Food and Agriculture Organization of the United Nations

WESTERN CENTRAL ATLANTIC FISHERY COMMISSION

FIAO/SLC/C1162 (En)

FAO
Fisheries and
Aquaculture Circular

ISSN 2070-6065

FISHERY PERFORMANCE INDICATOR STUDIES FOR THE COMMERCIAL AND RECREATIONAL PELAGIC FLEETS OF THE DOMINICAN REPUBLIC AND GRENADA

Cover photograph: FPI discussions with fishers in Grenada. © Freddy Arocha (2017)

FAO Fisheries and Aquaculture Circular No.1162 FIAO/SLC/C1162 (En)

FISHERY PERFORMANCE INDICATOR STUDIES FOR THE COMMERCIAL AND RECREATIONAL PELAGIC FLEETS OF THE DOMINICAN REPUBLIC AND GRENADA

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, 2018

ISBN 978-92-5-130416-7

PREPARATION OF THIS DOCUMENT

This document is part of a series of desk and field studies carried out under the Ocean Partnership Program (OPP) belonging to the Areas Beyond National Jurisdictions (ABNJ) program. The program is funded by the Global Environmental Facility (GEF) and the World Bank and executed by various agencies, including Conservation International (CI) and the Western Central Atlantic Fishery Commission (WECAFC) of the Food and Agriculture Organization of the United Nations (FAO) based at the FAO Subregional Office in Bridgetown, Barbados.

The Fisheries Performance indicator studies of pelagic fleets in Grenada and the Dominican Republic were carried out in April- May 2017 by a team under the leadership of Mr Brad Gentner and this circular was prepared in the period August-November 2017. The information presented in this circular was shared for comments with the fisheries sector leadership in the Dominican Republic and Grenada for comments and observations in November-December 2017, and the document was also presented to and reviewed by the members of the Consortium on Billfish Management and Conservation (CBMC). Preliminary outcomes were also presented to the Meeting of the Global Think Tank of the OPP, which took place on 24-26 October 2017 in Los Angeles, United States of America.

The study team was composed of Mr Brad Gentner (Gentner Consulting Group, USA), Mr Freddy Arocha (Oceanographic Institute of Venezuela, Bolivarian Republic of) and Mr Chris Anderson (University of Washington, USA).

In Grenada, the study team visited the Fisheries Division in St. Georges and two District Fishery Agencies in Carriacou/Petite Martinique, and Grenville. The team also visited to the Districts (Parishes) were meetings were held with local fishers organizations (Gouyave-St Johns, Victoria-St Marks).

The contract for this study was issued by Conservation International, in support of the business case development activities of the by WECAFC Secretariat coordinated Caribbean Billfish Project (GCP/SLC/001/WBK). Mr Raymon van Anrooy, WECAFC Secretary, supported the finalization of this circular with the latest information from FAO and WECAFC.

FAO. 2018.
Fishery performance indicator studies for the commercial and recreational pelagic fleets of the Dominican Republic and Grenada, by Brad Gentner, Freddy Arocha, Chris Anderson, Keith Flett, Pablo Obregon and Raymon van Anrooy.
FAO Fisheries and Aquaculture Circular No. 1162. Rome, Italy.

ABSTRACT

Fishery Performance Indicators (FPIs) were developed to address gaps in data and information on fisheries worldwide and in recognition that to be successful with fisheries investment, development or conservation projects measurable outcomes are needed. The focus of the tool and its indicators is to evaluate the effectiveness of management systems in aligning ecosystem health and human well-being. The Ocean Partnership Program (OPP) belonging to the Areas Beyond National Jurisdictions (ABNJ) program funded by the Global Environmental Facility (GEF) and the World Bank, supported the Caribbean Billfish Project and its development of billfish fisheries management and conservation business cases in the Caribbean. The Western Central Atlantic Fishery Commission (WECAFC), Conservation International and the fisheries authorities in the Dominican Republic and Grenada teamed-up to develop business cases at national level. The FPIs studies in both countries were conducted on the commercial and recreational pelagic fisheries. For Grenada, the commercial pelagic longline fishery, the commercial fish aggregating device (FAD) fishery and recreational fishery for billfish and other pelagics were assessed. For the Dominican Republic, the pelagic FAD fishery and the recreational billfish fishery were assessed. This circular details the information discovered during the FPI field work and discusses the resulting FPI scores. The information collected and analysed is used for the development of the business cases in both countries.

CONTENTS

ACKNOWLEDGEMENTS

The authors would like to acknowledge the creators of the Fishery Performance Indicator tool applied for this analysis. The Fishery Performance Indicator tool is a peer reviewed technique that has been applied in hundreds of fisheries around the world before being used for these five fisheries in two Caribbean countries.

A PLOS One description of the methodology can be found here:
Anderson, J.L., C.M. Anderson, J. Chu, J. Meredith, F. Asche, G. Sylvia, et al. 2015. The Fishery Performance Indicators: A Management Tool for Triple Bottom Line Outcomes. http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0122809

The commercial FPI User's Manual can be found here:
Anderson, J.L., C.M. Anderson, J. Chu and J. Meredith. 2016. Fishery Performance Indicators Manual (Version 1.3).http://isfs.institute.ifas.ufl.edu/projects/new-metrics/fpi-manual/

The recreational FPI methodology is described here:
Anderson, J.L., T. Garlock, C.M. Anderson, F. Asche, C. Crandell and B. Gentner. 2017. "Introduction to the Sport Fishery Performance Indicators: A New Instrument in the FPI Toolbox". Report prepared for the Environmental Defense Fund.

The authors would also like to acknowledge the assistance of the local conveners in each of the pilot countries.

In Grenada, Crafton Isaacs, Chief Fisheries Officer, Ministry of Agriculture, Lands, Forestry, Fisheries and the Environment, organized all of the meetings with fishers on the island of Grenada and Junior McDonald, Fisheries Officer, Ministry of Carriacou and Petite Martinique Affairs, organized the meetings in Carriacou and Petite Martinique.

In the Dominican Republic, Raul Gonzalez, Senior Fishery Officer, El Consejo Dominicano de Pesca y Acuicultura (CODOPESCA), organized all the meetings with local fishery officers and with the relevant sector stakeholders.

Without the help of these local conveners, the research undertaken would not have been possible.

ABBREVIATIONS AND ACRONYMS

Species

ALB	Albacore tuna (Thunnus alalunga)
BET	Bigeye tuna (Thunnus obesus)
BFT	Atlantic bluefin tuna (Thunnus orientalis)
BLF	Blackfin tuna (Thunnus atlanticus)
BUM	Blue marlin (Makaira nigricans)
CER	Cero (Scomberomorus regali)
DOL	Dorado/dolphinfish (Coryphaena spp.)
KGM	King mackerel (Scomberomorus caballa)
KNG	Kingfish (generally KGM, WAH or CER)
SAI	Sailfish (Istiophorus platypterus)
SWO	Swordfish (Xiphias gladius)
TUN	Other tunas
YFT	Yellowfin tuna (Thunnus albacares)
WAH	Wahoo (Acanthocybium solandri)
WHM	White Marlin (Tetrapturus albidus)

Fishing gears

LL	Longline
FAD	Fish Aggregating Device

Other

CBP	Caribbean Billfish project
CI	Conservation International
CODOPESCA	El Consejo Dominicano de Pesca y Acuicultura (Fisheries authority)
CPUE	Catch Per Unit Effort
CRFM	Caribbean Regional Fisheries Mechanism
DR	Dominican Republic
EEZ	Exclusive Economic Zone
EU	European Union
FAC	Fishery Advisory Committee
GDP	Gross Domestic Product
HACCP	Hazard Analysis and Critical Control Points
ICCAT	International Commission for the Conservation of Atlantic Tunas
JICA	Japan International Cooperation Agency
MAFF	Ministry of Agriculture, Lands, Forestry, Fisheries, Energy and Public Utilities (Grenada)
MPA	Marine Protected Area
RFMO	Regional Fisheries Management Organization
SIFH	Spice Island Fish House
TAC	Total Allowable Catch
USA	United States of America
WB	World Bank
WECAFC	Western Central Atlantic Fishery Commission

1. INTRODUCTION

Fishery Performance Indicators (FPIs) were developed to address gaps in data and information on fisheries worldwide and in recognition that to be successful with fisheries investment, development or conservation projects measurable outcomes are needed. To address the limited availability of standardized and reliable data, a tool was developed to measure the current state of ecological, economic, stock, governance and community dimensions related to fisheries. The focus of the tool and its indicators is to evaluate the effectiveness of management systems in aligning ecosystem health and human well-being. Effective fisheries management requires ecosystem sustainability, social acceptability and supports livelihoods through resource rents or profits. The development of the tool was funded by ALLFISH, a public-private partnership created by the seafood industry, the World Bank, the Food and Agriculture Organization of the United Nations and the Global Environment Facility (Anderson et al. 2015).

The commercial instrument was developed by James Anderson, Chris Anderson, Jingjie Chu and Jennifer Meredith. The commercial FPI user's manual can be found online (Anderson et al. 2016) and the recreational tool found online as well (Anderson et al. 2017). The reader is advised to consult both documents for further details on the overall methodology. After the success of the commercial instrument, a recreational tool was developed. The recreational instrument was developed by James Anderson, Taryn Garlock, Chelsey Crandall and Brad Gentner. Both recreational and commercial tools follow a similar development trajectory and overall format, so they will be discussed simultaneously here.

The indicators included in the tool fall into two categories, output and input factors. The output factors are a set of indicators that measure whether the fishery is delivering economically viable and socio-ecologically sustainable results. The World Bank has a focus on triple bottom line outcomes and the output factors correspond to environmental, economic or community well being. As a result these metrics correspond to the stock or to the harvester or post harvest sector on the commercial side or the angler, for-hire sector and ancillary business on the commercial side. These indicators also examine other important areas in global fisheries like gender, equity, risk/volatility and climate change. Tables 1 and 3 of Appendix 1 contain all of the output metrics for the commercial and recreational instruments respectively.

The input factors, or enabling conditions, contribute to the process of incentivizing socio-ecologically sustainable use of fish resources. These are the indicators that drive or support success. By linking the outputs to enabling factors, it is possible to link the weak areas in outputs to the supporting factors that are faltering. By knowing where to invest, changing outcomes become more efficient. Tables 2 and 4 in Appendix 1 contain the input metrics for the commercial and recreational FPIs respectively.

Both tools are fishery focused. That is the focus in on the fishery not the port, not the fishermen and not the species. A fishery is the combination of species, or species groups targeted, coupled with the gear type and size class. The FPIs are not your typical survey instrument. Every person interviewed will not fill out a survey. Instead one score sheet will be filled out for each fishery covered. This effort does not require a random sample or large sample sizes. Instead, the project consists of an expert scoring exercise. The panel of experts met with as many individuals or groups as possible during our time, aiming for key informants in the fishery. The panel then scores a single spreadsheet for each fishery collaborating on the scores for each metric. Many metrics can be scored directly if quantitative data is available on the fishery.

The two FPI studies, Grenada and the Dominican Republic, presented in this circular follow the general structure recommended in the FPI manuals. This circular presents the fishery profile and scores for the commercial and recreational pelagic fleets for both Grenada and the Dominican Republic.

2. GRENADA

Grenada is the southernmost island of the eastern Caribbean island chain, which is also known as the Lesser Antilles. It has a population of 106 825 people with a GDP of USD 984 million and a GDP per capita of USD9 212 (World Bank 2017). Agricultural production, particularly spice production, used to dominate the economy. Now the economy is service dominant, 76 percent of GDP, and the largest source of foreign currency is tourism (Grenada 2017, World Bank 2017). Grenada exports USD 38 million in goods and fresh tuna exports to the United States of America (916 tonnes in 2016) make up 18 percent (US$6.7 million) of that total (Grenada 2017, NMFS 2017).

Local demand for seafood is very high and the consumption of fish and fisheries products was above 30 kg per capita per year in recent years (FAO Food Balance Sheets). Traditionally, small, pan-sized demersal fish species are preferred for consumption. As local demersal fish stock abundance has fallen, consumption has shifted to coastal pelagics like Dolphinfish (DOL) and what is locally called “kingfish,” (KNG) which includes King mackerel (KGM) and Wahoo (WAH). In general, Grenadians do not prefer large portions nor dark colored flesh. However, the preferences in consumer demand are generally not resulting in any price differentiation in the local markets.

Grenada is located in an area where large pelagic fishes such as tunas (yellowfin, blackfin, big-eye, and albacore), blue marlin, white marlin, sailfish, dolphinfish and wahoo transit to and from the Caribbean Sea and adjacent waters. Grenada’s location allowed the development of an important pelagic fishery. This fishery is composed of longline (LL) vessels, small-scale fishing vessels using different hand gears around fish aggregation devices (FADs) and recreational vessels using big game trolling techniques. The LL fishery operates year-round targeting primarily yellowfin tuna (YFT) for the export market, however many other species are caught that are seasonally important, but used primarily for local consumption. The FAD fishery targets DOL, KNG and small coastal tunas primarily for local consumption. Finally, the recreational fishery primarily targets sailfish (SAI), Blue Marlin (BUM) and large YFT year-round.

Table 1 gives a quick overview of the pertinent details of the fisheries sectors discussed in this circular. This circular will go into detail describing each individual fishery profiled; LL, FAD and recreational. Each section will provide information on the harvest technologies, markets, product forms and FPI scores. The recreational section will also detail types of trips, tourism statistics and again the FPI scores. The FPI score sheets completed contain hundreds of individual metrics. The specific scores across all those individual metrics are not discussed in this circular. Summary metrics are however presented and briefly discussed.

Table 1. Description summary of selected fisheries in Grenada.

Fleet-type	Target species	Number of participants/vessels	Market	Landings	Revenue	Management
Longline	Primary: Yellow-fin Tuna (YFT) Secondary: Blackfin tuna (BLF), Sailfish (SAI), Dorado (DOL), Albacore (ALB), and others.	192 active vessels; 65 Type I and II and 127 Type III	Export Local Consumption	Between: 1 609 tonnes – 2 366 tonnes annually 1 126 tonnes in 2013 from the official landing statistics	Landed revenue approximately USD 7.2 million in 2013. Export revenue approximately USD 7.8 million in 2013 and USD 5.3 million in 2016	Fishing licenses required for vessels, otherwise open-access: "A fisherman needs a license, the vessel needs a registration and the first dealer needs a license. The first dealer is required to report all landings, volume and value, by species"
FAD	Primary: Dorado (DOL), Kingfish (KNG), Yellowfin (YFT) and small coastal tuna	Approximately 125 vessels are registered but only 80 are active, mostly in Grenville. There are a handful of active FAD fishers in Carriacou and 2 in Petit Martinique.	Local Consumption	22.2 tonnes in Grenville	Landed revenue was approximately USD 45 000 in 2013 in Grenville	"The Grenville FAD Fisherfolk organization" provide a model for FAD management. The FADs are owned and self-enforced by this organization and the FADs cannot be fished unless the fisher has a license issued by the organization. Similar arrangements exist in Carriacou, but in a less formal way.
Recreational	Primary: Sailfish (SAI), Blue Marlin (BUM), large Yellow-fin tuna (YFT) Secondary: Dorado (DOL), Kingfish (KNG) & others.	15 licensed sportfishing boats, 58 foreign boats licensed to fish the tournament and 45 boats that are not registered to fish but might occasionally fish (sailboats and yachts)	100% Catch & Release for Billfish DOL, KNG, and YFT sold to client/locals	?	The 2012 tournament generated USD 862 974 and raised USD 77 930 in tax revenue (Charles and Associates 2012). No estimates exist regarding the value of for-hire fishing or private angling	Licenses are required for private and for-hire vessels. Licenses are the same as for commercial fishermen allowing fish sales. Recreational fishers are not identified. The license is tied to the vessel, not to the angler, and foreign vessels are required to obtain a license but are not allowed to sell fish

2.1 General fisheries information

2.1.1 Species

Official landings data of large pelagic fishes in Grenada indicate that YFT, the main target species, has maintained an increasing trend in the landings since 2000, reaching its highest record value of 1 609 tonnes in 2016, of which 533 tonnes were exported, accounting for 77 percent of the landed catch of the main large pelagic species for 2016; Figure 1 (MAFF 2017). Generally, all fish of a better quality than Grade 3 are exported and the remainder are sold for local consumption. In 2013, the last complete year of landings statistics, 89 percent of all YFT and BET were exported. Figure 1 contains the landings for both pelagic fleets; LL and FAD, as Grenada does not collect gear type information in its landings data collection in the FAO data. Grenada has a proper commercial fishery data collection system that includes reporting of volume and value at from the first dealer. Unfortunatley, the system is based on paper forms and there is a data collection backlog that stretches back to 2013, the last year that has been fully entered. While some fish is landed and sold directly to the consumer, official under reporting of landings is estimated at between 10 and 25 percent (Personal Communication, Fisheries Ministry). It is likely that a larger proportion than that is being sold directly to consumer without being accounted for in the official statistics, particularly for demersal species and small coastal pelagics. Undercounting is very low for those fish species that are being exported.

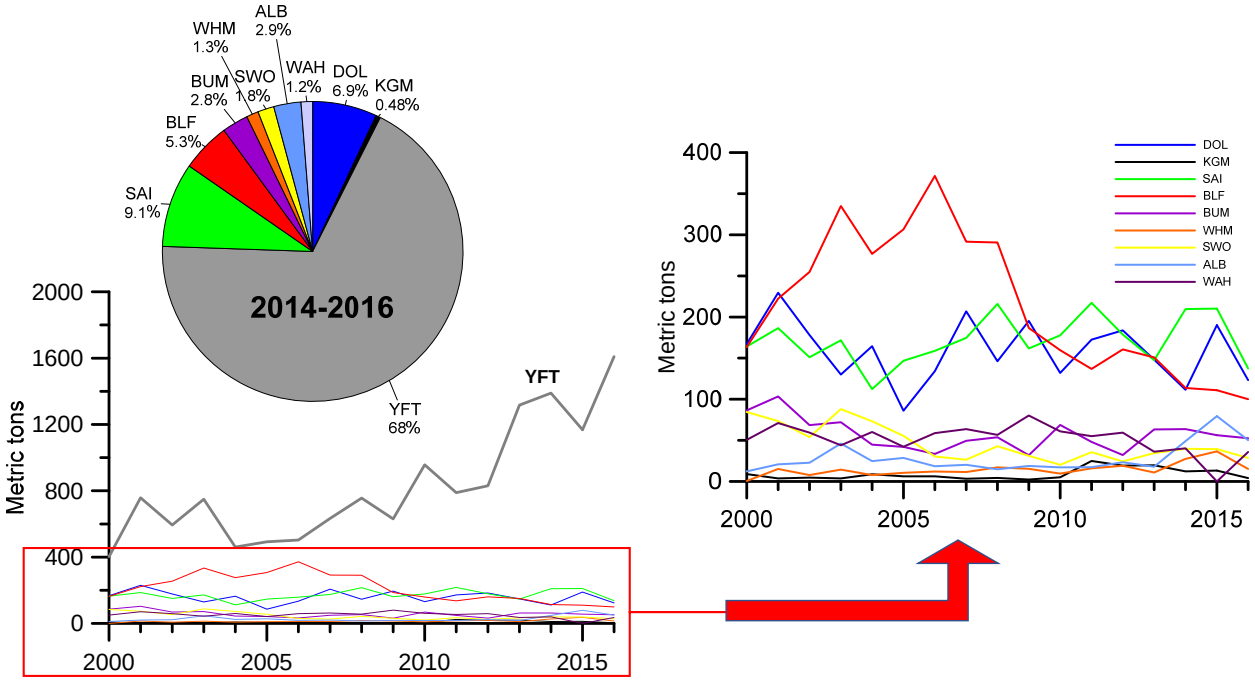
Generally, recreational fisheries harvests are not captured in the fisheries statistics unless the fish was sold through official channels. The recreational charter boats in the country and the Spice Island Billfish Tournament practice 100 percent catch and release for billfish. The charter vessels generally keep DOL, KNG and YFT for client consumption and sale. In this recreational fishery, the fish caught are the property of the boat. The captain 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 those sold fish end up in the official statistics.

For the LL fishery, YFT is the main target. The YFT is also the primary driver of the pelagic fishery value as the majority of YFT landed in Grenada are being exported as fresh product to the USA. A small part of the YFT is exported to the United Kingdom. Figure 1 presents the YFT landings since 2000. The landings have increased and are expected to continue to increase. The LL fishers regard their non YFT catch as bycatch. It is however not bycatch in the strictest sense as seasonally the catches of ALB, BUM, DOL, KGM, SAI, SWO, WAH and WHM are important for the income of the fishers. The LL fishers consider "bycatch" as covering trip costs, even in the YFT fishing season. All of the "bycatch" is kept in Grenada for local consumption. The rest of the commercial "bycatch" species landings show a relatively flat trend that remains below 400 tonnes.

