario is an outright loss. A 10% reduction in sailfish harvests reduce cash flows in Grenada by $1.9 million and in the Dominican Republic by $743,625. In both countries, the harvesters, and specifically the boat owners, bear the brunt of the reduction in cash flow.

Prices cannot be projected because no demand models were estimated. As volumes drop, all other conditions equal, prices for sailfish should rise, reducing these impacts. A 10% reduction in sailfish harvests translates into a 3.3% reduction in total seafood supply in Grenada, which is a small portion of total fish supply.[18] Additionally, from the FPIs and an examination of the landings data, there is very little market differentiation in price across all fish species. As a result, a small drop in volume in an essentially undifferentiated market for fish species is expected to induce small price increases. Also, if harvesters could change targets or make up for the difference in the harvest of other species, the impact of

[18] http://www.fao.org/faostat/en/#data/FBS

reductions would be less. Finally, if harvesters could otherwise reduce costs or change production practices, the impact of reductions could be less as well. As a result, these costs represent upper bounds on the true cost of these reductions.

Case 2 – 20% Harvest Reduction

All the same assumptions and prices hold for scenario 2. Table 29 contains the results of this scenario.

Table 29. *20% Sailfish Harvest Reduction Cash Flow Impact.*

Country	Fleet	Annual Cost	NPV Over 10 Years
Grenada	FAD	-$1,015.95	-$7,845
	Type I&II	-$133,693.35	-$1,032,345
	Type III	-$159,749.92	-$1,233,547
	Labor (Captains and Crew)	-$1,566.00	-$12,092
	Exporters	-$127,388.00	-$983,656
	Retail Markets	-$64,118.00	-$495,102
		Total	-$3,764,587
Dominican Republic	FAD	-$106,779.59	-$824,524
	Labor (Captains and Crew)	-$828.00	-$6,394
	Retail Markets	-$84,998.00	-$656,332
	Total		-$1,487,249

Based on the cash flow models and the existing prices for sailfish, the net effect of Case 2 is also a loss. A 10% reduction in sailfish harvests reduce cash flows in Grenada by $3.8 million and in the Dominican Republic by $1.5 million. In both countries, the harvesters bear the brunt, and specifically the boat owners, of the reduction in cash flow.

Prices cannot be projected because no demand models were estimated. As volumes drop, all other conditions equal, prices for sailfish should rise, reducing these impacts. Also, if harvesters could change targets or make up for the difference in the harvest of other species, the impact of reductions would be less. Finally, if harvesters could otherwise reduce costs or change production practices, the impact of reductions could be less as well. As a result, these costs represent upper bounds on the true cost of these reductions.

Case 3 – 30% Harvest Reduction

All the same assumptions and prices hold for scenario 3. Table 30 contains the results of this scenario.

__Table 30.__ 30% Sailfish Harvest Reduction Cash Flow Impact.

Country	Fleet	Annual Cost	NPV Over 10 Years
Grenada	FAD	-$1,523.92	-$11,767
	Type I&II	-$200,540.02	-$1,548,517
	Type III	-$239,624.88	-$1,850,320
	Labor (Captains and Crew)	-$2,349.00	-$18,138
	Exporters	-$191,082.00	-$1,475,485
	Retail Markets	-$96,177.00	-$742,653
		Total	-$5,646,880
Dominican Republic	FAD	-$160,169.38	-$1,236,786
	Labor (Captains and Crew)	-$1,242.00	-$9,590
	Retail Markets	-$127,497.00	-$984,498
	Total		-$2,230,874

Based on the cash flow models and the existing prices for sailfish, the net effect of Case 3 is also a loss. A 30% reduction in sailfish harvests reduce cash flows in Grenada by $5.6 million and in the Dominican Republic by $2.2 million. In both countries, the harvesters bear the brunt, and specifically the boat owners, of the reduction in cash flow.

Prices cannot be projected because no demand models were estimated. As volumes drop, all other conditions equal, prices for sailfish should rise, reducing these impacts. Also, if harvesters could change targets or make up for the difference in the harvest of other species, the impact of reductions would be less. Finally, if harvesters could otherwise reduce costs or change production practices, the impact of reductions could be less as well. As a result, these costs represent upper bounds on the true cost of these reductions.

Key Assumptions

In each case, we present the net present value of the stream of costs from these scenarios using a 5% discount rate.

In the case of Grenada, reductions are shared equally, according to current landing proportions, across all gear types.

It is assumed that the harvesters nor processors can change their production technology.

It is assumed that prices remain static for billfish, regardless of supply levels, landed and sold domestically or exported. Modelling seafood supply and demand relationships was beyond the scope of this project.

There are no assumptions made regarding how these harvest reductions will be obtained nor any prediction of stock changes. There could be additional costs in monitoring, control and enforcement in order to make these cuts, but those costs are not considered here.

Recommendations

Based on the losses demonstrated above, it is recommended that no sailfish harvest reductions be undertaken until the stock models support such an action. In order to demonstrate stock impacts from reductions like this, better temporal and spatial data on harvests would be needed to improve stock models. It is further recommended that both of these countries improve the quality and timeliness of their fisheries data collection. Additionally, both countries currently lack harvest control rules (HCRs) for any species. HCRs depend on solid stock assessments which currently cannot be provided at the Atlantic wide level by ICCAT. The current stock model is therefore incapable of providing levels of surplus production that could then be assigned to member nations. Currently, neither country is an ICCAT member. Additionally, both countries lack a history with either input or output controls to reduce harvest and lack the monitoring control and enforcement to enforce these reductions. It is therefore recommended that the focus on any investment be improving enabling conditions first and foremost.

Scenario 3: Economic impacts of increasing tourism growth in Grenada and DR, and options for funding billfish co-management trusts through recreational fishing user fees

Current State – Summary of Current Cash Flow and Economic Impacts in Both Grenada and in the DR

Based on data provided by the Fisheries Performance Indicators (FPI) and the expenditure and Willingness-To-Pay (WTP) study, the following estimates (Table 31) have been generated to demonstrate the current state of recreational effort and recreational economic impact (Gentner et al. 2018; Gentner and Whitehead 2018). Please note, all values are in 2017 USD.

Table 31. *Current State of the Recreational Sectors in Each Pilot Country.*

Metric	Dominican Republic		Grenada	
	Low	High	Low	High
Charter Business Cash Flow	$36,319,120	$43,761,744	$5,475,973	$16,640,454
Private Stamp Revenue	$993,243	$1,251,405	$490,769	$914,498
Government Stamp Revenue	$1,108,328	$1,396,401	$914,498	$1,020,458
Expenditures	$28,328,229	$45,116,709	$10,221,579	$14,340,177
GDP	$70,220,399	$111,835,911	$25,337,389	$35,546,625
Employment	2,870	4,571	1,036	1,453

Neither country estimates recreational effort. Effort estimates drive all values in the table above. As detailed in the expenditure and WTP report and above, two effort estimations techniques were used resulting in a high estimate and a low estimate of total effort. From the table, charter businesses in the Dominican Republic (DR) are generating between $36.3 and $43.8 million in cash flow, while in Grenada they are generating $5.5 to $16.6 million in cash flow. Overall angler expenditures range from $28.3 million to $45.1 million in the DR and between $25.3 million and $35.5 million in Grenada. The expenditures generate between $70.2 million and $111.8 million in contributions to GDP in the DR and between $25.3 and $35.5 million in GDP in Grenada. Finally, recreational fishing for billfish supports between 2,870 and 4,571 jobs in the DR and between 1,036 and 1,453 jobs in Grenada.

It has been proposed that a per person per trip fishing fee be imposed on recreational anglers in the country. From the WTP survey, an annual fee would range from $251.15 per year for a privately administered fund to $280.25 for a fund administered by the government. Taking that annual fee and converting it to a per person, per trip fee using survey data on the average number of trips a billfish angler takes per year in the region, that fee ranges from $32.32 if the fee is administered by the government and $28.97 if the fund is privately administered. For the purpose of this analysis, it is assumed that fee is levied on all resident and non-resident participant trips. If that fee is levied on only tourist anglers, the trust fund would be smaller. In the base case, the fee could generate a trust fund between $993,243 and $1.4 million dollars in the DR, depending on who administers the fund, and in Grenada could generate between $490,769 and $1.0 million.