Three species (BLF, DOL and SAI) can be considered of secondary in importance in the LL fishery and of primary importance to the FAD fishery based on the landing data. These groups of species represent about 21 percent of the landed catch from 2014 to 2016 (Figure 1). The rest of the commercial "bycatch" species, ALB, BUM, SWO, WAH and WHM, represent the remaining 10 percent of the landed catch for the same period, rarely reaching 100 tonnes annually.

The YFT and DOL availability to the fishers of Grenada varies seasonally. While both can be caught year-round, YFT tends to have higher abundance in the late Spring through Fall while DOL, SAI and BUM abundance is highest late Fall through late Spring.

Figure 1. Landings of Pelagic Fish Species in Grenada, 2000-2015.



2.1.2 Management system and stock trends

The major large pelagic fish species caught by the different types of LL vessels in Grenada are managed by the regional tuna RMFO, the International Commission for the Conservation of Atlantic Tunas (ICCAT). Of the major species caught by all fleets, three are regarded as Atlantic-wide stocks (YFT, BUM and WHM) and two are western Atlantic stocks (SAI and BLF). The other major species caught, are of little significance in the local catch and include SWO, ALB, WAH and KGM. These species are not addressed in this study as they comprise a small proportion of catch and, except for SWO, are not under ICCAT management.

All three Atlantic-wide stocks, YFT, BUM and WHM, are considered overfished by ICCAT. All three stocks have shown a decreasing trend over the last 15 years (Figure 3). However, Grenada's commercial catches of all three species are minimal in comparison to other countries in the region, even with the sustained increase of YFT catches in recent years. Grenada's catches of BUM and WHM are not in accordance with the actions taken by ICCAT to rebuild these stocks, which include, amongst others, a region wide Total Allowable Catch (TAC) for these two species. Those actions include a continued growth, both in vessels and vessel capacity, to target export grade YFT. Many commercial fishermen informed the study team that they could catch more billfish and would do so if the USA's importation ban was not in place. One exporter noted that he had completed a SAI smoking facility the season before the USA importation ban took effect. His goal was to export a value added product to the USA. Grenada has no TAC in place for any of the billfish species, but now they have become contracting party to ICCAT in 2017, they will be assigned quotas for some of the billfish species.

SAI and WAH landings in the Western Central Atlantic (Area 31) showed a decreasing trend in recent years; landings of SAI reached 636 tonnes in 2015, while landings of WAH reached 994 tonnes in the same year (FAO, 2017). In the case of the western stocks, only SAI has undergone a formal stock assessment. The results, although uncertain, indicate that SAI is not overfished nor undergoing overfishing, however a precautionary measure was adopted by

ICCAT to establish a catch limit of 1030 tonnes, considering that total catches over the last 15 years have shown a declining trend (Figure 2). Grenada has maintained a relatively stable volume of landings of SAI of around 150-200 tonnes annually over the last 16 years. While not in stock trouble, increasing local abundance of SAI would provide benefits for the recreational sector if sailfishing became good enough to attract more tourism trips.

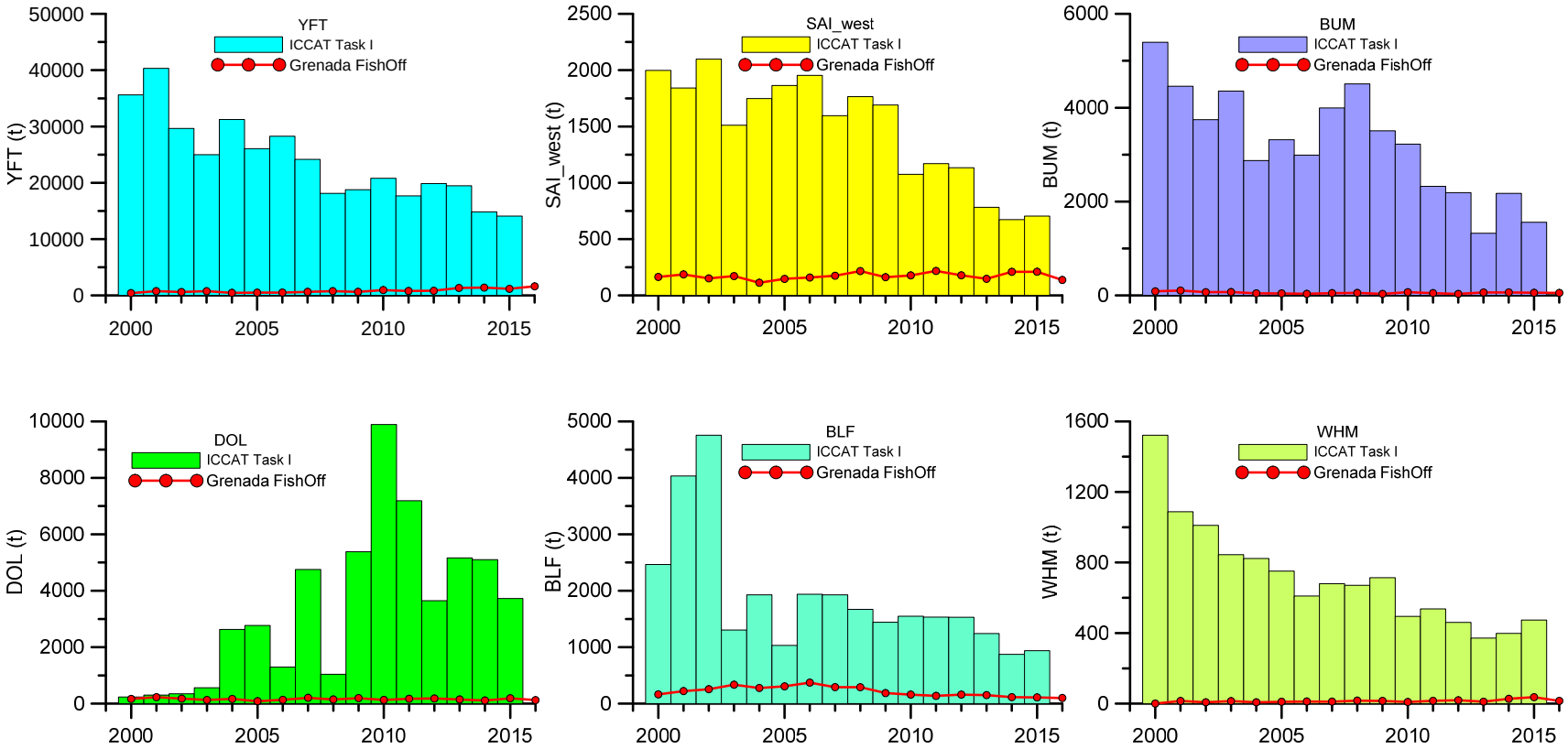
BLF and DOL are part of the Little Tuna Group reported to ICCAT, and have not been formally assessed by ICCAT. Sub-regional initiatives, under auspices of the Caribbean Regional Fisheries Mechanism (CRFM), and in close collaboration with the Caribbean Large Marine Ecosystem Project (CLME) and FAO, have been undertaken to evaluate the two stocks at a sub-regional level in the period 2012-2014. However, insufficient catch and effort data across a significant number of countries participating in the capture of these species made a formal assessment impossible. The observed trends in the ICCAT reported catches over the last 15 years show no clear trend (Figure 2). For BLF, after important catches initially, catches stabilized around 1 000 tonnes but with a decline in recent years. For DOL landings have shown a more or less continuous increase and have stabilized around 6 000 tonnes from 2013 to 2015 in the Western Central Atlantic (FAO, 2017). DOL landings should be used with caution as the estimate is Atlantic wide and was only recently added as part of the ICCAT mandate. It is however very likely that current landings are under-reported.

Grenada's fisheries governance is entrusted to a fisheries division, the fisheries management unit (FMU), as the lead agency responsible for management and development of fisheries. The FMU is a division of the Ministry of Agriculture, Lands, Forestry, Fisheries, energy and Public Utilities (MAFF). The functions entrusted to the FMU include extension, fishing technology, data collection and 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 following the advice of the Fishery Advisory Committee (FAC).

Grenada's Fisheries Act of 1986 was amended in 1999 and is accompanied by various legislative instruments, including the Fisheries Regulations of 1987 with amendments in 2001. The 1987 regulations define licensing requirements, segregating fishing vessels (foreign and national) into size classes, as well as specify the licenses required to process fish, transship fish between local vessels, and to trade fish (import or export). Subsequent regulations enacted include fish trade and its hygiene aspects (1999); the ban of trammel nets (2001); the delimitation of marine reserves and marine sanctuaries (2001). Additional specific regulations include fisheries closures (sea urchin), seasonal closures (lobster, turtle), size limits (conch), and prohibition of harvesting (turtle eggs). Currently (2018) fish aggregating devices management regulations are being developed. However, there are no regulations limiting catch and/or effort of large pelagic fishes. There is not any limitation on entry to the fisheries either.

Grenada's 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.

Figure 2. Annual landings of selected species in the ICCAT area and by Grenada.



The LL fishery for large pelagic species in the Exclusive Economic Zone (EEZ) of Grenada are of open access in nature, other than vessel registration. There are no restrictions on landings of large pelagic species, nor on the effort directed to catch those species. In contrast, some moored-FAD fisheries (Grenville) require local fishers to become members of the local fisherfolk organization to have access to fish around the moored-FADs. However, the access is only enforced through peer pressure and community norms. A FADs fisheries regulation is being developed. Fisheries directed at specific species that include invertebrates and sea turtles, have restrictions that include complete closures, season closures, and size limits. The demersal fish species fishery faces no restrictions on catch nor effort.

The required fishing licenses are tied to the vessels and not the individual fishers. Currently, other Ministries in Grenada view the fisheries sector as the employer of last resort. That is, open access is there to provide opportunities to earn income if a citizen can find no other source of income. As a result, while not disallowed by law, limiting entry would face an uphill battle. However, many fishers in both the FAD and LL sectors indicated a desire for limited entry regulations and a current update of the fisheries legislation is including provisions to allow limiting entry. This is a potential leverage point for capping fisheries effort, introducing harvest controls and for potential future reduction in capacity across both the FAD and LL fisheries, if needed.

Both sectors expressed concern about recent increases in the number of vessels. More and more medium sized LL boats are being built and the sector is experiencing strong growth. While the fish export infrastructure is undergoing growing pains, it is significantly better than it was in the past and it has created additional value in the fishery that is attracting new entrants. Currently, there is a export shipping bottle neck at times due to the lack of consistent outbound air freight shipments. Additionally, there is no shaded loading or cold storage at the airport to preserve product quality if shipping planes are delayed. Both factors increase shipping risk of this highly perishable product and reduce the total amount and quality of product being exported. Nevertheless, one exporter has managed to decrease this risk and enhance shipping pathways enough to offer consistently higher prices to fishermen that will land higher quality product. This increase in fishery value is attracting new fishers and is driving interest in increasing the number of exporters.

Current fishers know that new entrants will dilute the value available in the fishery, particularly now the country has joined ICCAT and will be allocated a country quota for YFT. By limiting entry now, they will be able to protect their value and, if any reductions in have to be made from current harvests, a smaller number of boats will be able to weather those reductions better and enjoy better gains if stock conditions improve. Additionally, several industrial LL captains expressed a desire for a limited entry permit because they know that fishery rents accrue to permits that are limited. They realize that having a limited entry permit is an asset with value that could potentially be traded in the market place. They look forward to such an asset and regard it as a retirement program. That is, when they are ready for retirement they can sell their vessel and permit and perhaps have enough income to retire. They felt that boat sales alone would not provide enough money.

While there is a similar sentiment among the FAD fishers regarding asset values that accrue to limited entry permits, they are more concerned about how current increases in the number of vessels are impacting their Catch per unit of effort (CPUE) and their revenues. It is very inexpensive to enter the FAD fishery. While there are *de facto* rights to the FADs out of

Grenville through the FAD Fishers Organization, there are no rules within the organization about letting the FADs rest and there is limited monitoring and enforcement of their rights on those FADs. As a result of fishing effort from both the FADs fishers organization members and free riders, the FADs are fished too frequently, are not being rested and CPUEs are low. As a result, the organization would like to limit the fishing permits in Grenville and require all fishers belong to the organization and pay landings taxes for FAD placement and maintenance. While not expressly mentioned in discussions, stronger property rights to FADs may also be a leverage point for capping the number of FADs in the water. There is a growing realization amongst the FAD fishers that the FADs themselves represent increases in fishing capacity.

There is a significant number of the smaller vessels (rowing boats) that appear not to be licensed; these vessels generally participate in other fisheries besides pelagic fisheries. While not heavily enforced by the FMU, fishers are motivated to license their vessels as it gives them access to concessions on fuel, gear, engines and import duties.

Fisheries monitoring is mainly conducted on site by Fishery Officers at local fish markets and fish processing plants. Due to the open access nature of the pelagic LL fishery, most of the enforcement at sea is in the hands of the Coast Guard, but its effectiveness may be limited due to the extent of Grenada's EEZ. Reports from the LL captains however indicate that there is little, if any, illegal fishing occurring in Grenada's EEZ. There are occasional incursions by Venezuelan vessels for piracy, but illegal fishing is not frequently reported.

2.2 Longline FPI

The commercial LL fishery in Grenada started in the early 1980's as a Government initiative with assistance from Cuba. Cuba donated four LL vessels and provided assistance to train local fishers. Figures 3 through 5 give an indication of the primary harvest technologies in this fishery. In the early 1980's, the LL fishing method was adopted by a number of surface-trolling pirogues (Type 1 boats, Figure 3) that were converted into operating pelagic LL gear that set about 45–60 hooks baited with flying fish at depths of 27–54 m, off St. George's and Gouyave (West Coast of Grenada). Initial operations were restricted to daily trips, operating between 6 am and 6 pm about 6 km offshore on the western side of the island. During the initial period of operations, fishing was restricted to the months when live bait (mainly the four-winged flyingfish, *Hirundichthys affinis*) was available, October-June. The main target species at the time, were YFT, SAI locally known as "ocean-gar", BUM, and DOL.

These Type 1 boats are 4.5–7m in length, equipped with single or twin outboard engines and set between 100–150 hooks. The Type 1 boats use a hand reel and spool to manipulate the gear and are manned by one or two fishers. They typically do not travel more than 10 nautical miles from the coast and return to port every day as they generally have no ability to carry ice. 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 at sea.

The pelagic LL fishery evolved in the late 1980's by building Trinidadian style fiberglass pirogues (~9 m) with a small cabin top, with capacity for three crew, and powered by two outboard motors, including some basic electronic equipment and safety gear. However, these small vessels had many of the same limitations in operations that the smaller vessels had. See Figure 4 for a picture. These vessels are single or twin outboard powered (40–75 HP) and set

200–300 hooks on overnight trips operating 30–35 nautical miles offshore. They usually have capacity. These vessels use a hand reel and spool to manipulate the gears.

In the early 1990's, with the assistance of the Japan International Cooperation Agency (JICA) eight LL vessels, jointly designed between Japanese and Grenadian technicians, were donated to start fishing operations for high quality products (mainly YFT) for the international export market. These Type III vessels (Figure 5) are capable of fishing trips 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. Type III vessels are 9–18 m fiberglass/wooden/steel vessels. The largest vessels are manned by four to six crew. They fish year round using frozen imported bait to chum for the preferred flying fish bait, while sometimes using locally caught jacks used live and dead bait when flying fish are scarce. The successful use of this type of vessel to capture export quality tuna has led to the increase and evolution of the LL fleet.

Figure 3. Type I Vessels.

Photo: Freddy Arocha

Figure 4. Type II Vessels.

Photo: Freddy Arocha

Figure 5. Type III Vessels.

Photo: Freddy Arocha

Capital investment certainly depends on the vessels being used. Type I and II boats are built locally at low cost. The Type III vessels are either repurposed king mackerel and inshore LL boats purchased from the USA or locally built boats. Carriacou and Petite Martinique are known locally for their boat building skills. Generally, the Type III vessels in the fleet are worth USD 30 000– USD 50 000.

Labor for each trip is compensated using the share system that is similar across all vessel types. Fifty percent of the net revenue goes to the vessel owner while the remaining 50 percent is split equally between the captain and crew. Type I and II boats are mainly operated by their owner, while fewer of the Type III boats are owner operated. However, even for Type III boats, the number of owner operators is high.

There are 2 028 licensed fishing vessels included in the vessel registry list provided by the Fisheries Division. All fisheries are completely open access and the fisher needs a license, the vessel needs a registration and the first dealer needs a license. The first dealer is required to report all landings, volume and value, by species.

Unfortunately, there is no clear delineation in the registration list regarding gear types or fisheries in which the boat lands fish. Additionally, the vessel register does not use the same nomenclature (Type I – III) that the Fisheries Division has adopted. There are 336 open pirogues in the list (Type I), 278 pirogues (Type II) and 81 long line vessels (Type III) in the register in 2017. 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 fish exporter, who appears to handle 80–90 percent of all export tuna, he says there are 60 to 80 Type II and mostly Type III boats active in the fishery that sell to him. If you include the Type I vessels, the total number of active vessels may increase by another 40 vessels. While all these boats have sold fish to the fish exporter in the past, he regularly works with the same 60 vessels. Speaking to the Fishery Officers, there are 192 active LL vessels in total with 127 Type III vessels and 65 Type I and II.

The traditional primary LL fishing season depended on the availability of four-winged flying fish (*Hirundichthys affinis*) as live bait, which occurs in the Grenadian waters during the period October through June. Currently, most LL boats will purchase thread herring

(*Opisthonema oglinum*), imported from Florida, USA at USD 0.50- 0.60 per pound. They use the thread herring rarely as the LL bait, but instead use it as chum to catch flying fish, which they use live if possible, but mostly dead. The use of flying fish and relatively short drop lines contributes to the "bycatch" of SAI and BUM and may represent an opportunity to reduce billfish harvest. Additionally, flying fish abundance and therefore availability has been highly variable in recent years, which is attributed to the influx of sargassum seaweed. Flying fish caught and used as bait are not included in the landings data and therefore are not being used in stock assessments of this sub-regional stock. When flying fish availability is low, LL vessels will use threadfin herring dead, local caught live carangids caught in seines or dead caringids imported from nearby islands. While the preferred baitfish is flying fish, a couple of ports have switched to carangids. In these ports, dedicated carangids seiners catch bait, hold them in a pen and sell them live to the LL vessels in the port. While the LL fishery is still seasonal, they can fish year round and are typically full time fishers, even from the smaller boats. Switching bait types from flying fish to caringids may provide a leverage point that addresses both flying fish sustainability and reduces billfish catch at the same time.

2.2.1 Market and product forms

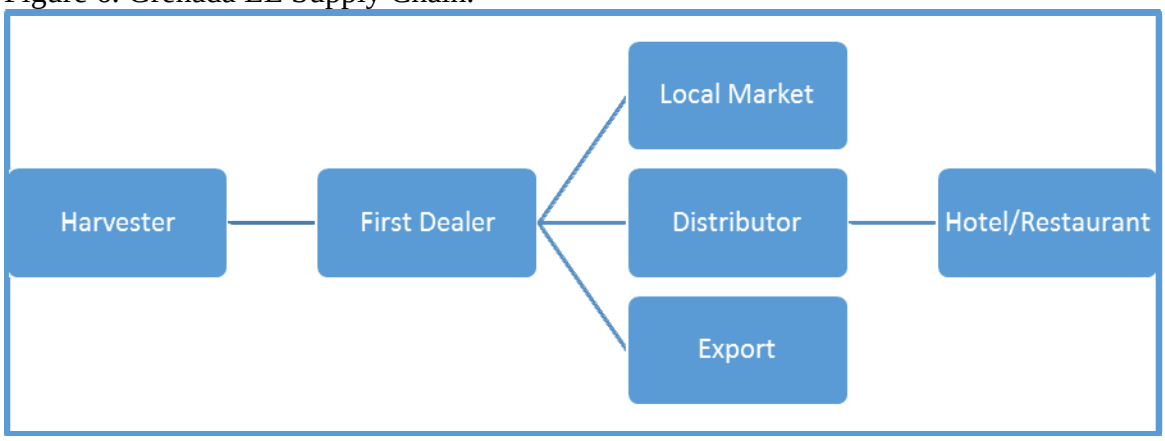
The LL fishery for pelagics primarily catches YFT for export. In 2016, Grenada exported 916 tonnes of YFT worth USD 6.7 million. The YFT is exported fresh via commercial passenger and freight aircraft. The YFT that is exported is minimally processed. It is gilled and gutted while at sea, by the Type II and III boats, and packed in ice. The Type I boats will actually run export quality fish directly back to the buyer leaving their gear in the water returning to the gear after selling the fish. Billfish, DOL and WAH and tuna that do not meet the requirements for the export grade are all sold in the local markets. This "bycatch" (the fishers call it bycatch) is economically important and may be sold fresh or frozen for later sale locally.

Figure 6 presents a the LL supply chain in Grenada, which is a very simple supply chain. For the LL fleet, the key points in the supply chain are the three fish houses built by JICA, and two other private facilities. Right now (2017) there are three export tuna buyers but really only one buyer that handles the bulk of the activity. This buyer operates out of one of the JICA facilities, which was purchased from the government, renovated with private capital and is 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 fully HAACP compliant. The other two exporters operate from private docks or take delivery from the public JICA developed docks and move the product to their facilities. On the west side of the island, in Gouyave, there is another JICA constructed facility. It has an ice plant, a retail market, cold storage and a Hazard Analysis and Critical Control Points (HACCP) compliant processing facility. Currently this facility is not involved in exporting tuna, but there is interest in re-opening it for that purpose. There is one exporter active at the facility, who has recently scaled back his operations considerably, pushing many fishers to St. George's to sell to either exporter there. Essentially, there are three fish exporters in Grenada, but one is nearly out of business, one has a small share of the market and one handles the vast majority of the export volume.

The exported tuna is graded in the USA by the importer and the price is determined once graded. The importer will not take any of the grading risk, which leaves that risk to be shared between the exporter and the fisher. Tuna grading is not an exact science. Exporters that do predictive grading seem to do better in the US market. Many risk factors could harm the product grade once it leaves the exporter's hands that he/she has no control over. All

exporters try to handle this grading risk in different ways and have tried many different ways in the past. Some are selling on consignment, transferring all the risk to the fisher, but generally resulting in higher dockside prices. However, the resulting delays in payout and settlement can create tension between the fisher and the exporter. Some offer "standard" prices for tuna transferring all the risk back to the exporter, but not without compensation for that risk. Because pricing is frequently done in a non-transparent manner, the trust of fishers in the exporters is low. This is driving interest in two locations in Grenada to start a cooperative that also does the exporting and pays the fishers either on consignment or via a predicted grade/price with mark ups for ice packs, boxes and shipping costs.

Figure 6. Grenada LL Supply Chain.



The processing facilities are relatively small, but not much room is needed as very little processing takes place. Fresh fish that has been gilled and gutted at sea are boxed and refrigerated for twice weekly flights to the USA. All processing is done at sea, except for one buyer that has some value added capability with a smoking plant. He used to smoke SAI for export to the USA until the USA banned imports of billfish. The largest exporter's state of the art ammonia ice plant can freeze 20 tonnes of ice a day. All first dealers front the vessels fuel, ice, bait, gear and provisions and there is an expectation if a vessel took the loan of supplies, the vessel will land their fish at the same dealer that provided the supplies.

Currently (2017), cargo flights from Grenada to the USA are flying infrequently and not according to a reliable schedule. There are not any cold storage facilities at the airport or even a shaded loading area. This puts transport by air at great risk of losing grade if there are any delays in the shipping chain. Increasing the exported volume of both fish and agricultural products would increase the demand for cargo flights and possibly attract more frequent and consistent service. Investing in a refrigerated cargo terminal at the airport would pay dividends to the fishery sector and agricultural product sector in Grenada.

2.2.2 Scores and discussion

Figure 6 displays the output scores for the Grenadian pelagic LL fishery. Complete (detailed) score sheets are not included in this summary report, but are available upon request from the authors. The LL fishery receives the highest scores for processing owners and managers, risks, harvest performance, owners, permit holders and captains and post-harvest industry performance. It scored the lowest on harvest asset performance because the fishery is completely open access and therefore, without limited entry, fishery value will not accrue to

the vessel or the permit.[1] As mentioned above ending the open access regime is a desired intervention in the LL fishery. It should be pointed out that this may be a good leverage point for moving in the direction of rights based management as the participants understand that a limited entry permit is a valuable asset (property) and that fishery rents accrue to that permit.

The LL fishery also had lower scores in the ecologically sustainable fisheries as YFT, BUM and WHM are all overfished. Given the fact that these pelagic resources are shared at Atlantic ocean level and Western Central Atlantic ocean level, the same scores would largely apply for similar fisheries elsewhere in the region. All other metrics were scored moderately well. This is another good point for leverage as Grenada has recently (2017) become contracting party of ICCAT. The main exporter supported joining ICCAT for the added professionalism it would bring to the fishery and fishery management within Grenada, but expressed concerns about country quotas and what their impact might be on his business. Fisheries are not regarded as a "professional" or "important" industry in Grenada. That hampers the investments made to improve regulations and management of the fishery locally. The attention to the sector may be on the rise, with the appointment of a Minister for Fisheries in 2016, and renewed efforts to develop a fisheries sector policy, review of the fisheries act and drafting of FADs fisheries regulations. It is thought that ICCAT membership, accompanied by implementation of the ICCAT recommendations by Grenada, and limiting entry to the fisheries sector would be good first steps in demonstrating the importance and value of pelagic fishing to the Grenadian government. Pursuing those paths will improve sustainability.

[1] As discussed in the text above, open access fisheries dissipate rents, because entry is not limited and anyone can build a boat, taking a share of the resource rent. Limiting entry is often a first step in fishery rationalization. By limiting entry, some of the resource rent accrues to the newly created permit, creating an asset that can be bought or sold. The permit has value because it limits access to a valuable resource, value that is dissipated if entry is not limited.

Figure 6. LL output scores.

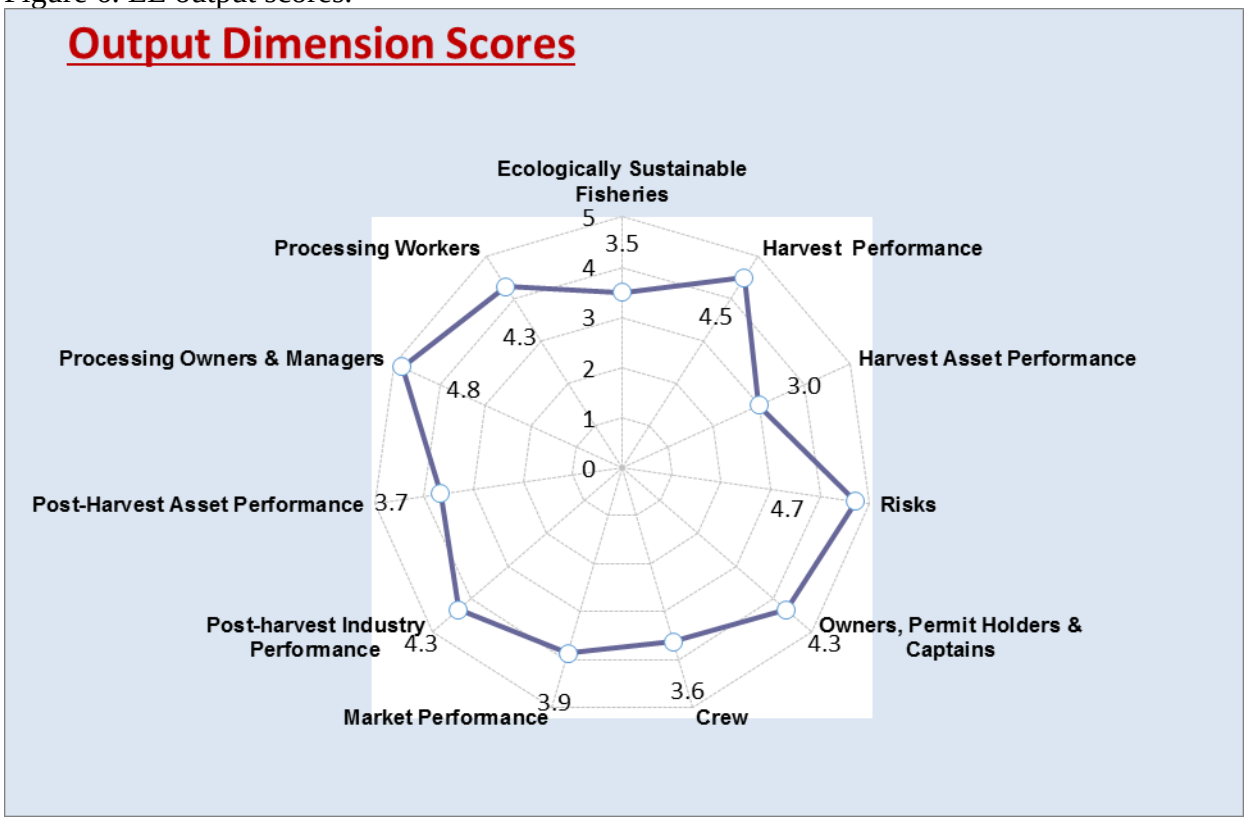
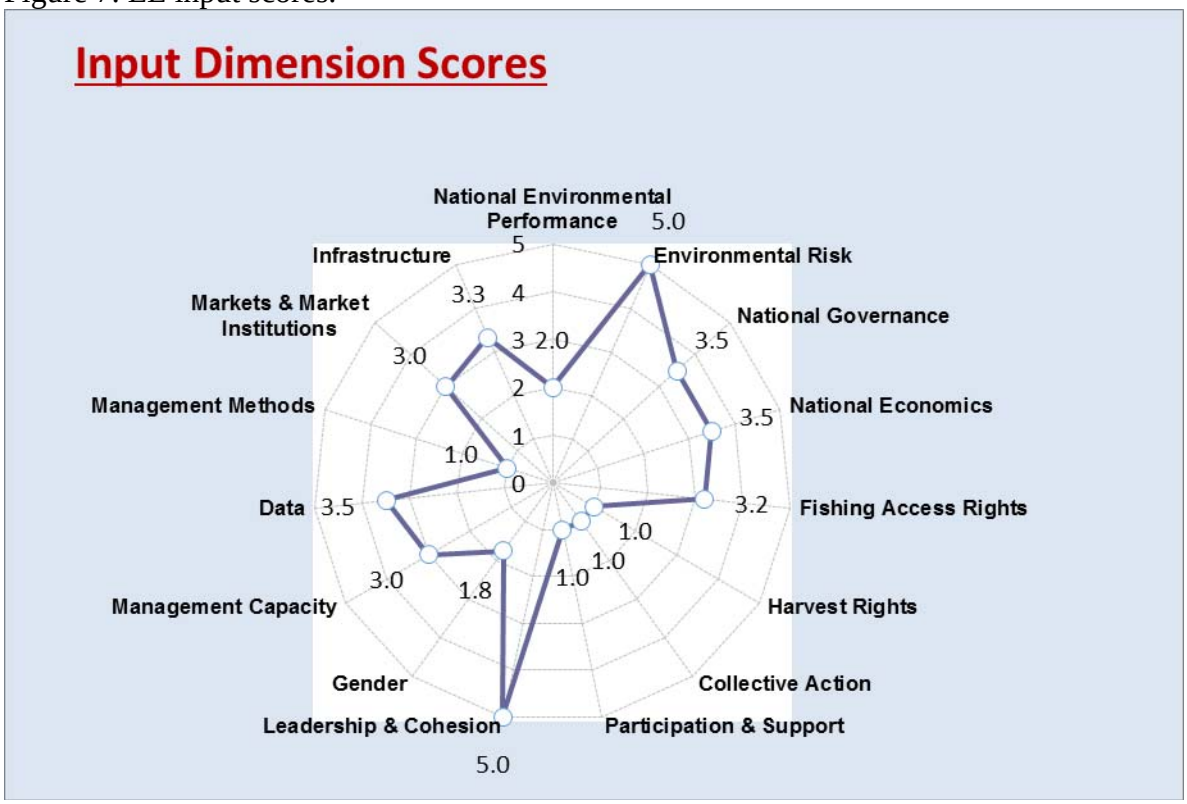


Figure 7 displays the summary of the input scores. The fishery scored well for environmental risk and leadership and cohesion. The fishery scored moderately on national governance, national economics, fishing access rights, infrastructure, markets and market institutions, data and management capacity. National governance received its moderate score because many of the enabling conditions are available to allow for good management. With minor improvements to its landings data collection, including electronic reporting, it would have a very high quality statistics and management information system. As mentioned above, fishery management gets little respect. There is a need to "professionalize" the image of the industry in the eyes of the government. Fisheries employment has been treated as the employer of last resort. This has led to high effort and culture that believes that open access and having many participants in the fisheries is a social good. Also, even though tuna exports contribute 18 percent of all foreign exchange earnings for Grenada, the sector is not treated or regarded as a valuable industry.

Figure 7. LL input scores.



On the input side scores were poor on participation and support, collective action, harvest rights, national environmental performance, gender, and management methods. Participation and support is driven by two scores: participation in management and management cost recovery in the fishery. Both dimensions received low scores. There are virtually no regulations applicable to the pelagic fishery. Moreover, there are no stakeholder meetings with the LL fishery sector, and options for public comments or general participation in the management process are absent. The Fisheries Advisory Committee (FAC) is provided for in the fisheries act, but has not been functional in recent years. While the Fisheries Division's officers have a good and open relationship with the fishers, there is no formalized connection between those relationships and the management decision making processes. This will be a critical point in moving forward with any intervention that requires new regulations or management frameworks. There are no fish landings taxes, port user fees or a mechanism for cost recovery of any sort in the fishery.

Collective action scores are derived from proportion of harvesters in industry organizations, harvester organization influence on management and access to and influence on business and marketing. This is an excellent point for leverage in bottom up driven management interventions. It seems that membership in fisherfolk associations and cooperatives was higher in the past than it is now. However, because of the reduction in the number of fish buyers and exporters, there is a realization among the fishers that it would be beneficial to organize and perhaps form export cooperatives. These cooperatives should aim to improve the prices the fishers receive for their products and lead to more control over their financial future. Since there is very little direct regulation or management and there are no open meeting or public comment rules, the few organizations that exist do not have much influence on fisheries management and generally function as mutual aid groups.

The score for harvest rights is low because there are no rights in place and all the other categories that follow on are scored as not applicable. If rights would be instituted in the future, this score will rise. Limited entry is not considered rights based management in the FPI manual.

National environmental performance score is a single metric and the score is taken directly from the countries score on the Environmental Performance Index estimated and maintained by Yale University.[2] The score considers factors such as disease, water quality, air pollution, bio-diversity, natural resources and climate change.

Gender received a low score as there is very little involvement of women in business management, resource management or participation in the harvest sector. There is a 20-40 percent female participation in the post-harvest sector, mainly as office or clerical staff. All box packing and any additional processing is dominated by men.

Finally, management methods were scored low. That score is based on whether or not MPAs or sanctuaries are utilized, whether spatial management is used or whether there are fishing mortality limits. All were scored with the lowest score available as none of those tools are used for pelagic fisheries in Grenada or the region at large. It is possible that spatial regulations could be used to reduce SAI mortality if inshore areas were closed to LL fishing at least during the heaviest part of the SAI seasonal migration. Mortality limits are inevitable now ICCAT membership has been obtained, so this score is expected to rise.

2.3 FAD fishery

Figure 8 shows the typical FAD fishing vessel used in Grenada. Generally they are very similar to the Type I boats above, but without LL reels. Typically, they are 4.5–7 metres long and equipped with a single outboard engine. Most of the Grenville FAD fishing vessels have ice holding capacity and they generally use ice. These vessels may participate in other commercial activities, including water taxi (in Carriacou), other demersal fisheries and some recreational charter fishing. The center of the FAD fishery in Grenada is the port of Grenville but there are also active FAD fishers in Carriacou and Petit Martinique.

In Grenville, the heart of Grenada's FAD fishery, there are 125 vessels registered but only 80 are active. There are only a handful of FAD fishers in Carriacou and really only two in Petit Martinique. The fishers out of Grenville maintain and fish five FADs and the local FAD fishers organization collects a levy of USD 1.85 for every 50 pounds of fish landed for maintenance and replacement of the FADs. They informally enforce their ownership of these FADs. Before this arrangement of FAD ownership to the FAD organization, there were a lot of conflicts, such as line cutting and violence. The "Grenville FAD Fisherfolk Organizaton" are a model for FAD management. The FADs are owned by this organization and the FADs cannot be fished unless the fisher has a license issued by the group. This could be a leverage point for increasing the strength of their right and as a way to bring exclusivity and increase incomes. Currently, free riders and lack of rules within their own organization result in lower than expected catches around the FADs, reduction of CPUEs, increasing costs and therefore reducing fishers incomes. The ideal would be to rotate FAD use, resting each FAD several days after each day of fishing to allow the fish to return and CPUEs to stay high, however the FAD Fisherfolk Organization would need to formalize use and enforcement of their FAD

[2] http://epi.yale.edu/

rights. Currently, these FADs are often fished multiple times a day, reducing CPUEs significantly.

Figure 8. FAD fishing vessel

Photo: Freddy Arocha

The Carriacou fishers recently set five FADs, but only two are still in operation. Those that were set on the east side of the island of Carriacou are subject to strong currents and ship strikes. The FAD fishery by fishers of Carriacou is fairly new and the fishers are figuring out how to manage the FADs best. The fisherfolk organization owns and manages the FADs in a similar way to Grenville, but is organized in a less formal way. This could be a significant leverage point to move into the more formal rights direction as is practiced in Grenville. Additionally, the fisherfolk organization could work towards improving quality of the landed fish, which could enable the access to export markets. The two Petit Martinique FAD fishers maintain two FADs each and they fish them individually and independently. One FAD owner sets his FADs very far offshore (65-70 miles offshore) to protect his ownership and to reduce free riding and the associated decreases in CPUE and reductions in income. He does not share his FAD locations and the FADs are not marked. He is also one of the only FAD fishers that sells YFT for export. He is able to do this by developing relationships with the LL boats that port in Petit Martinique but sell their catch at Spice Island Fish House (SIFH) near St George's and he is able to combine his FADs catch with the LL catch. This example shows that it is possible to catch the large tuna necessary for sashimi export from FADs and demonstrates that FAD fish can be exported, improving FAD fishers livelihoods. While technically a grey market, exporting catch to the high-end resorts in neighboring St. Vincent and the Grenadines is occurring. This, within CARICOM trade, could be formalized and encouraged.

The primary harvest technology by the FAD fishers of Grenville is trolling around the FADs using small plastic squids locally called "skoochies."[3] Preferred colors vary, but the fishers currently like green or green and pink. The catch consists of DOL, BLF, small neritic tunas,

[3] Also called "hoochies" in the United States.

YFT, KGM, WAH and occasionally marlin or sailfish. All of the fish are for local consumption in Grenville. The YFT the fishers catch are typically smaller, 40–140 pounds, and, as a result, are not necessarily of export size.[4] This year, their primary target has been YFT as DOL are very scarce. The local market prefers the lighter DOL to the darker meat of YFT. The FADs fishers have no access to export markets logistically and, as a result, there is not much interest in Grenville for exports. This presents another potential leverage point as the international airport where the St. Georges harvests are exported is only 32 km away with less than an hour drive time. The Grenville landing facility would have to obtain HACCP certification and fishers would have to ice any tuna over 60 pounds. Additionally, the fishers of the FADs fisherfolk organization would have to develop a relationship with a fish importer in the USA or elsewhere. Some of the other exporters in Grenada ship very low volumes to the USA infrequently, so it appears possible and economically feasible to export small volumes as well. However, Grenville port fishers have historically never caught very large YFT and YFT catches by Grenville fishers have been down the last few years. The Grenville fishers use drop lines with live bait, which is a gear type that has high billfish catch rates and is used heavily in other FAD fisheries in the Caribbean. Drop lines consist of a single line affixed to a jug or float. That line contains one or two hooks as sometimes a weight. See Figure 21 for a picture of this gear.

The Carriacou and Petit Martinique fishers are slightly different. They troll skoochies, but mainly to catch bait and fish drop lines around the FADs. Their drop lines are set from 8 to 25 fathoms (15 to 46 metres). Their primary catch consists of YFT, BET and BLF. Most of the catch is for local consumption. The fishers also export fish to the other islands of the Grenadines using their own vessel. FAD fishers in Petit Martinique have access to export markets via transshipment by LL boats. Petit Martinique is the homeport for the vast majority of the larger LL boats. As such, there are regular trips by LL vessels from Petit Martinique to the fish houses in St. Georges. As a result, the Petit Martinique FAD fishers have access to the exporters in St. Georges through the LL fleet that will transship larger YFT to the export buyer. If a FAD fisher catches a YFT that he thinks will grade well, he will have it transshipped to St. George's for export.

Capital investment for this FAD fishery is low. The single outboard 18' boats are inexpensive and handline trolling gear is cheap and available locally. Sixty percent of the captains also own their vessel. They use a share system to share revenue. Generally the boats are operated by one captain and one crewmember. In Grenville, they use the share system for remuneration and the shares are as follows; 50 percent for the boat owner and 50 percent is shared equally between the captain and the mate. In Carriacou, and Petit Martinique, the share is 50/50 for the owner and the crew, but the FAD itself gets one whole share, just as a crewmember would. That pays for upkeep and maintenance for the FADs. FADs cost USD 500 to USD 1 800 to build and set, depending on depth. The FADs installed so far last four to five years at the very longest. The FAD fishers that operate out of Gouyave have had a real problem keeping their FADs from disappearing when they set them on the west side of the islands. They attribute those losses mainly to merchant ship traffic as there is more traffic on the west side.