Proposed Increases in Effort

The following three increases in effort are considered for the purposes of decision making:

- 3% increase in effort each year over ten years
- 5% increase in effort each year over ten years
- 10% increase in effort each year over ten years

The intention here is to anticipate potential changes in effort as billfish stock abundance increases or as tourist ministries increase angling tourism through advertising campaigns. For instance, in the DR, overall tourism has increased 4% - 7% a year over the last five years. In Grenada, tourism has been increasing 5% - 10% a year over that same timeframe.

Scenarios

Tables 32 and 33, include only the value of the increases in recreational effort and not the base amounts. The first tables contain the net present value (NPV) for the base case above in both countries.

Table 32. *Dominican Republic Base Case.*

Metric	Dominican Republic Base Case NPV	
	Low	High
Charter Business Cash Flow	$280,446,620	$337,916,591
Private Stamp Revenue	$7,669,563	$9,663,016

Metric	Dominican Republic Base Case NPV	
	Low	High
Government Stamp Revenue	$8,558,212	$10,782,641
Expenditures	$218,743,078	$348,379,270
GDP	$542,223,308	$863,567,259

Recreational fishing for billfish makes a significant contribution to the DR economy. Over ten years, a recreation user fee on all tourist anglers for every day they fish would generate as much as $10.8 million not accounting for any increases in effort.

Table 33. *Grenadian Base Case.*

Metric	Grenada Base Case NPV	
	Low	High
Charter Business Cash Flow	$42,284,009	$128,493,177
Private Stamp Revenue	$3,789,588	$7,061,508
Government Stamp Revenue	$7,061,508	$7,879,704
Expenditures	$78,928,325	$110,731,046
GDP	$195,648,602	$274,481,618

Recreational fishing's contribution to the Grenadian economy is smaller than that of the DR but is still substantial. A recreational user fee could generate as much as $7.9 million over the next ten years, assuming that effort stays static at the 2017 level. It is important to point out that the per person per trip fee used to calculate the amount a user fee could generate is a measure of the total recreational surplus available. Charging a fee that high would drive participants away from the activity, especially given that user fees in similar target destinations are much lower. Cabo San Lucas charges $13/person/day, $25 for a week, $35 for a month or $46 for the year. Costa Rica charges $15, $30 and $50 for a week, a month and a year respectively. Annual, non-resident license fees in the US range from $40/year to over $100/year.

Given the uncertainty of effort estimation in Grenada, particularly with regard to the number of tourist fishing trips, it is assumed that these are upper bound estimates for Grenada. The high side effort estimates for non-residents was generated using response to the Grenadian Tourism Ministry's tourist exit survey. From that survey, there were 7,215 person trips taken in Grenada. Using the US average number of persons per trip, that is equivalent to roughly 1,500 vessel trips. From the FPI work, there are only a small number of charter captains operating in Grenada, maybe as few as two full time captains and maybe another two part time captains. The one full time captain we spoke to during the FPIs ran, at most, 250 trips a year. The one part time captain we spoke to ran, at most, 150 trips a year. The four boats in Grenada may therefore be taking, at most, 800 trips a year.

The next set of tables (Tables 34 and 35) examine annual increases in effort at the rates specified above. The levels of effort increase, compounding annually at the rates in the table, seem reasonable especially at the lower-bound estimates. For Grenada, a 3% annual increase generates between 76 and 143 additional trips over the ten-year time series. If the current charter operators are operating at capacity (200-250 trips per year), this represents less than one more full-time charter business. A 5% increase rate generates between 113 and 282 trips for the entire time series. A 10% increase rate generates between 461 and 859 additional trips. At the 10% annual effort increase rate, assuming all new trips were tourist trips, additional charter infrastructure would need to be developed.

For the DR, a 3% annual increase generates 352 additional trips on the high side and 179 additional trips on the low side over the ten-year time series. If the current charter operators are operating at capacity (200-250 trips per year), this represents either slightly more than one full time charter or slightly less. A 5% increase rate generates 698 trips on the high side and 355 trips on the low side for the entire time series. The 5% level of effort increase could certainly support an additional three full-time charter operations by the end of the 10-year time period. A 10% increase rate generates 2,695 additional trips on the high side and 2,122 trips on the low side. At that annual effort increase rate, assuming all new trips were tourist trips, an additional ten charter boats would need to come on line to support that new demand assuming all current vessels are operating at or near capacity.