One of the FAD fishers on Carriacou takes a few charter recreational trip each year and showed interested in expanding that business. There are no other charter fishing operations on the island of Carriacou. This may create a leverage point for diversifying and improving incomes for FAD fishers. While Grenada is not viewed as a recreational fishing hotspot, it

[4] Export YFT or BET have to be over 60 pounds.

has significant tourist volume and it may be possible to support the further development of charter fishing businesses. There are relatively few excursions available on Carriacou, which is a quieter destination that Saint George and caters to a more adventurous tourist. It may be possible to support several light tackle charters operated out of traditional FAD fishing vessels that target SAI, small tunas, wahoo and other coastal pelagics with limited investments and potentially little stock impact if the fisheries are catch and release as a condition of investment.

2.3.1 Market and product forms

Fish are barely processed by the FADs fishers. Larger fish are gilled and gutted at sea, but most fish are landed whole. Processing is generally left to the retail customer's desires or sold whole. The supply chains are extremely short in Grenville. They offload at the JICA built facility and their catch is sold at the facility directly to the customers. There is no further distribution. Any unsold fish are frozen or salted and dried. As with the LL fishery, there is very little competition in first buyers. The JICA facility in Grenville has an ice plant and frozen storage capacity.

2.3.2 Scores and discussion

The scores for this fishery, particularly on the input side, are similar to the LL fishery. Figure 9 displays the output dimension scores for the FAD fishery. On the output side, the FAD fishery scored nearly identically except for harvest sector performance and market performance scores that were substantially lower and post-harvest industry performance slightly lower. Harvest scores were driven lower mainly by lower CPUEs and a larger number of vessels involved, particularly in Grenville. Too much fishing effort around FADs, drives down the CPUE and increases the costs to achieve the same revenue or just simply reduces revenues from the fishery. The fishers sincerely feel that if the fleet would be reduced by 50 percent, they would have to fish half as hard to realize the same harvest levels, improving their profitability. This report, being an FPI report, makes no quantitative estimates of capacity, however. Part of the reason CPUEs are lower is because the fishers are not resting the FADs between fishing events. Resting their FADs is a goal of the Grenville FAD fishers' organization, but new entrants and little enforcement of the organization's rules generally mean the FADs do not get rested and CPUEs suffer.

Market performance received the lowest output score by either commercial fishery in Grenada. The market performance summary score is driven by the scores across ex-vessel price compared to the historic high, final market use, international trade, final market wealth, wholesale price compared to similar products, capacity of firms to export to the European Union or USA and ex-vessel to wholesale marketing margins. This section received its highest score for the stability of ex-vessel prices. For final market use, all product is direct to moderate value human consumption since it is all consumed locally. There is very limited international trade of fish caught by FADs fishers and thus a very small capacity to export to the EU or USA. Because nearly 100 percent of the catch is used for local consumption and the Grenadian Gross Domestic Product (GDP) per capita is just over USD 9 000, this fishery scored low on the final market wealth metric. Wholesale prices compared to similar products elsewhere were less than half the global average when comparing YFT prices available from the sashimi market. Finally, ex-vessel to wholesale margins were in the 10-20 percent range. Because hardly any FAD fishery product is being exported, there is very little motivation to meet EU and USA import standards and this pulled the market performance score down.

Figure 9. FAD output scores.

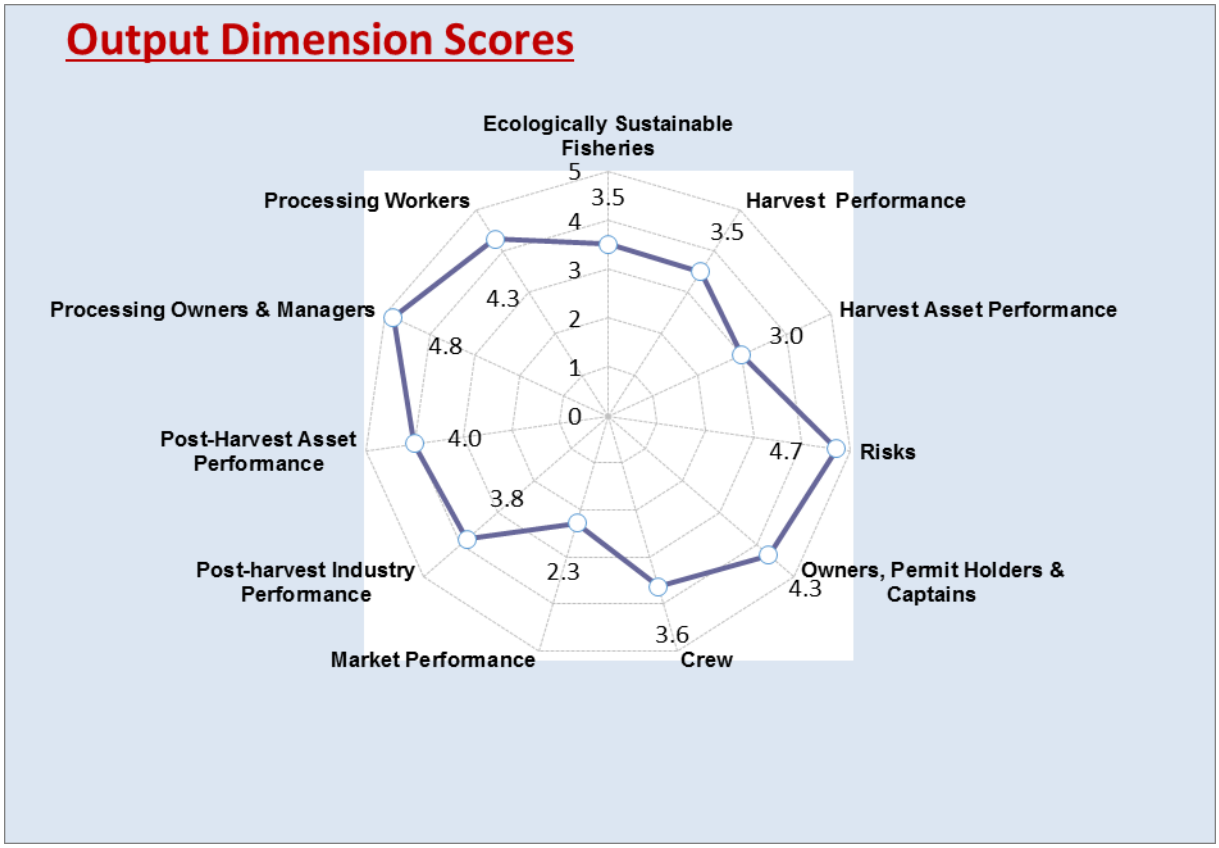
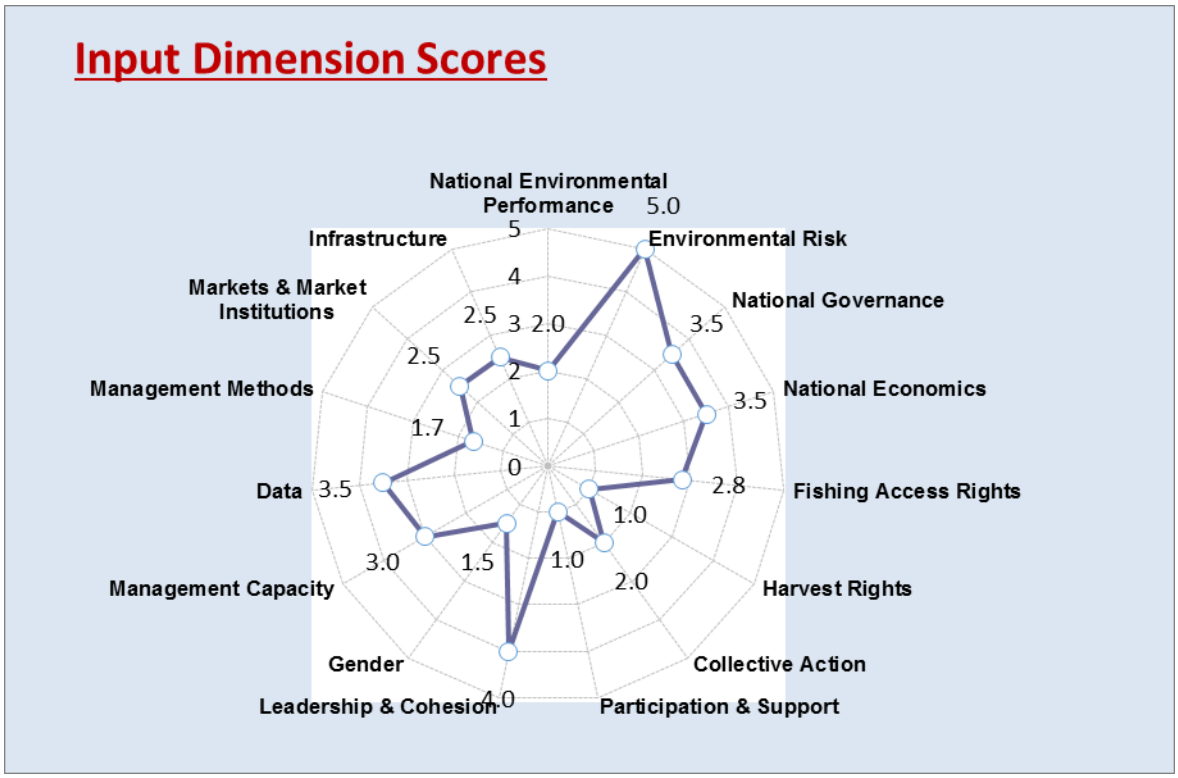


Figure 10 displays the scores on the input dimension. The FAD fishery scored lower for Markets and Market Institutions, Infrastructure and Leadership and Cohesion. This fishery scored lower than the LL fishery on Markets and Market Institutions, because the landings pricing system is unresponsive and uncompetitive. It is hard to see what is going on, but prices do not change seasonally and vary very little from year to year. Partly this has to do with the limited competition at the buyer level. There is only one fish buyer active in Grenville and similarly few buyers in Carriacou and Petit Martinique. Additionally, there is virtually no vertical integration in the FAD fishery.

Infrastructure scores were lower for the FAD fishery, mainly because there is little to no access to international shipping services, very little cooperative extension and less access to refrigeration and ice than the LL fishery. The FAD fishery scored lower, but only slightly lower, in the Leadership and Cohesion metrics mainly because there is less central leadership within the fishery. The FAD fishery scored better on Collective Action and Management Methods. The fishery scored better for collective action because there is a functioning cooperative that participates in co-management for the Grenville FAD fishers and there seems to be a lot of will to expand collective action in other areas. The FAD fishery also scored slightly better on Management Methods because their voluntary FAD ownership and management is a type of spatial management.

This fishery scored poorly on the harvest rights metric for the same reason as the LL fishery; there are no harvest rights. There is no TAC nor any limited entry applied to the FAD fishery. It is truly an open access fishery. It scored slightly better on access rights because the FAD fishers in Grenville are trying to secure and protect their community rights to the FADs through charging maintenance fees and issuing of licenses to use the FADs.

Figure 10. FAD input scores.



2.4 Recreational fishery

The recreational fishery in Grenada is very small. While the Grenada Game Fishing Association (GGFA) suggests there may only be a dozen private sportfishing boats in both marinas in St. George's, Ehrhardt and Fitchett (2016) suggest there are as many as 60 recreational fishing boats across all three islands. During the study teams' touring around all three islands, it was difficult to support the 60 vessel number, when looking for typical 30' or larger vessels with outriggers set up for trolling; the type that target pelagics. Upon further examination, there are only 15 boats registered as recreational fishing vessels and 58 foreign vessels that obtain a license for the Spice Island Fishing Tournament. The 60 vessel number came from an older survey of all yachts and sailboats and asked about occasional fishing participation. These boats are not likely targeting pelagic species. Without a recreational fishery specific fishing license, it is impossible to know the exact number of recreational fishing vessels. It also virtually impossible to determine if an unrigged wood or fiberglass vessel is a commercial or recreational vessel, therefore exact number of vessels involved in recreational fishing remains unknown.

There are two active recreational fishing charter captains and two more that are not currently in the fishery due to various issues. The recreational fishery using charter vessels is primarily a blue marlin fishery that catches a better than average sized fish, but catch rates are low. It is a 100 percent catch-and-release fishery for billfish. Both active charter captains have begun to actively target large tunas during the right seasons. The vessels also troll for DOL, WAH, KGM and barracuda in order to put a fish in the box if the client wants one or to earn a little extra income. Both active captains sell fish if they get good quality DOL and YFT. In this fishery, any harvested fish belongs to the boat, but generally the captains will give the client

enough fish for a meal at their hotel that night. This is definitely not a meat fishery for the clients and they have no facilities to freeze or package catch to take home.

It is hard to estimate the total number of recreational participants as there is no angler fishing license. Instead, the vessel registry will include a recreational designation and there are 15 recreational boats registered. Additionally, while licensing is required, the recreational fishing license is the same license that commercial fishermen obtain and it allows for fish sales, except for the non-residents that come for the tournament. There were 58 licenses issued to foreign recreational boats in 2017, but they do not include the concession for fish sales. Technically, if fishers are local and are not going to commercialize or sell the fish, there is no need for a license. As a result, a few years ago a survey of all boats was conducted to determine if other types of vessels, such as sail boats or yachts, ever fished. That survey estimated that 60 vessels at least occasionally fished.

Private and for-hire captains all have to get the license, which is tied to the vessel. Out of island visitors are required to obtain a license if they are bringing a boat, but not if they fish on board of a charter boat. Technically, however, it is nearly impossible to license foreign vessels, which poses an issue for visiting anglers and for the international tournament held in Grenada. The ministry issues exemptions for the Spice Island Billfish Tournament. It would be a good idea to move towards a separate recreational fishing license and use the license as data collection sample frame. Offering a range of license options from day-passes to an annual permit for residents and non-residents, would give an insight in the participation and the efforts of recreational fisheries in Grenada. There are currently no effort or catch estimates for this fleet.

Grenada hosts one international billfish tournament, the Spice Island Billfish Tournament. It is a four-day release tournament held in late January each year. 2017 saw 62 boats enter the tournament with 70 percent of those boats from Trinidad. In 2012, the tournament organizers commissioned a study to estimate the economic impact of the event (Charles and Associates 2012). The 2012 tournament generated USD 862 974 and raised USD 77 930 in tax revenue. The sponsors and organizers of the tournament have recently started a non-profit called the Grenada Game Fishing Association, which is an umbrella organization supporting the tournament. However, it may also function as a leadership organization for this project moving forward.

Figure 11 displays the typical recreational fishing vessel in Grenada, this one belonging to one of the for-hire operators. Typical boats in this fleet mirror fleets in other big game fishing destinations. Generally, they are 30’ to 50’ (9 to 15 metres) in length and are equipped with dual inboard diesels with cabins and modern amenities. The recreational fishing fleet is not as modern as in some other ports, but the boats are well cared for and comfortable.

Figure 11. Typical recreational boat.

Photo: Freddy Arocha

The two active recreational fishing charter vessels are captain owned. The other two that are currently out of commission, both are also captain owned. Only one charter boat makes his entire income from charter fishing and the other captain has other income sources. Each vessel fishes with the captain and one deck hand. Both pay their mates a wage plus a share of tips. Boats of this caliber can be quite expensive and all of the specialized rods and reels are very expensive. There are excellent marine service providers locally in Grenada and basic tackle is also available. All specialized lures, rods, reels and electronics are imported from the USA.

2.4.1 Markets and product forms

In total, there were 473 762 visitor arrivals in 2016 (Pure Grenada, 2017). 314 913 of those visitors were cruise ship patrons and 155 579 visitors were stayover visitors. Forty-one percent of all stay over visitors are from the USA. Most stayover visitors are staying at large international all-inclusive resorts. Both types of visitors, cruises and all-inclusive, tend to be very price conscious travelers. Grenada conducts and exit survey that includes participation in fishing activity, but, to date, Grenada has not analyzed the response to this question.[5] With only two for-hire boats in the water during this study, it is roughly estimated that only 350–400 charter trips are taken each year. If two more charter boats are in operation, that level of effort could double. It is estimated that there are only a dozen private recreational fishing vessels in either marina in St. Georges harbor. It is possible that visiting private anglers from Trinidad and other islands are responsible for as much effort, or more, than Grenadian recreational fishing vessels. There are however no data on effort, catch or participation in either for-hire fishing or private boat angling.

One issue with attracting more fishing visitors is the difficulty of traveling to Grenada. While there are more flights to Grenada than ever before traveling from the West Coast of the USA

[5] June 25, 2017

can take two days and requires two connections. While Grenadian recreational fishing is good, there are better destinations, in terms of catch numbers or catch size, which are a shorter plane flight from the USA. In comparison, a destination like the Dominican Republic, which is ranked as the #2 BUM destination in the world, is no more than one flight connection from anywhere in the USA and there are multiple markets with direct, inexpensive flights.

Additionally, there is little awareness of Grenada as a fishing destination in the USA market, and neither of the active charter boats do much marketing in the USA, relying instead on a web presence, referrals and relationships with the local hotels. One charter captain used to attend fishing shows in the USA to advertise his business, a common and proven technique, but found it the return on investment was too low. It seems however, there is scope for growth in this sector. The Ministry of Tourism, Civil Aviation and Culture of Grenada is keen to support the development of recreational fishing and might be open to increasing sport fishing's visibility in their marketing campaigns. This ministry attends many tourism exhibitions in the USA to advertise Grenada as a tourism destination. It could be possible to have the Ministry attend sport fishing exhibitions and conferences on behalf of these captains. In recent years, there has been relatively good fishing magazine coverage of the recreational fishing opportunities in Grenada, but this hasn't really generated additional business. One of the barriers mentioned by the charter captains is the type of tourist that visits the country. Most are either visiting under an all inclusive resort package or are cruise ship passengers. Neither are the ideal client as they tend to be value conscience travelers and are unlikely to spend upwards of USD 750 for a fishing trip.

2.4.2 Scores and discussion

Figure 12 provides the output dimension scores for recreational fisheries in Grenada. This fishery scores well across many metrics. Its weakest score can be found in For-Hire Economics, which was driven down by a number of factors. One, because there is no limited entry, there is no asset value in this fishery. As described in the LL and FAD fisheries above, as long as a fishery is open access, resource rents can be dissipated. By limiting entry and requiring a limited permit, some of the resource rents will accrue to that permit. As a result, the fishery is automatically scored a "1" across current asset value and the trend in asset value, pulling the average score down. This fishery also scored poorly on trip price compared to historic price. Charter fees have been very flat and are not keeping up with inflation. This is likely due to an increase in budget minded cruise ship passengers and budget minded all-inclusive resort guests, both of which have been increasing. Generally, in markets dominated by cruise patrons and all-inclusive, package deal tourists, there is a lot of price competition for excursions and Grenada is no different. Both for-hire recreational fishing businesses take a lot of these types of patrons, but prefer the dedicated angler that is less price sensitive and will book two to three charter days on a single visit. This recreational fishery has zero vertical integration, further dragging this score down.

Ancillary businesses score was just above the score for For-Hire Economics and this score was pulled down by the proportion of local expenditures on fishing tackle and gears being low as most of this equipment is imported from the USA. Basic tackle like line, hooks, weights, swivels and other terminal tackle are widely available on the island as many of those items are used also in the LL and FAD fisheries. Lures, rods and reels and other higher-end tackle are imported and face nearly 100 percent duties. Moreover, this score was brought down by the proportion of anglers fishing from private boats as the private angler community is small.

Figure 12. Recreational output scores

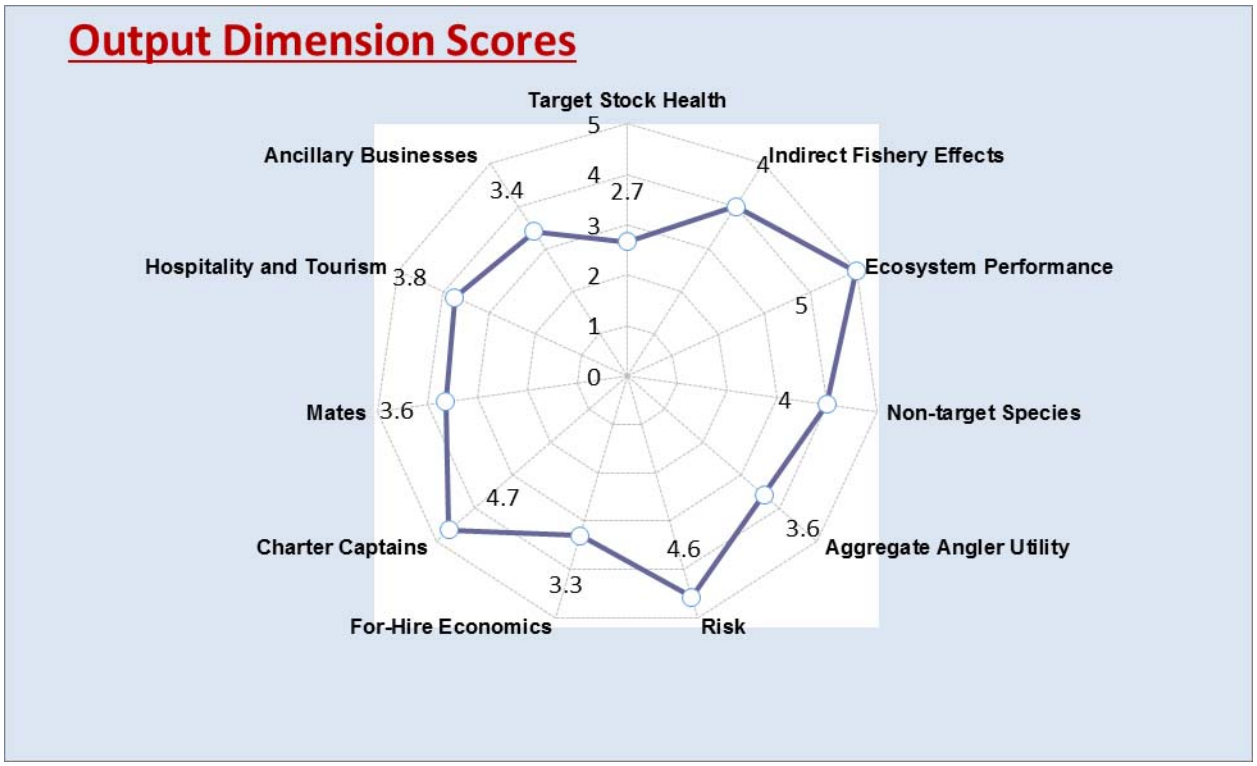
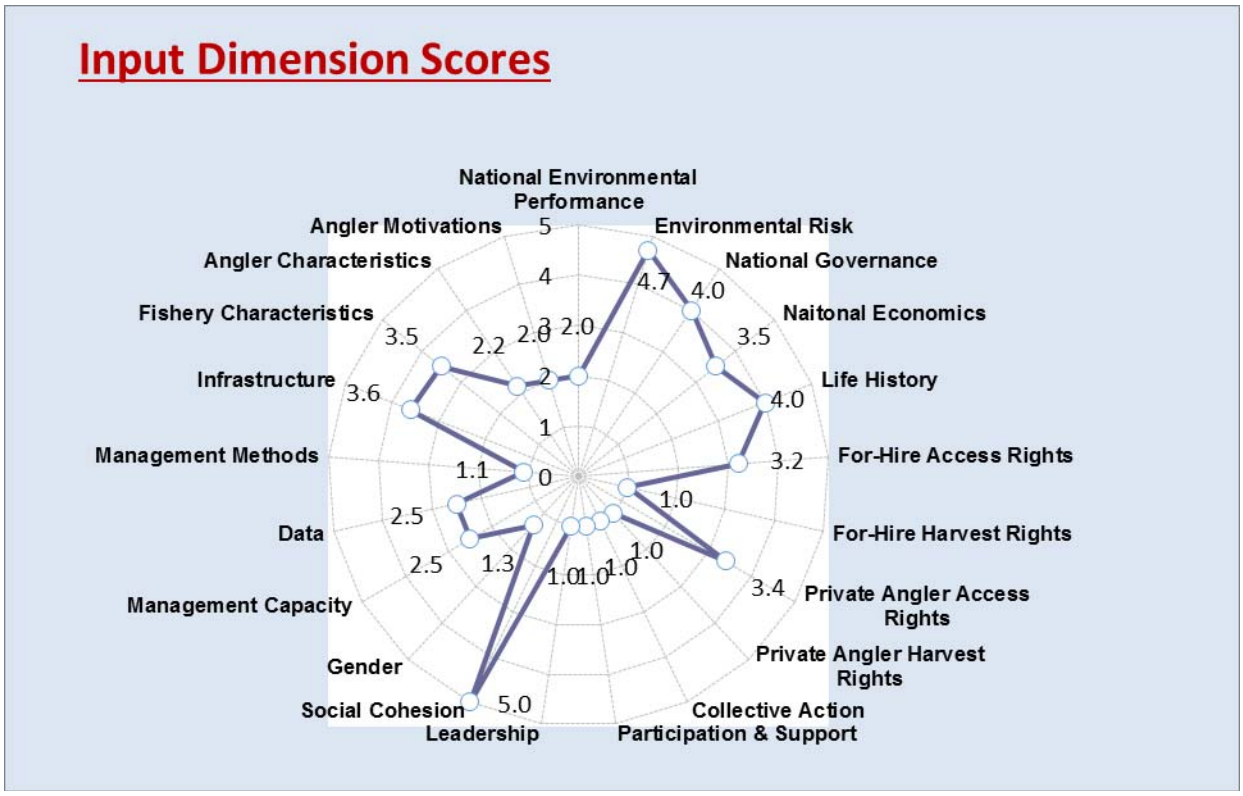


Figure 13 displays the recreational input dimension scores. Scores for the environment, governance, national economics, life history, access rights, harvest rights, gender and management methods were similar as those for the commercial fisheries.

The angler metrics of Angler Characteristics and Angler Motivations received low scores. Angler Characteristics received low scores as the fishery is dominated by the for-hire sector and the for-hire patrons are generally inexperienced and relatively low skilled. Additionally, recreational fishing at this destination is generally just one of many activities that a tourist would enjoy during their vacation. Generally, while the captains prefer angling parties with high centrality to fishing lifestyle, these are casual anglers. The anglers are also not so specialized that this is the only fishery they enjoy.

Angler Motivations received low scores as the fishing is average for numbers of fish caught and slightly above average for size of fish. Less than 25 percent of anglers pursuing a trophy fish pulled this down as well. Non-retention voluntary policies among the private and charter fleet for billfish species also pulled the score down for consumption orientation. Even though large fish are caught here, because of the inexperienced and opportunistic nature of most charter patrons, few charter patrons come to target trophy fish. While not tested, trophy fishing for YFT may be possible. YFT is a popular and growing target in big game fishing circles and currently there is potential to catch 200 pound plus YFT fairly consistently. This may be able to also attract additional tourist particularly if a fish closer to the 300 pound mark can be caught in the area. The all-tackle world record for YFT currently stands at 427 pounds.

Figure 13. Recreational input scores



2.5 Potential fishery interventions

This section is not normally included in an FPI report. However, because of the nature of the funding for this study as part of the Caribbean Billfish Project and the project's need to develop bankable business plans to support triple bottom line outcomes, a brief discussion is included below about potential interventions in the studied fisheries that could help improve its environmental, social and economic performance. The latter could include improvements associated with:

1. Stock recovery: implementation of catch and effort controls, buyouts, conservation agreements, creation of alternative livelihoods for fishing communities.
2. Operational efficiency: activities that reduces the cost of fishing or delivering seafood through the supply chain, better administrative arrangements for managing the fishery, strengthening of community associations and local capacity for co-management.
3. Market gains: improvement of quality as a price differentiator, marketing of new seafood products, investment in storage facilities or distribution centers to control prices, fishery certification, engage buyers who are committed to sustainable sourcing.

The main opportunities identified in the Grenada pelagic fisheries, and therefore the leverage points for reform, as well as some potential interventions, are summarized in Table 2. Initially, it was thought that a recreational fisheries user fee could be used to fund billfish conservation measures by commercial fisheries. However, once visited, it was clear that there were insufficient recreational effort and participation to support this idea. With not more than

a dozen private recreational boats and probably less than 500 for-hire recreational trips a year, even a high user fee would not generate much revenue.

Table 2. List of opportunities and potential interventions.

Fishery sector	Fishery deficiency	Potential fishery intervention
All sectors	Lack of timely fishery data	Reduce underestimation of landings by monitoring direct sales. Electronic reporting and traceability Collect cost and earnings data of the various fleets Collect recreational effort and participation data
	Limited professionalism in the fishery sector	None of the fisheries sectors are viewed as legitimate, foreign exchange earning industries although tuna export generates 18% of the country's exports. Sport fishing is really ignored as well.
LL	No limits on fishery entry	Limit Entry into the fishery. Increase incomes by creating an asset that will accrue
	Improve product quality	Improve fish handling on-board of the vessels. Increase ports/landing sites capability to support export grade products
	Lack of transparency in landing prices	Cooperatives can use consignment sales to increase value returning to fishers. Lack of competition in buyer/first dealer for export
	Export volume bottlenecks	Build a special terminal at the international airport for refrigerated cargo with shade and weather protection Build short term refrigeration facilities at the airport Increase the frequency and consistency of cargo flights - encourage through increasing the volume for export and synergies with agricultural exports
	Reduce billfish harvest	Test and train fishers on the use of circle hooks and the release of billfish. Improving landed prices for YFT will drive a bigger wedge between billfish value and YFT value encouraging fishers to land more YFT and less billfish Test and train fishers on fishing deeper with dead baits. An added benefit of using dead baits would be the reduction of unreported flying fish harvest
	Flying-fish may be overfished and bait is imported	Carangids and/or squid can be used as alternative bait. Flying fish catches to be monitored through logbooks and monitoring of landing sites
	Lack of opportunities for small scale nearshore LL fisheries	Develop diamond back squid fishery for the inshore LL fleet, using vertical long-lines. Promote this squid for export. This might make it possible for an inshore LL closure.
	High SAI mortality	Establish a seasonal nearshore fisheries closure for SAI. Reduce SAI mortality by commercial LL fisheries and improve recreational fishing

Fishery sector	Fishery deficiency	Potential fishery intervention
FAD	Limited income diversity	Promote FAD fishers involvement in recreational fisheries tourism, specifically fishing for demersals and SAI. Improve their training and invest in equipment to increase charter business opportunities
	Weak rights to FAD use	FAD fishers in Grenville collectively own and maintain FADs, which could be expanded for more secure FAD rights. Issuance of licenses to those allowed to fish needs to be combined with better enforcement.
	Low product quality	Improve ice-carrying facilities on-board of vessels and promote the use of ice by FAD fishers. Develop price premiums for quality.
	Limited access to export markets	Develop HACCP facility. Establish relationships with USA and EU importers that are willing to receive small shipments. Develop the distribution channel to the international airport. Explore the opportunities for local exports to high-end resorts in neigbouring CARICOM states and facilitate the legal trade of fisheries products between the states.
	High billfish mortality	Rights based management could be introduced to increase income from billfish. If coupled with better access to export markets, it may be possible to leverage that to reduce billfish harvests
Sport Fishery	No recreational fishing license	A regime for short term and annual recreational fishing licenses could be introduced Resident and non-resident licenses could be used The licenses regime should be priced high enough to cover administration cost and generate conservation funds Use the license system as a data collection frame
	Low fishing tourism	Increase visibility of Grenada as a fishing destination in the EU and USA Advertize billfish and tuna fishing opportunities Explore a directed SAI fishery. Can catch rates match other high catch SAI destinations? Cooperate with the Ministry of Tourism, Civil Aviation & Culture to collaboratively market the country as recreational fishing destination Develop a small boat, light tackle SAI fishery in Carriacou for FAD fishers interested in recreational fisheries tourism business
	No for-hire data	Institute a for-hire logbook. Could be electronic via smart phone

Overall, there is a need to change mindsets to recognize the value of fishing jobs and to professionalize fishing as a career choice. The study team noticed during interactions with some government officials and the wording of the fisheries act that the fisheries sector is being treated as the employer of last resort. That attitude can trap the sector in a position that keeps incomes low and stocks overexploited. When the fishery is treated as a social welfare program there is either zero desire to limit the number of participants or an active program to increase participation in the sector. If fisheries values are driven low by competition for the resource that results from encouraging too much fisheries participation and there are no opportunities outside of fishing to move into, it traps fisherfolk in poverty. Combining this with a failure to recognize the ability of the fishery to generate foreign exchange and the result can be a benign neglect in fisheries management. This could be a communications problem as tuna exports generate significant foreign exchange and participants in LL earn good livings.

Both LL fishers and FAD fishers were in support of limiting entry into fisheries and perhaps some reduction in the fishing capacity. Currently all fisheries in Grenada are 100 percent open access, mainly justified to provide employment opportunities. FAD fishers were in favor of licensing the FADs themselves and limiting the number of FADs. These fishers are sophisticated and understand that with fewer competitors, it will be easier to improve incomes through better fish quality and cost savings while also improving resource sustainability.

Additionally, with limited entry, resource rents accrue to the fishing permit holders, giving fishers an asset that improves livelihoods and provides an exit strategy at retirement age. Several LL fishers said they would like to upgrade their vessels with larger holds, more ice capacity and bigger LL reels, but they are reluctant to make such investment as long as the fishery remains open access. Fishing participation is currently likely to be higher than it needs to be for maximizing benefits. This high participation may be driving very low abundance, and therefore result in lower CPUEs and higher fishing costs, particularly for non-migratory species and perhaps some migratory species. Small fish sizes seen in the markets may be indicating this problem is occurring.

Eighteen percent of Grenadian export revenue originates from tuna exports in a country that has low exports and needs more foreign exchange. That aspect needs to be promoted and further developed. It is quite possible that tuna exports could be grown significantly. Value could be increased through landing higher quality fish, promoting better handling to reduce fish rejections for quality reasons and by increasing market channels for exports without harvesting a single additional tuna. The industry needs more competition in the first dealer/exporter space. Additionally, if export volumes increase, it will improve airfreight frequency and quality improving their export ability and product quality and therefore the price received for the product. The airport needs to improve its freight handling capabilities and include cold storage/refrigeration facilities on site. This type of infrastructure investments would also pay dividends for other perishable agricultural products as well.

2.5.1 Longline fishery

From the summarized, annual landing data in 2016, the entire pelagic fishery in Grenada lands 452 376 pounds of billfish (SAI, WHM, BHM). From the dealer data from 2013, Grenada landed 301 613 pounds of billfish. Sixty-seven percent of the landings of billfish consist of SAI. By value, billfish harvest represents 8 percent of the total pelagic fishery value. Most of the SAI are caught by the FAD fleet or the small-scale LL day boats that fish

seasonally. The BUM and WHM landings by the larger scale LL fleet are limited to only 3 percent of their catch. This analysis fits with the statements from the larger LL boats that say they do not catch many billfish. It is however clear that SAI landings are relatively high and that interventions to reduce SAI harvest would be best focused on the small LL day boat fleet and the FAD fishers. Currently SAI stocks are not overfished at ICCAT level but probably close to fully exploited and decreasing commercial harvest could increase local abundance for recreational fisheries. This strategy would only yield more value if the recreational fishing fleet can capitalize on higher SAI numbers by attracting more anglers to Grenada.

There is potential for a win-win-win solution for the larger scale LL boats, at very low cost. The LL fleet currently sets very shallow drops, the lines that drop off the main long line that carry the hooks, using live flying fish as bait. It is widely known in the gear technology literature that both shallow baits and live baits increase billfish catch and particularly sailfish when near to shore. Using deeper drops and dead baits could therefore reduce billfish catch at a low cost, while maintaining catch levels of YFT and other species targeted. Currently, LL boats are importing threadfin herring to use as chum to catch live flying fish, adding labor cost to bait cost. The flying fish availability to fisheries has been affected by the sargassum seaweed influx in recent years and the LL fleet is considering alternative bait options. Some small LL vessels have been converted to fish for bigeye scad (*Selar crumenophthalmus*) and other carangids for use as live bait. Switching to dead squid, even if imported, would cut out the bait catching cost, give the flying fish stock the opportunity to recover and would reduce billfish mortality. By setting deeper drops, it is also possible that the size and quality of the tuna will improve as tuna caught out of deeper, colder water take less ice to keep cool. Finally, if circle hooks could be used in addition to fishing deeper drops and the use of dead bait, more billfish hooked could be released alive. The incentive for these changes would be improved tuna prices and overall value through a higher proportion of tuna harvested and potentially higher quality fish.

Another intervention being discussed to address SAI mortality is to have some of the small-scale LL dayboats convert to fishing for diamondback squid for export. JICA did some test fishing in the recent past and some of the gear is available for use from the fish houses. There is currently a buyer trying to set up a business to purchase and export these squids. This would reduce pressure on SAI stocks primarily.

Overall, anything that enhances tuna catch and improves product quality would bring more value to this fishery, which could be used as a wedge to encourage the live release of billfish. Billfish are large and take up a lot of hold space and bring a lower market price per pound. However, more fish is preferred to less and the fishers will keep billfish if they have the hold space available. During the off season, when YFT is difficult to find, billfish pay for the trips. Often, billfish and other “bycatch” is enough to cover the costs of a fishing trip and tuna catch provides for the “profit.” The average per pound price for all billfish was USD 1.98 in 2016 and the average price per pound for tuna was about USD 3.21. That is more than 1.5 times the price of billfish. When a BUM could weigh easily twice the weight of the biggest, 200 pound, tunas, the incentive to keep billfish is obvious. Currently, the exporter pricing strategy aims at providing consistent prices to fishers, which puts all the price risk on the exporter but it also does not pass a quality price signal to the fishers. If a quality premium could be captured by fishing deeper, handling fish better or by moving to a consignment price model, that differential could be increased which could increase the incentive to release billfish.

2.5.2 FAD fishery

Sailfish are worth more as a recreational target than a commercial target, but reducing SAI mortality in the FAD fishery will be a challenge. The techniques used in the FAD fishery are very effective for catching billfish and particularly SAI. Overall harvests as discussed above are relatively low. The FAD fishers desire limited entry to the fishery, particularly in Grenville. They would also like to see formal limited entry for the installation and use of FADs. Right now, the Grenville FAD Fisherfolk self-limit the number of FADs, enforce ownership of those FADs within their community and share expenses for FAD maintenance. This is a form of community owned rights based fishery management with co-management.

Currently, this FAD fishery at Grenville has no access to export markets. The FAD fishers on Carriacou have access to export opportunities to other islands and to the international tuna market through their Petit Martinique/St. George's exporter connections. However, this access is limited and the extra transport distance increases the risk of having the tuna downgraded in quality. It may be possible to incentivize the fleet to catch fewer SAI and other billfish by improving their access to local and foreign markets to attain better prices for tunas. Because the billfish are caught on tended trolling gear or tended drop lines, these fish could likely be released alive very easily. Verification of any release would be difficult and programs elsewhere that have tried to pay for fish releases have had all sorts of problems.

2.5.3 Recreational fishery

The recreational fishery in Grenada is very small, however there seems to be a real opportunity to increase fishing tourism. Several interventions seem to make a lot of sense in Grenada. First and foremost would be a recreational fishing license that is tied to the angler and not to the vessel. That license would be required for tourist and resident anglers alike. Ideally, the license would be easily purchased online or at several well placed outlets. Charter captains could either include the license costs in their charter fee or require the angler to purchase a license either on board or at the marina office. There is an established literature on using willingness-to-pay surveys to establish license costs and the recently complete billfish willingness-to-pay survey could be used to set license fees.

It is also recommended that the license fees be held in a separate trust fund and not allocated to the general tax fund. By establishing a separate trust fund, the funds are protected for the exclusive conservation and recreational fisheries management costs. If it is not possible to craft this sort of license under Grenadian legal framework for fisheries, it is recommended that the license be issued by a non-profit organization that holds the fees in trust for the recreational fishing industry. This type of private license system is already in place in several locations in the Caribbean in the scuba-diving sector. The system would be easily adapted to the recreational fishing sector in Grenada. A fishing license tied to the angler enables the collection of funds to support conservation and management as well as provide a frame for collecting data on recreational fishing.

It is further recommended that Grenada institute a recreational data collection program. Mandatory for-hire reporting by the recreational fisheries charter vessels imposes very little burden and enables the collection of the bulk of the fishing effort data from this sector. To capture private recreational information, it may be enough to develop a cell phone application and institute mandatory reporting via the application. Other options would include dockside creel surveys or telephone interviews with license holders. These options are more expensive than self-reporting but allow for independent verification of catch. Dockside interviews are expensive and would be very inefficient given the low amount of fishing effort in the region.

A concerted marketing effort could increase fishing tourism in Grenada. Unfortunately, the fishing is not remarkable for blue marlin, but there is potential to have an excellent YFT and SAI fishery. Currently the Ministry of Tourism, Civil Aviation & Culture focuses the majority of its fishery related attention on the Spice Island Billfish Tournament, and there is scope to promote the charter boat industry. Generally, even in speaking to those in the tourism business, the will to increase fishing tourism seems lacking except in a few isolated incidences.