Based on the charter cash flow models and the current expenditure rates, the net effect of these scenarios is significant. It bears pointing out again that the tables above represent only the increase and a total NPV would require adding these values to the base case value also presented above. The impact for the co-management trusts is moderate. For Grenada, under the most optimistic increase scenario, the trust only raises an additional $363,557 over ten years. For the DR, under the most optimistic increase scenario, effort increases would raise almost an additional million dollars in trust funds ($861,598). In the DR, this means that, over ten years, a user fee could generate over $11 million dollars for conservation investments. In Grenada, a user fee would generate over $8 million dollars for conservation.

Besides the co-management trust funding, however, increases in fishing tourism have large benefits for the economies of these countries and, since most of the recreational fishing for billfish in both is catch and release, it is a very sustainable path to increase wealth from the ocean and protect coastal community income. Charter business cash flows could increase by as much as $4.4 million under a 3% increase scenario in Grenada to $49.3 million under a 10% increase scenario. GDP could increase by $105.3 million dollars under a 10% increase scenario in Grenada. The story is even more positive in the DR. Charter cash flow could increase from $11.5 million under a 3% increase scenario to $129.6 million under a 10% fishing effort increase scenario. GDP could increase by as much as $331.2 million if fishing effort increase 10% a year for the next 10 years.

Table 34. *Grenadian Scenario Analysis Results.*

Grenada Effort Increase Scenarios NPV						
Metric	**3%**		**5%**		**10%**	
	Low	**High**	**Low**	**High**	**Low**	**High**
Charter Business Cash Flow	$1,437,048	$4,366,919	$2,607,606	$7,924,026	$16,217,993	$49,283,441
Private Stamp Revenue	$13,666	$28,869	$24,798	$52,385	$154,231	$325,807
Government Stamp Revenue	$15,250	$32,214	$27,671	$58,454	$172,101	$363,557
Expenditures	$2,682,427	$3,763,262	$4,867,419	$6,828,656	$30,272,887	$42,470,791
GDP	$6,649,237	$9,328,426	$12,065,423	$16,926,964	$75,040,842	$105,277,173

Table 35. *Dominican Republic Scenario Analysis Results.*

Dominican Republic Effort Increase Scenarios NPV						
Metric	**3%**		**5%**		**10%**	
	Low	**High**	**Low**	**High**	**Low**	**High**
Charter Business Cash Flow	$9,531,150	$11,484,302	$17,294,819	$20,838,926	$107,565,044	$129,607,599
Private Stamp Revenue	$54,303	$68,417	$98,536	$124,147	$612,845	$772,134
Government Stamp Revenue	$60,595	$76,345	$109,953	$138,532	$683,853	$861,598
Expenditures	$7,434,117	$11,839,883	$13,489,633	$21,484,147	$83,898,707	$133,620,550
GDP	$18,427,791	$29,348,862	$33,438,285	$53,255,196	$207,969,254	$331,220,432

Key Assumptions

In each case, we present the net present value of the stream of costs from these scenarios using a 5% discount rate.

Effort increases are simply hypothetical. They could arise from better catch rates driven by conservation activities. They could arise from the general growth in tourism in both countries. They could arise from marketing campaigns to attract fishing tourists.

It is assumed that effort increases in the same proportion by mode (private boat or charter boat) and resident status (resident and non-resident) found in the baseline estimates above.

It is assumed that prices and expenditure levels per trip remain at their 2017 levels.

The conservation fee is charged of all anglers on all trips.

There is no assumption regarding how the fee will be collected or any costs associated with administering such a fee.

Recommendations

Overall, the Grenada effort estimates in the base case are likely upper bounds on effort. As a result, the economic estimates provided for Grenada are likewise upper bounds. There is considerably more confidence in the DR estimates. At the lower end of the DR estimates presented here, the estimates are likely lower bounds for total effort as those estimates came from an actual trip count census at the two most popular marinas. There are other marinas and sources of effort in the DR. The upper bound represents the best estimates of total effort as derived by Club Nautico, which would include effort at the other, smaller marinas in the country.