3. DOMINICAN REPUBLIC

The Dominican Republic (DR) covers two-thirds of the Island of La Hispaniola, one of the Greater Antilles Islands. The country has a population of 10.5 million people with a GDP of USD 68 billion and a GDP per capita of USD 6 469 (World Bank 2017a). The Dominican Republic is the ninth largest economy in Latin America. Agriculture used to dominate the economy, but now the economy is dominated by service industries, providing 67 percent of the GDP. The largest industry in the service sector is tourism with earnings over USD 1 billion annually (Dominican Republic, 2017). The DR is the most popular tourism destination in the Caribbean. Six million non-resident visitors flew into the DR in 2016, of that total 825 thousand of those were Dominicans living outside the DR (Dominican Republic 2017). Tourism demand grew with nearly 6 percent in 2016, the highest growth in the Caribbean, and all forecasts point to continued strong growth.[6]

Commercial fishing contributes only 0.5percent to the GDP of the country and exports very little pelagic finfish. All fishing vessels in the DR are small-scale boats and annual production across all fisheries is 13 000 tonnes (Perez, 2004). There are approximately 10,000 fishers operating from 3 750 boats across all fisheries (Perez, 2004). Local demand for seafood is high as is consumption per capita. Per capita fish consumption was estimated for 2012 and 2013 at of 8 kg per person.[7] Over 70 percent of all seafood consumed in the DR is imported (van der Meer et al. 2014). Traditionally, small, pan-sized demersal species are preferred for local consumption. As demersal stock abundance has fallen, local fish consumption has shifted to coastal pelagics like DOL and what is locally call “kingfish,” which includes KGM and WAH.

The DR, like most Caribbean Islands, is situated in an area where large pelagic fishes transit into the Caribbean Sea from adjacent Atlantic waters. The DR’s location has allowed for the development of a pelagic fishery using fish aggregating devices (FADs) that operates year-round targeting migratory species. In recent years the numbers of FADs have increased substantially with no control on their proliferation.

Table 3 gives a quick overview of the pertinent details of the FAD and recreational fisheries sectors that are discussed in this circular. The remainder of this circular will drill deeper into the FAD and recreational billfish fisheries. The commercial FAD fisheries section will detail harvest technology, market, product forms and Fisheries Performance Indicator (FPI) scores. The recreational fisheries section will also detail harvest technology, types of trips, tourism statistics and again the FPI scores.

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[6] Travel Daily News. https://www.traveldailynews.com/post/dominican-republic-announces-2016-developments-and-boasts-strong-tourism-statistics

[7] Data from the FAO Food Balance Sheets available at: http://www.fao.org/faostat/en/#data/FBS. The effect of the consumption of fish by tourists might not be fully accounted for in the data.

3.1 General fisheries information

3.1.1 Species

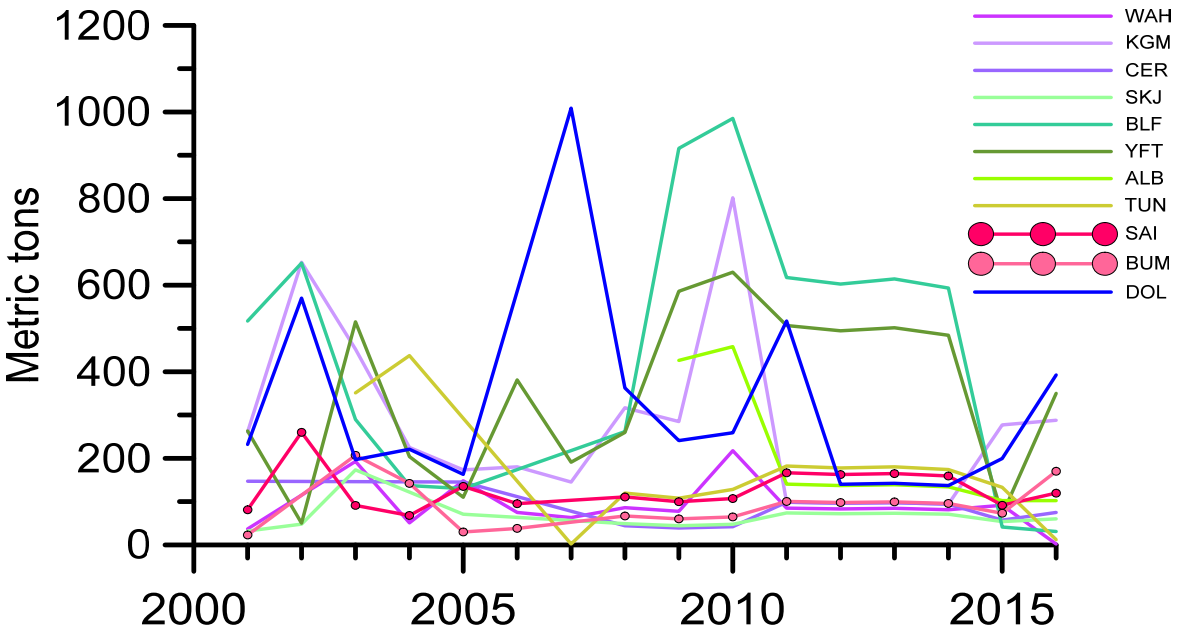
El Consejo Dominicano de Pesca y Acuicultura (CODOPESCA), the fisheries authority of the Dominican Republic, collects fisheries landings through a series of enumerators at every landing location. These enumerators use paper notebooks to record landings data. Regarding volume, CODOPESCA only recently switched from using subjective species groups to individual species for data collection. Additionally, there is currently (2017) 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, it is not possible to delineate the pelagic fishers in the data set objectively. CODOPESCA records gear type and fishing location, but there is significant overlap with other gears and locations that it is impossible to identify FAD fishing trips with 100 percent accuracy. With the backlog in data entry, the fisheries statistics reported to FAO for recent years should be regarded as rough estimations.

CODOPESCA's official FAO reported landings data on large pelagic fishes in the DR, indicate that DOL, BLF, YFT, and KGM represent the most landed species in that fishery between 2001 and 2016 (Figure 14). The landings of the rest of the large pelagic fish species including SAI, BUM, ALB, SKJ, TUN (including a small number of bluefin tuna), WAH and CER have maintained a relative stable trend through 2014. However, since 2014, landings of DOL, YFT, KGM, SAI, and BUM have shown noticeable increases. Average landings in recent years (2014–2016) indicate that the group representing all tunas account for almost half (49.4 percent) of the landings for that period (Figure 15), followed by the group that represents landing of kingfishes (KGX); while the billfish group and DOL represent equal proportions, roughly 14.5 percent, of the average landings in 2014–2016.

Table 3. Summary of selected fisheries in the Dominican Republic.

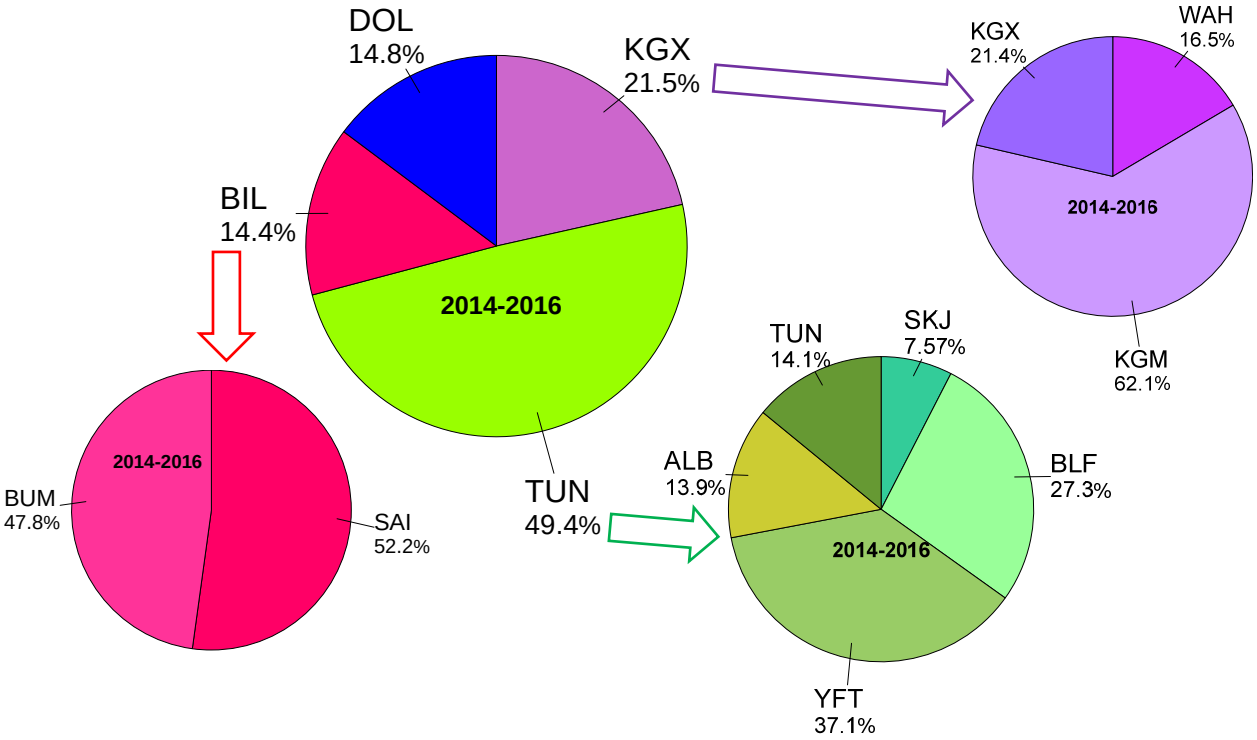
Pelagic fleet-type	**Target species**	**Number of participants/vessels**	**Product market**	**Landings**	**Revenue**	**Management**
FAD (*hand-gears*)	Primary: Dolphin fish, king mackerel, wahoo, cero mackerel, billfish, blackfin tuna, yellowfin tuna	8600 fishers total across all fisheries. At least 258 boats set FADs and fish them (estimate from three regions only and likely an underestimation)	100% Local Consumption	1300 tonnes	?	Management of fisheries is limited to enforcement of fishing licenses. The product quality is very low as few boats use ice. The fish landing infrastructure is poor. Many captains are perpetually in debt to the fish buyers/boat owners. Captains have low incomes. Vertically integrated businesses do better. Very short supply chains often completely vertically integrated.
Recreational *(big game trolling)*	The Dominican Republic is one of the premier billfish fisheries destinations globally Primary: Sailfish, blue marlin, white marlin Secondary: Dorado (DOL), Kingfish (KNG) & others.	350 slips on the south coast are capable of hosting large sport fishing vessels. The local fleet follows fish from west to east seasonally. Peak season, there are many recreational fishing vessels from other countries. Estimates of the number of boats, effort or catch are not available.	100% Catch & Release for Billfish DOL, KNG, and YFT consumed or sold to client/local consumption	Two largest marinas keep accurate effort and catch statistics. These two marinas account for 1483 trips in 2016 catching and releasing nearly 3500 billfish	If all 1483 trips from the two marinas were charter trips, revenues can be estimated at being between USD 2.2 and USD 4.5 million	Licenses required for private and for-hire captains; the licenses are the same as those for commercial fishermen and allow for fish sales. There is no delineation in the licenses to identify recreational fishers. The license is tied to the vessel, not to the angler. No other regulations exist for recreational fisheries.

Figure 14. Official DR reported landings of large pelagic fishes caught by commercial artisanal fisheries during 2001-2016.



Among the groupings shown in Figure 15, KGM represents the most common species (62.1%) in the KGX group; while YFT and BLF form an important proportion (64.4%) in the landings of all tuna in recent years. Billfish landings, on the other hand, contain SAI and BUM in nearly equal proportions, but SAI edges out BUM slightly at 52.2% of the billfish group. Other species, like little tunny (*Euthynnus alleteratus*), frigate tuna (*Auxis thazard*), rainbow runner (*Elegatis bipinnulatus*), jacks (*Seriola sp*), and barracuda (*Sphyraena barracuda*), can be considered secondary species that are commercialized and consumed in local communities (Herrera et al., 2011).

Figure 15. Average landings proportions by large pelagic species groups, 2014-2016.



The pelagic fishery in the DR is mainly a FAD fishery. The FAD fishery in the DR is a year round small-scale artisanal fishery where catch composition varies seasonally. The fishery targets all migratory species that are attracted to the FADs and their surroundings. In the southern part of the DR, where most of the FADs are deployed, there is seasonality in the catch. In the first quarter and the first half of the second quarter, SAI is common in the area and becomes the target species of the FAD fishers. On the rural coastline from Barahona around south and west to Haiti, the SAI abundance is so high that all fishermen will target SAI with drop lines, often right off the beach. DOL fishing season occurs during the second quarter of the year through to the first part of the third quarter. The remainder of the year YFT is the most dominant species in the landings. Kingfishes are mostly common in the second half of the year. BUM occurs occasionally around FADs when prey is available, year round, although commercial harvest seems to increase in the period July through September.

3.1.2 Management system

Fisheries governance is entrusted to CODOPESCA, a government body under the Ministry of Agriculture. The head of the CODOPESCA is the Executive Director, whom is appointed by the Minister of Agriculture. CODOPESCA is the lead agency responsible for management and development of fisheries within the DR. The functions entrusted to CODOPESCA include:

1. The formulation and execution of a national fishery policy.
2. Promotion of artisanal fisheries to alleviate pressure on shallow water coastal resources.
3. Promotion and support of fishers associations.
4. Coordination of fisheries research.
5. Estimation the magnitude of the fishery resources being exploited.
6. Periodically establish the size of the fishing fleets, among other related actions.

CODOPESCA was created by the Dominican Republic Legislative Act No. 307-04 of 2004, which transferred all assets (physical and financial) related to fisheries and fishery resources from the Ministry of Agriculture and the Ministry of the Environment & Natural Resources, including all current field stations.[8]

The FAD fishery for large pelagic species is an open access fishery and largely treated as the employer of last resort. The Dominican Republic legislation does not contain specific articles to control fishing effort. Other than fisher license and vessel registration, there are no restrictions on landings of large pelagic species, nor on the effort directed to catch those species. The vessel registration is basically a navigation authorization granted by the Coast Guard. There is precedent for regulations in the pelagic fisheries, as the lobster fishery, the conch fishery, and the mangrove crab, have seasonal closures in each.[9] In the case of the sea cucumber, the fishery was closed due to overexploitation. In addition, a regional agreement, signed by all member countries of the Central American Integration System (SICA)/ Organization for the fishing and aquaculture sector of the Central American isthmus (OSPESCA) was incorporated in the Dominican Legislation for fisheries to ban shark-finning practices in all Dominican fisheries.[10]

Monitoring is conducted on site by enumerators, or data collectors, assigned to one or several landing sites. Landing sites could simply be a beach or a fishing community where fish are normally landed and sold to the local fish market. Each data collector records the landings, fishing operations information, operational expenses, beach activity, and observations on a form called the *Registro de Desembarco y Liquidacion Pesquera en Playas* (Registry of Landings and Fishery Liquidation on Beaches).[11] Before 2014, landings were collected in subjective species groups. Since 2014, some species are recorded by species but some are still collected in aggregated species groups. For instance, billfish, is being recorded by aggregated species group. Sometimes billfish can be separated into SAI and BUM catch based on notations made on the individual form but this information is rarely recorded in the database. The data collection form is compiled in a small booklet. The day's work in the booklet is revised at the Regional Office by the Regional Fishery Officer. Once verified, the data is sent to the central office of CODOPESCA for data entry. Currently, there is a data entry backlog stretching back to 2011.

There is limited enforcement of fisheries regulations. Since there are no written restrictions on pelagic fishing, there is in fact little to enforce. Enumerators and local fishery officers enforce only licensing and reporting requirements. There are no strong, individual or community rights to FAD access. However, the community enforces some limited ownership rights. If a person is caught fishing a FAD they did not deploy or contribute to its deployment, the community will ask that fisher to quit using that FAD. If the offender breaks this informal rule again, the community will ask the Coast Guard to temporarily revoke the offender's navigation license. Usually, this request is granted and the offender is barred from fishing for a specific time period. At some landings, the fishers will also use a name-and-shame strategy that calls for a boat with a revoked license to be turned upside down for the duration of the revocation. Another unique power the Coast Guard holds is the

[8] http://www.codopesca.gob.do/2013-05-18-04-20-11/ley-de-pesca-307

[9] http://www.codopesca.gob.do/

[10] http://www.codopesca.gob.do/2013-05-18-04-20-11/regulaciones-internacionales

[11] http://www.codopesca.gob.do/2013-05-18-04-20-07/sistema-de-informacion-pesquera-y-acuicola

ability to close a port or landing based on weather conditions. This has caused consternation among the recreational fleet in some cases as the recreational fishing vessels can handle larger seas and enjoy some of the best fishing in heavy seas.

3.1.3 Stock trends

The major large pelagic fish species caught by the FAD fishery in DR are managed by the RFMO, ICCAT. Of the major species caught, two are considered Atlantic-wide stocks, YFT and BUM, and two are western Atlantic stocks, SAI and BLF (ICCAT 2017). The other species of importance caught by the FAD Fishery are kingfishes (WAH and KGM), DOL and ALB (north stock).

Both Atlantic-wide stock species, YFT and BUM, are considered overfished by ICCAT. Both stocks have shown decreasing abundance over the last 15 years (Figure 3). However, the commercial catches of both species by the DR are minimal in comparison to other countries in the region. Nonetheless, DR catches of blue marlin are not in accordance with the actions taken by ICCAT to rebuild these stocks, which are based on a Total Allowable Catch for this species. However, due to the way billfish are reported to CODOPESCA, the possibility exists that marlin species may be miss-reported, considering that white marlin, and other species (like spearfishes) are commonly and occasionally found in Dominican Republic waters. Most of the billfish landed in DR are juveniles and it can be very difficult to differentiate young WHM, BUM and spearfishes. Additionally, the CODOPESCA data collection form does not separate out these species, except on an ad-hoc basis in the field notes.

In the case of the species that are regarded regional for the Western Central Atlantic, only one has undergone a formal stock assessment, SAI (SAI_west). The results, although uncertain, indicate that the stock is not overfished nor undergoing overfishing, however a precautionary measure was adopted by ICCAT to establish a catch limit of 1 030 tonnes, considering that total catches over the last 15 years have shown a declining trend (Figure 16). DR reported landings of sailfish have maintained relatively stable between 90 and 260 tonnes over the last 15 years.

The DR landings of species of the ICCAT Small Tuna Group (including BLF, WAH, KGM and DOL) represent their most important large pelagic resources. In the case of WAH and BLF, the landings in DR form a substantial part of the total reported catch to ICCAT. In the case of the other two species, DOL and KGM, catches from the DR are of minor importance in the total catches reported to ICCAT. These last two species represent however important income to fishers in the FAD fishery in the DR as they are the highest value species in the large pelagic fish market.

Figure 16. ICCAT Task 1 reported catch for the western Atlantic portion of YFT, SAI and BUM and official Dominican Republic reported landings, 2001-2016.

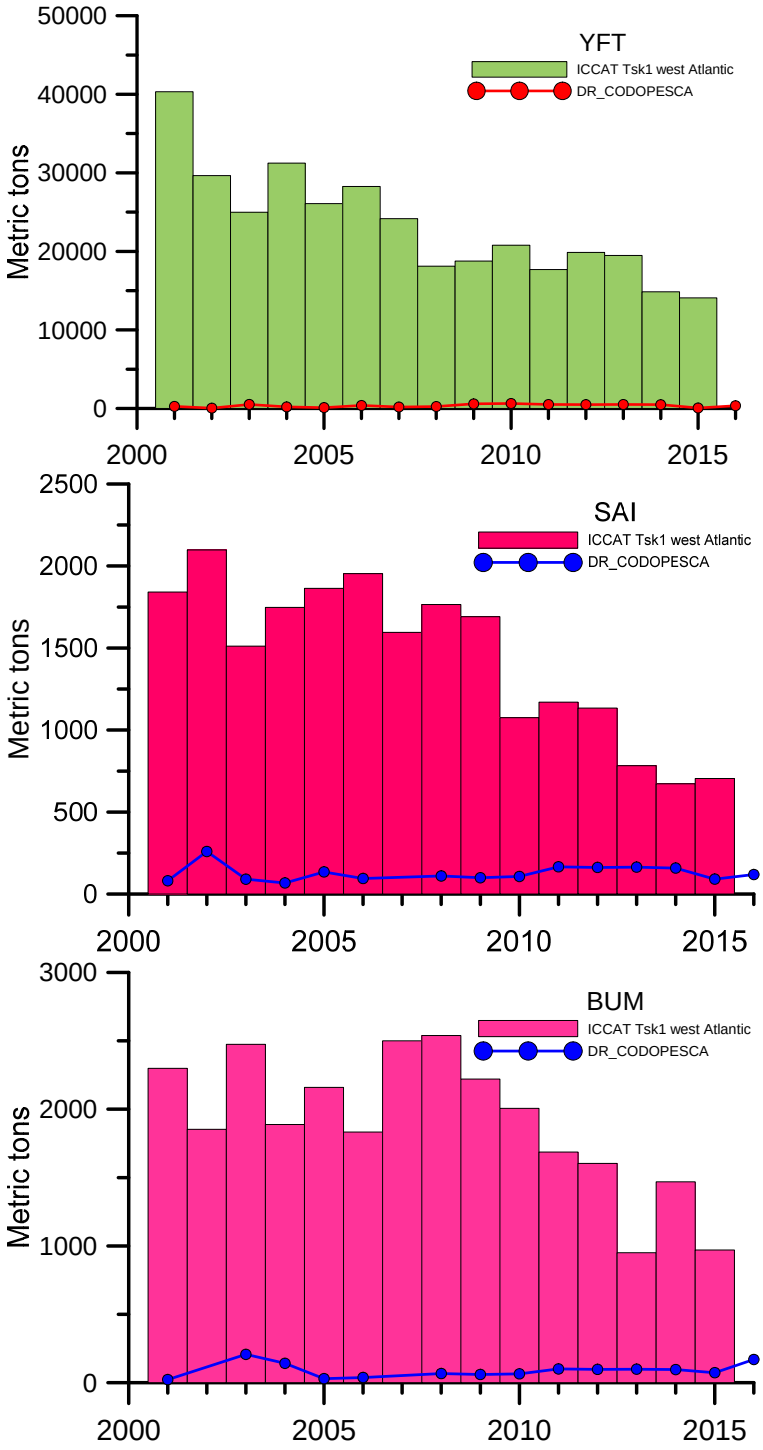
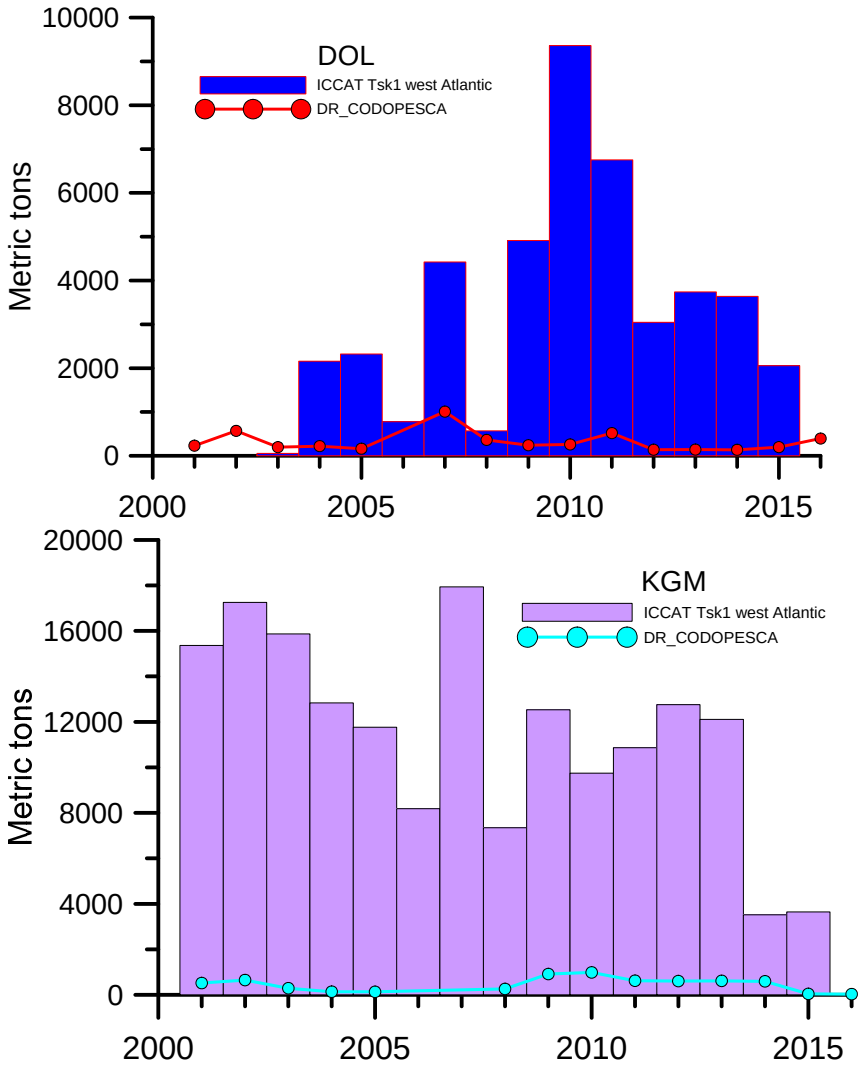
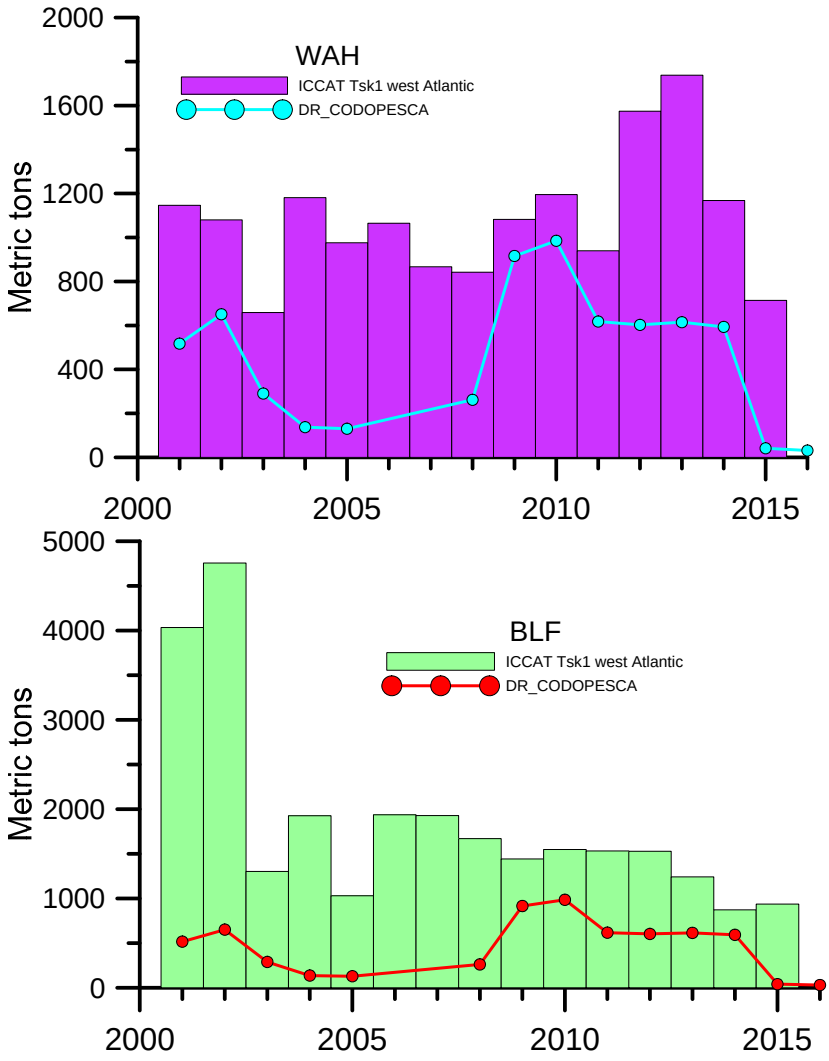


Figure 17. ICCAT Task 1 reported catch for the western Atlantic portion of DOL, KGM, WAH and BLF stocks the stocks and official DR reported landings of the same species for the period 2001-2016.




WAH
ICCAT Tsk1 west Atlantic
DR_CODOPESCA
Metric tons
2000
1600
1200
800
400
0
2000
2005
2010
2015
BLF
ICCAT Tsk1 west Atlantic
DR_CODOPESCA
Metric tons
5000
4000
3000
2000
1000
0
2000
2005
2010
2015

3.2 FAD fishery

Overall, the pelagic fisheries in the DR are largely similar to the FAD fisheries in Grenada. The fishers troll small plastic squid skirts for DOL and bait around the FADs and will fish with drop lines for billfish and tuna around the FADs. Figure 19 displays the yola style fishing boat. It is a flat bottomed wooden boat of less than 7 metres long and either rowed or powered by a 5–25HP outboard engine. These types of boats are most used for the demersal hand line or bottom LL fishery and are rarely used to fish FADs or fish for pelagic at all. They are generally only used for pelagic fishing during the seasonal aggregation of SAI around Barahona, when everyone with a boat fishes drop lines for SAI.

Figure 19. Yola style fishing boat.

Photo: Freddy Arocha

Figure 20 shows the panga style fishing boat which is far more widely used for FAD fishing. These 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. These boats use various sizes of outboards based on the length of the vessel. A general rule of thumb is 15HP for a 5 metre panga, 30HP for a 6–7 metre panga and 40HP or greater for a 7 metre or greater panga.

Figure 20. Panga or Bote style fishing boat.

Photo: Freddy Arocha

Each vessel carries two fishers and each fisher operates two trolling lines. Live bait is caught by trolling small plastic squids or by fishing cut bait. Trolling will also catch BLF and KGM. 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 (approximately 70 to 90 metres) deep and is fished weighted or unweighted depending on species targeted.

Figure 21 displays a cluster of droplines. In some locations there have been agreements to fish only a certain number of drop lines, however, those agreements are often violated. These types of agreements are primarily in place for the SAI 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 SAI pulse fishery, boats will set more than 20 droplines along the coast not associated with FADs. This creates severe gear conflicts and also results in lost gear that continues to fish (ghost fishing) killing fish that are never landed. FAD fishers report seeing dead SAI 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 USD 2 300 to 2 700. FAD construction costs range from USD 100 to150. Figure 22 shows a FAD laying in a typical panga. The most expensive input in FAD construction is the cable/rope that connects the anchor with the buoy, sometimes as much 50 percent of the total cost. The buoys (bolsa) are usually constructed of recycled plastic jugs or recycled styrofoam insulation tied together or encased in a scrap seine net. Most of the cost associated with the buoy is in the labor to construct it. The anchor (or “the doll” or muñeca) is made of concrete poured into large cans with a 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 fishers report loosing as many as two thirds of their FADs annually.

Figure 21. Dropline gear.

Photo: Freddy Arocha

Generally, the fish buyers finance the fishing trip costs. They will loan the boats fishing line, hooks, squid skirts, fuel and food, payable upon settlement of the fish ticket. Fuel costs are, by far, the single biggest fishing trip costs. It is common for the fishers to be in debt to the fish buyers. The buyers 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 debt to the buyer, sometimes this debt is very high, taking many high catch trips to pay off.

The government has offered soft credit lines to fishers that are part of an association of fishers registered with the CODOPESCA. However, most of the credit lines offered are for investments in vessels and engines. The investment in fishing gear is generally provided on loan by the fish buyer. Some fishing associations offer financing and cost sharing options. In some ports the associations will purchase fuel cooperatively at lower bulk rates, provide medical benefits, provide on-water rescue and have some lobbying power with CODOPESCA.

The proportion of boat ownership by the captains may be as high as 60 percent of all vessels. The other 40 percent are owned by vertically integrated buyers. These buyers typically used to be fishermen that saved enough money to buy a second boat and/or a truck and a freezer to become a buyer. Most buyers buy from independent captains, but also own several vessels themselves. The share system is used in the DR with one-third going to the boat and one-third to each of two crewmembers net of trip expenses.

Figure 22. FAD ready for deployment including buoy and anchor.

Photo: Freddy Arocha

There are approximately 8 600 fishers across all fisheries of which approximately 60 to 70 percent are licensed (van der Meer *et al.,* 2014 and FAO 2017). It is likely that almost all fishers are active, at least seasonally, because that is their only way of living and they must pay debts accumulated on fishing operations that were unsuccessful. A rough estimate from a census carried out by CODOPESCA in 2011-2012 pegged the number of vessels (panga and *yolas*) in the eastern and southeastern provinces of La Altagracia, La Romana and San Pedro de Macorís, utilizing fishing gear associated with the capture of large pelagic fishes at 258 vessels. Figure 23 shows the Dominican provinces and La Altagracia, La Romana and San Pedro de Macorís make up a small proportion of the total southern coastline where FAD fishing predominates. Considering that most vessels carry two fishers, an estimate number of fishers in the area potentially targeting large pelagic fishes would be more than 500. If each vessel is placing as many as 10 FADs that means there are upwards of 2500 FADs in the water, over just a small area of coast.

The fishers show a sense of belonging to their fishing grounds, and appear to be very territorial (Herrera et al. 2011). While there is no formal ownership right on the FADs, rights are maintained and enforced. Noting that the FAD fishery for large pelagic fishes depends on the seasonality of the target species, it is unlikely that fishers would divert to other sources of non-fishing income in the fishing season. Only during the SAI pulse when the SAI come close to shore will other fishers and even non-fishers enter the fishery and target these pelagics. While the fishers are generally territorial, this pulse fishery with other fishers' involvement is tolerated.

Figure 23. Dominican Republic Provinces.[12]

Map: ephotopix http://www.emapsworld.com/dominican-republic-states-map.html

3.2.1 Market and product forms

All pelagic species landed in the DR are used for local consumption. The primary markets are the landing site towns and restaurants and markets in the large cities. There is no export market for large pelagic fishes because the vessels lack proper refrigeration and cold storage and refrigeration at the landing sites is poor. In order to develop exports, DR would have to develop HACCP compliant facilities in each port interested in exporting. However, Dominican Republic's fisheries sector supplies only 30 percent of the country's seafood demand. The remaining 70 percent is imported (van der Meer et al., 2014).

Once the fish are landed, the landed catch is immediately sold to the fish house which owns the boats trip debt or a buyer who owns the vessel. For some landing sites, the buyer is the owner of a small pick-up truck with a residential chest freezer in the bed or a small-

[12] http://www.emapsworld.com/dominican-republic-states-map.html

refrigerated box truck. The catch is off-loaded directly into the vehicle for immediate transport to a larger city. If there are cold storage facilities at the landing site, the buyer keeps the fish generally in household chest freezers until the fish are sold to the local market or transported to the larger cities and sold to supermarket and restaurants. In all the interviews and site visits, the study team only saw one commercial walk-in freezer and, in another location in the capital, a cluster of three box-truck refrigerated boxes converted to small walk-in freezers. Most fish buyers are at least partially vertically integrated. They typically will own boats, a small fish facility, sometimes only large enough for one or two small household chest freezers, and sometimes they will also own the vehicle to transport to the larger cities. Most of the fish witnessed in cold storage were severely freezer burnt.

At most landing sites, the first dealer is also a retailer to the local community. The landed catch must be sold and moved quickly because of the lack of cold storage on the vessels. If there is too much fish to be sold locally, the catch is distributed to the larger cities. Each landing site has several buyers, but there is very little competition because each fisherman is either fishing in one of the buyer's boats or is in debt for trip expenses to a buyer before a trip starts. There is an expectation that the fisherman sells only to the buyer holding his debt.

It is not uncommon for a fisher to remain indebted to a buyer across several fishing trips where the fisher was unable to catch enough fish to cover trip costs. Most buyers will still make a payment for trip that did not cover trip costs in order for the fishermen to have some sort of income. However, this perpetual indebtedness creates a potentially exploitive relationship. The generally low prices are evidence of this potentially exploitive relationship. There is little to no price variation between buyers at the first buyer level and prices only respond downward when there are market gluts. During fish supply shortages, when there are increases in retail prices in the cities, it appears that the buyer/distributor simply pockets the difference as an increase in his margin and those prices do not pass through to the fishers.

The fishery products originating from the FAD fishery are only minimally processed. There are no processing plants for large pelagic fishes in DR and no HACCP compliant fish processing facilities. Catch is either sold whole or is sold after having been gilled and gutted at sea. The fish are processed at the retail market into steaks or fillets based on customer requests. For larger pelagics, such as billfish, these are sectioned and sold in steaks at the local markets.

3.2.2 Scores and discussion

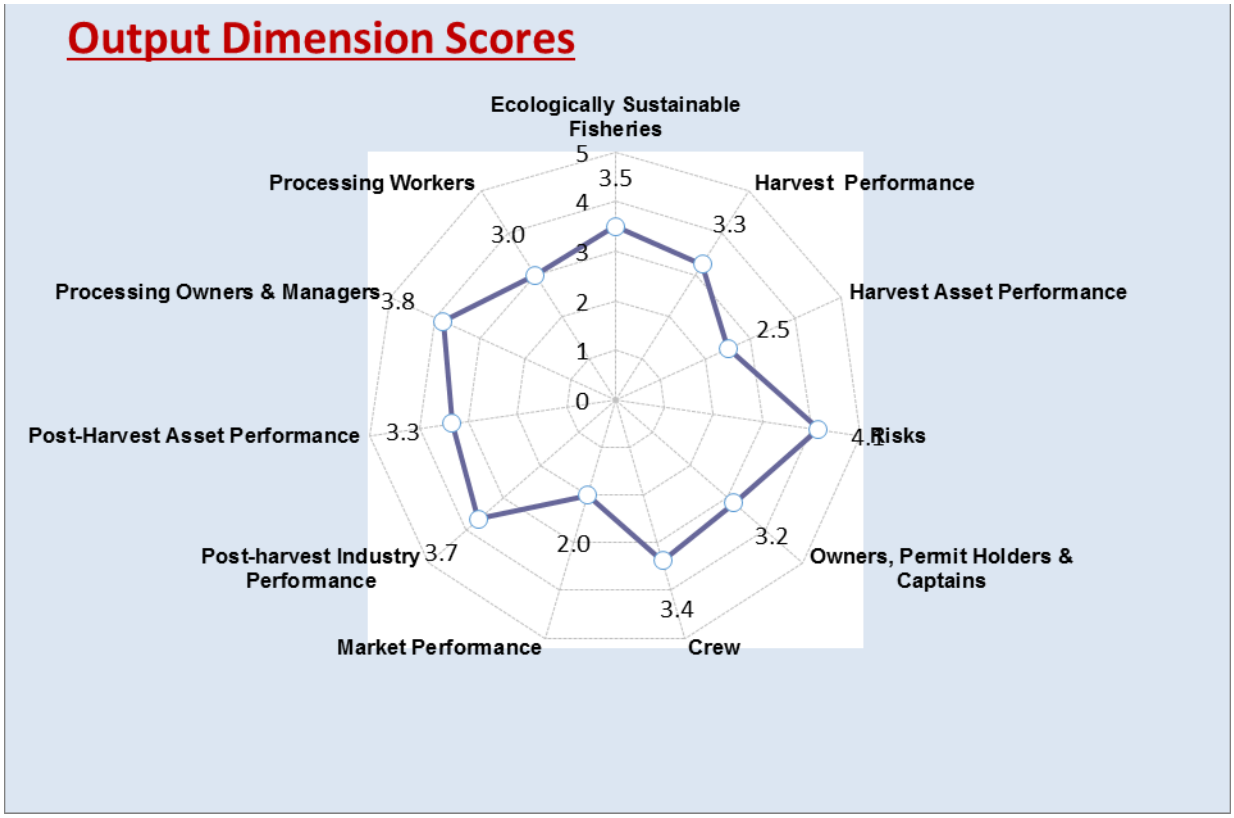
Overall, the FAD fisheries in the DR scored much lower than the same fisheries Grenada on the output side across all metrics (Figure 24). DR has a very basic supply chain selling low value products for local consumption. There appears to be large amounts of shrinkage due to poor handling of fish both by the fishermen and by those involved in the distribution, marketing and retail supply chain. The few storage freezers encountered were full of freezer burnt fish, generally large groupers and large billfish, which were of a quality that would not be for human consumption in the USA. Fishermen are being treated as lower class workers and the government regards the fisheries sector as the employer of last resort.

DR scored lowest across Market Performance, Harvest Asset Performance and Processing workers, scoring a three or below for all those metrics. Regarding Market Performance, the DR received its lowest scores across international trade, wholesale price compared to similar products and capacity of firms to export to the USA and the EU. The FAD fishery scored one on the international trade metric because it does not export fish. The FAD fishery scored one on the wholesale price compared to similar products because the product is poorly handled

and is one of the lower priced protein sources available to low income consumers. The FAD fishery scored one on the capacity of firms to export to the USA and the EU metric because there is not a single HACCP compliant facility in the entire supply chain. The FAD fishery also received a low score of two for final market wealth as there is not much value addition taking place on the product and is mainly seen as a protein source for local consumers. The FAD fishery also scored a two on ex-vessel to wholesale marketing margins because margins are in the 10–15 percent range. This represents a potentially huge leverage point for improving income and livelihoods as 70 percent of seafood consumption is being imported and the vast majority of the high quality seafood consumed by tourists is being imported. It is therefore possible to increase value by improving quality, adding value and by targeting tourist outlets. Significantly more investment would be required to develop the necessary infrastructure to comply with export market regulations and standards. Moreover, there seems to be resistance to this idea due to their already high dependence on imported seafood.