The uncertainty in this effort data highlights the need to collect recreational fisheries data more formally in the case of the marina-based catch and effort data collection in the DR or at all in the case of Grenada. Both countries should design and maintain catch, effort and participation data collection efforts.

It is also important to point out that the per person per trip fees for the co-management trust were derived using the average number of annual trips taken by billfish anglers from the WTP survey and the estimate of the WTP for a conservation trust estimated as an annual number. The estimates presented above are based on charging both resident and tourist angler that average amount. The per person per trip value, around $30 per person per trip, may be too high for resident anglers, particularly in Grenada. It would likely be preferable to charge resident anglers an annual fee that was less than $30 a fishing trip. If residents were charged a lower fee, the trust would raise less funds. In the model, approximately 60% of the effort is resident effort. That resident/non-resident effort proportion was taken from US surveys of US highly migratory species anglers. It is likely that the proportion is too high for these island nations where most of the effort comes from non-residents, but there was no source of data that would better inform this split available.

Finally, the concept of a user fee has wide support in the DR. In fact, a fee is already being charged by the two most popular marinas. There is a lack of transparency in that program and that is driving a little distrust in the entire system, but the residents understand the need for a user fee. Currently those fees are being assessed to the vessels through their slip fees. It is suggested that the fee be assessed directly at the angler level and the fee be collected by the marina office or by an enforcement official assigned to the marina as is done in Costa Rica and Cabo San Lucas, Mexico. In these locations, the angler is required to pay a daily fee and is required to show proof of that fee before leaving the marina. There is no support for a user fee in Grenada. There are very few charter boats and the marinas are such that there are not well-defined choke points, like inlets, to check fee payment like there are in the DR or in the other places, such as Costa Rica and Cabo San Lucas.

Scenario 4: Transitioning the low-value commercial artisanal billfish fishermen towards a higher-value recreational fishery

Conservation International asked for an examination of the possibility of converting commercial fishermen to charter captains to both increase livelihoods and reduce billfish mortality. Increasing livelihoods would require the economic realities to line up. Reducing billfish mortality would require the new captains to practice catch and release fishing and would require limited entry on the commercial side so that any exiting captain wouldn't simply be replaced with another commercial captain.

Current State – Economic Realities in Both Sectors

From the previous case on the current state of recreational fishing in the pilot countries and forecasts of the economic activity generated under several tourism increase scenarios, an increase in tourism activity would be required to support any additional entrants into the for-hire fishing sector in either country. From that analysis, a 3-5% increase in tourism or better would support one additional full-time charter captain in Grenada at the end of the 10-year period. For the Dominican Republic, a 3% increase in fishing tourism would support nearly two full-time charter captains and a 10% increase could support up to an additional 10 full time charter captains at the end of the 10-year period examined.

Proposed Scenario

In this section, financial incentive to switch from commercial fishing into for-hire recreational fishing will be examined. At an individual firm level, Table 36 details the economic realities in the pilot countries in both sectors.

Table 36. *Average Cash Flows by Country and Sector.*

Country	Fleet	Average Annual Cash Flow
Both	Charter	$17,400
Grenada	FAD	$3,038
	Type I&II	$52,148
	Type III	$54,042
Dominican Republic	FAD	$1,221

From the Willingness to Pay (WTP) study, the average annual cash flow for a full-time charter business in the region is $17,400 (Gentner and Whitehead 2018). Average annual cash flow is based on the average vessel in operation in the region which is a larger, twin inboard diesel yacht with a cabin. Twin inboard types of vessels charge upwards of $1500 per day for a full day of fishing. While other, smaller and open vessels operate in the region on a for-hire basis, they typically only charge half of that amount or less. While GCG did not encounter any panga fishermen taking for-hire trips, GCGs experience in Latin America indicates that a full day fishing aboard a panga with very basic or patron supplied gear would cost $250 for a full day of fishing.

In Grenada, all but the FAD fishing fleet already make more than annual cash flow for a for-hire vessel. The FAD fleet makes substantially less money, so the incentive is there to potentially switch. From the FPI work, several small-scale FAD fishermen on Carriacou expressed an interest in developing a for-hire business for themselves. At present, there are no for-hire fishing vessels in Carriacou (Gentner et al. 2018).

In the Dominican Republic, the FAD fisherman annual cash flow is far less than what a full-time charter captain would make. From the previous analysis, it would not take much of an increase in recreational fishing tourism to support additional charter captains if they simply wanted to make more than they make fishing commercially. An important reality to consider is the cost of entry in to a charter business. Table 37 looks at the cost of financing different types of vessels.

Table 37. *Vessel Purchases Costs.*

Vessel Type	Vessel Cost	Annual Payment at 10% Interest for 15 Years
New Inboard Yacht	$500,000	$64,476
Used Inboard Yacht[19]	$214,258	$27,624
Used Center Console	$50,000	$6,444
New Local Panga (25' 40 hp)	$6,000	$768

It is unlikely that any small scale commercial fishermen would have a half a million USD for the purchase of a vessel or access to that type of credit. Even if that type of credit were available, a charter business would not be able to afford a $65,000 annual boat payment based on the annual cash flow figures from the first table. Even a used inboard yacht of the type currently in-service would be beyond the reach of even the most successful for-hire captains at $28,000 per year over 10 years.

Scenario Analysis

The table below examines the potential cash flow in year ten of the 10-year tourism growth scenarios from the previous scenario analysis. Table 38 assumes the high side of the growth projections and the charter fee that could be charged using a twin inboard yacht but does not include the purchase of such a

[19] Average current value of Caribbean fo-hire fleet. 35’ twin inboard diesel.

vessel. If fishers wishing to convert, used their existing, open panga style boats they would have to charge 60-80% less. The "Panga Cash Flow" in Table 38 below is 60% of the "Gross Cash Flow."

Table 38. *Cash Flows for Various Effort Increase Scenarios.*

Percent Increase Over 10 Years	Grenada Trips	Grenada Gross Cash Flow	Grenada Panga Cash Flow	Dominican Republic Trips	Dominican Republic Gross Cash Flow	Dominican Republic Panga Cash Flow
3%	143	$16,588	$6,635	352	$40,831	$16,332
5%	282	$32,711	$13,085	698	$80,966	$32,387
10%	859	$99,642	$39,857	2,695	$312,614	$125,045

There are several ways to look at these results. One, a commercial fisherman could not count on making enough money to pay for a new twin inboard yacht type vessel under these scenario assumptions. Second, in Grenada, a FAD fisherman facing a 3% increase in tourism could expect to make about twice his current cash flow, if only one fishermen made the switch at the end of 10 years. At the 10% increase level in Grenada, if two fishermen switched, they would make slightly more than the basin wide annual average cash flow in the charter business. Generally, this shows there is not a much opportunity to switch unless growth happens more aggressively in Grenada.

The story is different in the Dominican Republic and this table explains why many commercial fishermen have already made the switch in Macau. The lowest level of increase, 3%, generates slightly less cash flow than the annual, full-time cash flow average for the entire Caribbean. However, this represents 13 times more annual cash flow than a FAD fisherman in the DR currently makes a year. As a result, even if each boat was not running 180 trips a year, 13 commercial fishermen could convert to recreational fishing and still be better off than fishing FADs commercially. At the highest level of tourism increase, 10%, seven new full-time charter captains could be supported at the basin wide average cash flow, or slightly less than 100 fishermen could convert and make slightly more money than fishing FADs commercially.

Key Assumptions

It is assumed that the Caribbean basin wide average cash flow for the for-hire sector is applicable to the Grenada and the Dominican Republic for-hire industries.

Loan rates are on the low side for the Dominican Republic where loan rates for fishing vessels run in the 12-18% range. Bank rates in Grenada are around 10%.

Additional trip predictions are all taken from the upper bound of the previous scenario analysis.

Gross cash flows below do not include the purchase of a vessel suitable for recreational fishing.

Scenarios assume average, full day charter fees from the WTP survey. Assuming the average, full day charter fee generates an upper bound estimate on the cash flow as panga trips are generally 80% less costly than trips on twin inboard diesel yachts.

Per trip cash flows assume a full-time year is 180 trips resulting in a $116 per trip cash flow for the captain/owner of the vessel.

Recommendations

The conversion from commercial to charter sector is already happening in the Dominican Republic. In the region around the all-inclusive resorts in Punta Cana, many of the FAD fishers from the port of Macau have converted from fishing commercially to offering low cost, split charters to all-inclusive resort guests. They operate from moorings just off the beach from these all-inclusive resorts. They operate from very old twin inboard motor yachts often with the second inboard removed and the weight balanced with sand bags or concrete. The professional charters in the region refer to these outfits as “pirate” charters who sell at cost or below cost trips and use fish sales to make up their profits.

While the professionalized fleet practices 100% catch and release for billfish, this fleet relies on killing billfish to hang back at the resort to help sell trips for the next day. The professional charters are very much in opposition to these charter businesses feeling that they kill too many fish and give the sport a bad name by offering short, inshore trips on unsafe equipment. Any effort to convert more commercial fishermen to for-hire captains should include measures to professionalize this fleet.

One of the many “enabling conditions” that need work in the DR is the professionalization of the entire for-hire industry and this Macau fleet in particular. The pirate charter vessels need to be safety inspected and perhaps some sort of “certified charter captain’s license” be required that required certain training on the customer experience and on catch and release and other conservation principles. It might also be a good idea to register charter vessels and perhaps examine limited entry for the fleet. The business case in the DR that examines the conservation trust concept may include these exact recommendations.

It bears mentioning again that for the more budget minded or adventurous angler, panga trips may offer new market in the region. Panga charters are very popular for the budget minded angler that doesn’t mind bringing their own gear or directing their own trip. The overhead for these types of trips is very low as these trips are often conducted using commercially outfitted pangas. A panga based operation type of operation might be very suitable for the island of Carriacou, Grenada. The tourism there is aimed more at adventurous travelers with an “eco” theme. The operators there already own pangas suitable for fishing for sailfish and other pelagics with very little investment in gear. A panga based strategy might also work for the DR, however, more controls on the industry need to be instituted before exploring an expansion of the industry there.

Discussion

The work presented here detailed the complete development of cash flow models of the commercial and recreational fishing sectors across the two pilot countries of Grenada and the Dominican Republic. The effort demonstrated that it is possible to rapidly and inexpensively gather fishery context, map supply chains, design cash-flow models, populate those models with primary and secondary data and analyze scenarios that provide context and background for the larger business cases currently in development. The context, model, data and supply chain maps were passed to Wilderness markets and provided the core of their financial models for the business cases. GCG worked closely with Wilderness

Markets to develop and ground-truth those financial models and to help develop the business case scenarios.

Highlighted throughout this document are the basic shortcomings in enabling conditions found in both pilot countries. Fortunately, both countries have good commercial data collections systems. However, neither can keep their landings statistics updated in a timely fashion. The use of electronic data entry terminals would provide both seafood traceability, perhaps leading to better export market access, and provide the local fisheries managers with more timely data. Additionally, neither country collects any data on recreational fishing. It would be easier to formalize that data collection and warehouse it in the ministry because the two largest marinas in the Dominican Republic already collect catch and effort information. Grenada would have to institute a data collection system from scratch.

Neither country does stock assessments nor sets any harvest control rules (HCRs). In the case of Grenada, who is currently in the process of joining ICCAT, it will become necessary to address HCRs in order to manage their billfish quotas. The Dominican Republic is not currently looking to join ICCAT. Both countries would also be well advised to begin looking at a process to limit entry in all of their fisheries.

Finally, it may be possible, given the willingness of recreational anglers to pay for access, to generate funds to pay for additional enabling conditions or even a Coasian bargain in the case of FAD access in the Dominican Republic. However, while the funds may be available, it would be pointless to compensate FAD fishermen in the Dominican Republic if there wasn't at least some sort of tracking and registry for FADs or at best limited entry for the ports being compensated. It is clear that previous compensation schemes have increased capacity in two Dominican Republic commercial fishing ports.

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