Regarding Harvest Asset Performance, the FAD fishery scored poorly on ratio of asset value to gross earnings and asset value compared to historic high. The FAD fishery scored a one on ratio of asset value to gross earnings because the fishery is open access and there is no asset, such as a limited entry permit or individual quota, beyond the boat and tackle, both of which are depreciating assets. The FAD fishery scored a one on asset value compared to historic high, because there is no limited entry to the fishery. Also, vessel values do not appreciate. This represents a strong leverage point for limiting entry in the fishery and limiting the number of FADs and tying those limits to strong private or community property rights to the FADs.

Figure 24. DR FAD output dimension scores.



Regarding Processing Workers, the fishery scored poorly on earnings compared to regional average earnings, worker wages compared to non-fishery wages and social standing of processing workers. The FAD fishery scored a two on regional average earnings because processing wages were 50 to 90 percent of the regional average for similar types of employment. The FAD fishery scored a two on worker wages compared to non-fishery wages, because those were also 50 to 90 percent of the regional average. The FAD fishery scored a two on social standing of processing workers because they are equivalent to unskilled blue collar or service jobs in the region. Again, this can be a potential leverage point tied to the harvesting sector. If higher value markets could be targeted, this could potentially also improve wages and livelihoods for those working in the processing sector as well.

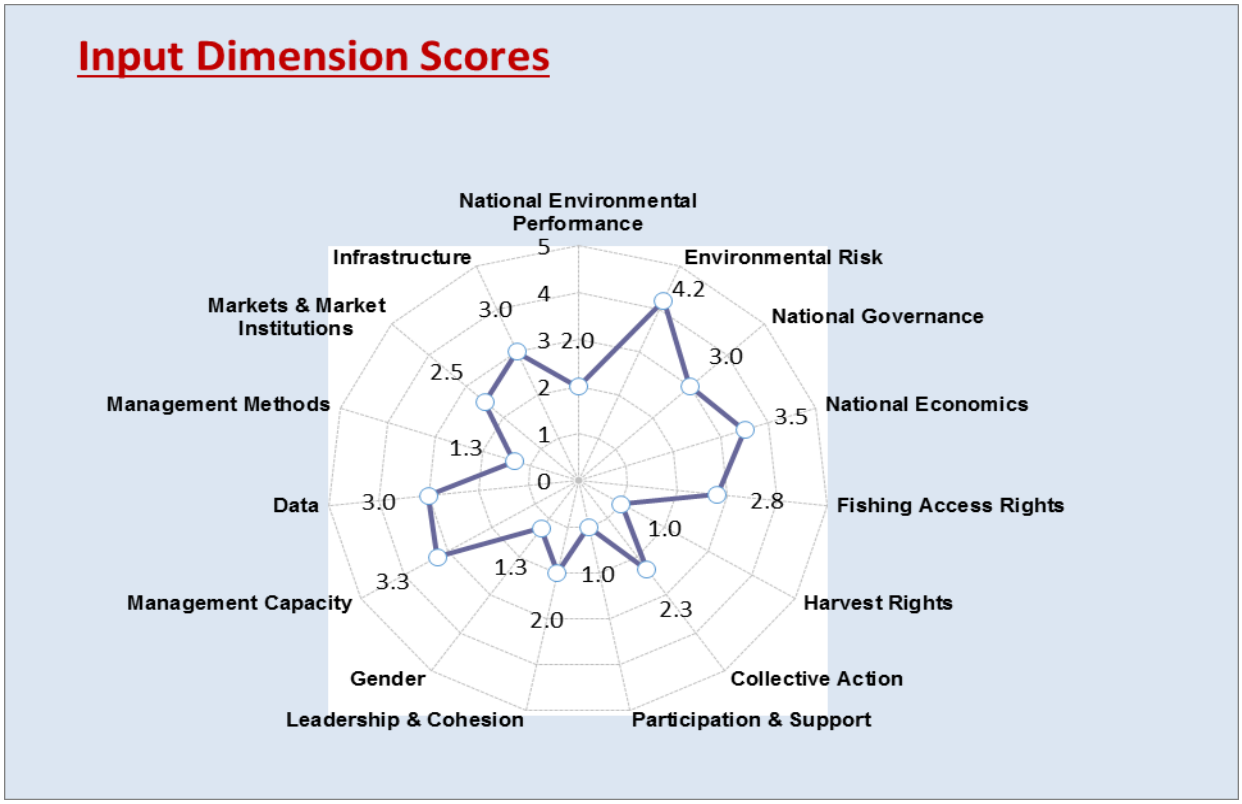
The FADs fishery in the DR obtained one score over four and that was for Risks. Risks covers annual revenue and landings volatility and, in the DR, that volatility is low. Prices and landings are very stable in the country with the exception of the drop in DOL and YFT landings in 2017.

The DR also scored lower than Grenada across the input dimension metrics, but performed slightly better in Infrastructure and Management Capacity (Figure 25). DR has excellent road and air infrastructure. The DR has far more air and sea freight and passenger traffic, making export conditions better than in Grenada if they decided to export pelagic finfish. With two international airports on the south coast, the area of operation for the FAD fishery, no landing site is more than two hours from an airport. The road network makes it possible for fishery products to be transported quickly and easily from port to the main cities of Punta Cana and Santo Domingo. If fishers could improve fish handling at sea, fresh, high quality product can be transported quickly to restaurants and markets in the big cities where market prices for these products are higher.

The DR also scored better than Grenada in the Management Capacity metric because the DR subsidizes their fisheries significantly less than in Grenada. In the DR, there are nearly no subsidies provided to the sector, with the exception of some government guaranteed financing that is only periodically available. There was an increase in the number of participants in the 1990s when the German government offered very low and no-interest loans to fishermen and dockside landing facilities. Most of the fish landing site infrastructure is from that era. Interestingly, the local fishery officers were instrumental in the approval process of the financing for fishermen and related businesses.. The financial support created an interesting, paternal type relationship between those fishers that benefitted from that financing and the fishery officers that approved the funding.

Grenada and the DR received equal scores across National Environmental Performance, National Economics, Harvest Rights and Markets and Market Institutions. The National Environmental Performance in the DR is based on an external score generated by Yale University. Since there are no harvest rights in either country, both countries receive a score of one for having no rights and “not applicable” scores for the right quality metrics.

Figure 25. DR FAD fishery input dimension scores.



DR received low scores on the Markets and Market Institution dimension because it scored low across landings pricing system, number of buyers and level of tariffs. The landings pricing system is a very critical part of the leverage that may be available to investment in the conservation and management of billfish resources. This metric gauges the "proportion of the harvest sold in a transparent daily competitive pricing mechanism, such as an auction or centralized ex-vessel to wholesale market wherein sellers interact with many buyers and prices are public information." There is often only one buyer in each fish landing location. If there are multiple buyers, the fishermen are generally linked by debt to one buyer. There is no transparency and little competition between the buyers. Obviously, given this, the FAD fishery scored a two across number of buyers as there is "a small number of coordinating buyers." Finally, the DR charges at least 20 percent duties for imported fishery products giving the level of tariffs a score of one.

The DR scored poorly in Data, National Governance and Leadership and Cohesion. Regarding the data score, while there is a good system of enumerators in every port, there is very high turnover in those positions. There is no codified enumerator training manual or process and as a result, data lack consistency. Due to budget shortfalls, the CODOPESCA have not fully entered the enumerator data since 2011. On the positive side, DR has collected cost and returns data for every trip recorded by enumerators but unfortunately that data has not been entered. This is highlighted below as an enabling condition that should be addressed to improve fishery management.

Regarding National Governance, this score is the result of averaging several World Bank indices covering governance quality and governance responsiveness. Quality is an average of government effectiveness, regulator quality, rule of law and control of corruption. The DR average across these metrics was a -0.40, which results in a score of three in this FPI dimension. Governance responsiveness was taken as the average of voice and accountability and political stability. The DR averaged 0.15 scoring squarely in the middle of the FPI scoring bin three.

Leadership and Social Cohesion scores showed mixed outcomes. Leadership is poor in these ports. A score of one was given, which equates to no recognized leader providing vision for fishery stakeholders. In several cases the fishery officer was the only person that could possibly be viewed as taking on this role. In other ports the fishery association president had open conflicts with fishers during our interviews. Social Cohesion scored a 3 as the study team witnessed some tensions between fishing ports and some conflicts between owners/ operators, vertically integrated boat owners and hired captains and crew.

The DR scored slightly worse than Grenada in Gender and Fishing Access Rights. Regarding access rights, both countries have informal ownership rules for their FADs. In Grenada, those rules are collectively enforced through shared maintenance, licenses and fee collection. In the DR the enforcement of those rights is far more informal and there seems to be much more free-riding on other fishers' FADs. Part of the reason for that is the much larger number of FADs used in the DR. In Grenada, there are less than 10 FADs in use in the entire country. In the DR there are thousands. Increasing the rights of ownership, either as collectively owned FADs or individually owned FADs, would decrease competition for fish and would decrease search costs, increase CPUEs and ultimately increase revenues through cost reductions.

3.3. Recreational fishery

The recreational fishery in the DR is substantially larger than in Grenada. There are far more private and charter boats involved in the billfish fishery. Most of the recreational fishing effort is clustered on the south coast 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, SAI, BUM and WHM, all on the same trip, and although rare, possible to catch a super slam, SAI, BUM, WHM and spearfish. Figure 26 displays the typical sport fishing boat used in the DR.

3.3.1 Markets and product forms

The recreational fishery is very seasonal with the different species moving from west to east through the year in different waves. There are essentially four marinas for recreational fishing vessels that target billfish from the southern coast. All marinas operate under a 100 percent billfish catch and release policy, although the private boats and charters will keep DOL, YFT and WAH for home consumption by clients and crew 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.

Figure 26. A typical recreational fishing vessel in the Dominican Republic.

Photo: Freddy Arocha

The private recreational fishing fleet is mostly located at Club Nautico in Santo Domingo. The Club Nautico marina has 100 slips and about 50 private recreational fishing boats. It is against their rules to run a chater business out of their marina. Twenty to twenty-five 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 recreational fishing boats that may target billfish. That area is Puerto Bahia with approximately 20 boats. The study 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 recreational 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. These 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 recreational fishing boats. The marina has a high occupancy rate of 80-90 percent. Of the 130 or so boats at any one time, 18 are full-time charters and another 15 to 20 boats will charter seasonally. Most of those seasonal charters are vessels coming from the USA and three come 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 SAI less than a mile from the marina entrance.

While Cap Cana marina promotes year-round fishing, SAI season is January to April, WHM peaks from April to August and BUM peaks August through October, but lately BUM 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 BUM release record was broken on 11 December 2016 with 23 BUM released in a single day, and since the marina has been flooded with charter bookings. Numbers for 2017 have nearly surpassed 2016 numbers in May 2017. Marlin magazine covered that record, increasing demand.[13] The 2016 Billfish Report ranked Cap Cana the #2 Billfishery of the Year for 2016.[14] Finally, Club Nautico Cabeza del Toro is not a full marina in the traditional sense, but instead 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.

Overall, all recreational fishing 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. These boats will charge USD 3 000+ per day and their clients will typically book multiple days. There is one large vessel that charges USD 5 000/day. These 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 cheaper. Their fees are around USD 1 500 a day and sometimes will run split charters.[15] Their market is inexperienced big game fishers who are in Punta Cana for a vacation that includes various 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.

There is one final note regarding the charter fleet in Punta Cana. Punta Cana is dominated by value priced, all-inclusive resorts. These tourists look for value priced vacation activities, including recreational fishing. To cater to this group, there is a fleet of 20-30 charter boats that moor inside the reef just off the beach from the hotels. The hotels will book these boats per head, also known as split charters, for less than USD 200 per person. The fleet is in very poor shape. Anecdotally, some clients have refused to board their boats due to safety concerns. Often one of the motors in the twin-engine boats will have been removed and replaced with concrete to balance the weight. These boats advertise marlin fishing trips but generally don't go very far off shore and mostly catch barracudas, DOL and KGM. They

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

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

[15] 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.

typically kill everything they catch, including billfish. Professionalizing this fleet, improving safety and convincing them to release billfish should be a high priority.

The DR hosts many billfish tournaments. International Billfish Tournaments hosts two international tournaments; one in Casa de Campo and one in Cap Cana. [16] These are big money, multi-day tournaments that attract teams from all over the world. There are numerous smaller tournaments, particularly fishing out of Cap Cana.

Several captains at Cap Cana talked of a recent initiative to create a billfish no-harvest Marine Protected Area (MPA) that potentially covers the area from Boca de Yuma around the eastern side of the DR to Boca del Toro. The FPI study team was not able to obtain details of the agreement that was prepared. The MPA would prohibit WHM, SAI and BUM harvest with the aim to protect spawning habitat and spawning activities of billfishes. It is not clear what the agreement was or whom the agreement was brokered between. It was rumored to have been brokered between the fishers of Playa Macao and the Ministry of the Environment and Natural Resources. CODOPESCA does not recognize the MPA stating that the proposal did not follow proper protocols and there was no examination of the livelihood implications of creating the MPA.

The use of FADs in the DR is a complicated issue for recreational fishers. Many charter captains feel the improvement in BUM and WHM marlin fishing in the region of Cap Cana and Casa de Campo is due to the proliferation of FADs in the area. There are several thousand FADs located between these two recreational ports. These captains feel the FADs hold bait year round and have changed the behavior of the small to medium BUM such that they linger in the area far longer than in the past. The majority of charter captains and most private anglers interviewed would like to see more and better-constructed and maintained FADs. The Cap Cana recreational fishing fleet fishes FADs placed by the Playa Macao FAD fishers. The Casa de Campo recreational fishing fleet fishes FADs placed by the San Pedro de Macorís FAD fishing fleet. There has been much conflict between the commercial fishers and the recreational fishers regarding FADs.

Due to on-water conflict and violence, both marinas began to collect FAD fees from all marina slip renters and from tournament participants. The amount of money raised yearly is USD 25 000 to USD 50 000 each year for each Marina. There is a general lack of transparency in the disposition of these fees with a lot of concern that the monies collected are not making it down to the fishers. There are not strong rules regarding what the money is to be used for or whether or not these payments come with exclusive rights to fish FADs or not. Many feel this payment vehicle, particularly in light of the fact that the payments may not be making it to the individual fishers, has become something that is inducing “pirate” behavior on the water. There seems to be an influx of new FAD fishers, particularly in San Pedro de Macorís, that have entered the fishery to obtain these payments. Now, there are boats that will follow sport boats until they hook fish, ask to have the fish and if they are denied, they will simply take the fish off the end of the angler’s line. Some boats will also ask for food or clothing handouts.

[16] http://www.intlbillfishtourns.com/

3.3.2 Scores and discussion

Figure 27 displays the output dimension scores for the recreational fishing sector. Overall Grenada and the DR scored very similarly in this output dimension. Since they fish the same stock, fish with the same technology and have the same offshore attributes, they scored the same for Ecological Performance indicator dimensions of Target Stock Health, Ecosystem Performance and Non-Target Species. The two countries also scored the same across the Fishing Performance indicator dimensions of For-Hire Economics and Mates.

The DR scored higher, much higher, for aggregate angler utility mainly because DR has the reputation for being a world-class fishery that attracts high net worth, experienced billfish anglers. It scored slightly lower than Grenada for Charter Captains and nearly a point lower for Risk. The latter score was mainly driven by high variability from year to year in billfish catches. While the DR has some of the best billfish catch rates in the world, there is considerable seasonal variation in the catches and the number of trips taken. Even during the low season, CPUEs are higher than Grenada in its high season. It is worth noting that the DR scores are based on actual data provided by the marinas while the Grenada scores are based on conversations about catch and effort volatility. The two countries also scored the same across the Support Industry indicator dimension of Ancillary Businesses. They scored the same because while basic terminal tackle is available locally, all lures, rod and reels and advanced electronics are imported from the USA.

The next lowest score dimension after Target Stock Health was For-Hire Economics at 3.3, which is still a relatively high score. This score was lowered by a one in asset value to gross earnings, a one in for-hire asset value compared to historic high and a three in trip price compared to historic price. Both asset value metrics scored a one because the fishery is 100 percent open access. To enter the recreational fisheries charter business, one needs only to purchase a vessel and start booking clients. As a result, the only asset is the vessel and the for-hire vessel market is the same as the private vessel market. Generally, recreational fishing vessels are depreciating assets. Regarding trip price compared to historic high, prices have remained fairly stable, within 10 percent fluctuation over the past 10 years.

It is important to highlight the difference between the charter markets in the DR. The local charter vessels cater mostly to tourists and most tourists are guests of all-inclusive resorts and fishing is one recreational activity out of many they can choose from. These casual anglers are very sensitive to price. In this market, there are 20 or so “pirate” for-hire vessels that run split charters in barely seaworthy craft for very low prices. The local charter boat fleet that actually targets these tourists faces a lot of competition and feels that they cannot raise prices to keep up with inflation. The second market for charters is high net worth anglers that travel all over the world to fish for billfish. DR has become known as one of the best places in the world in terms of the numbers of fish caught per trip and the best place for fly or light tackle angler to catch a blue marlin. These wealthy tourist anglers will pay between USD 3 000 and USD 5 000 a day to fish on some of the most modern luxury sport fishing vessels around. These captains feel like they can charge anything they want for a trip and do not really feel like prices have been too flat. They are often booked years in advance.

The DR scored lower than Grenada in Hospitality in Tourism mainly because less than 10 percent, and likely less than 5 percent, of the 385 000 rooms in Punta Cana are owned by DR residents. Most of the resorts in Punta Cana are part of international hotel chains or are independent resorts owned by foreign nationals.

Figure 27. Recreational output dimension scores.

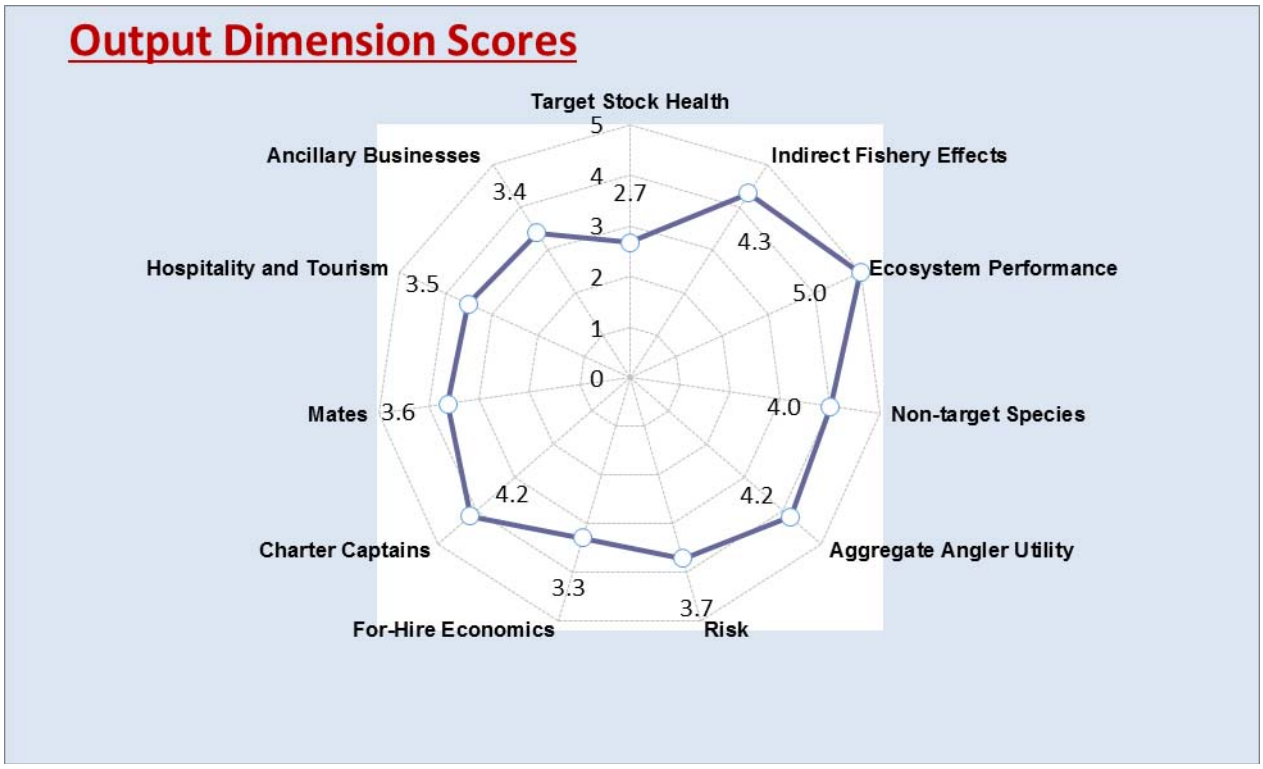
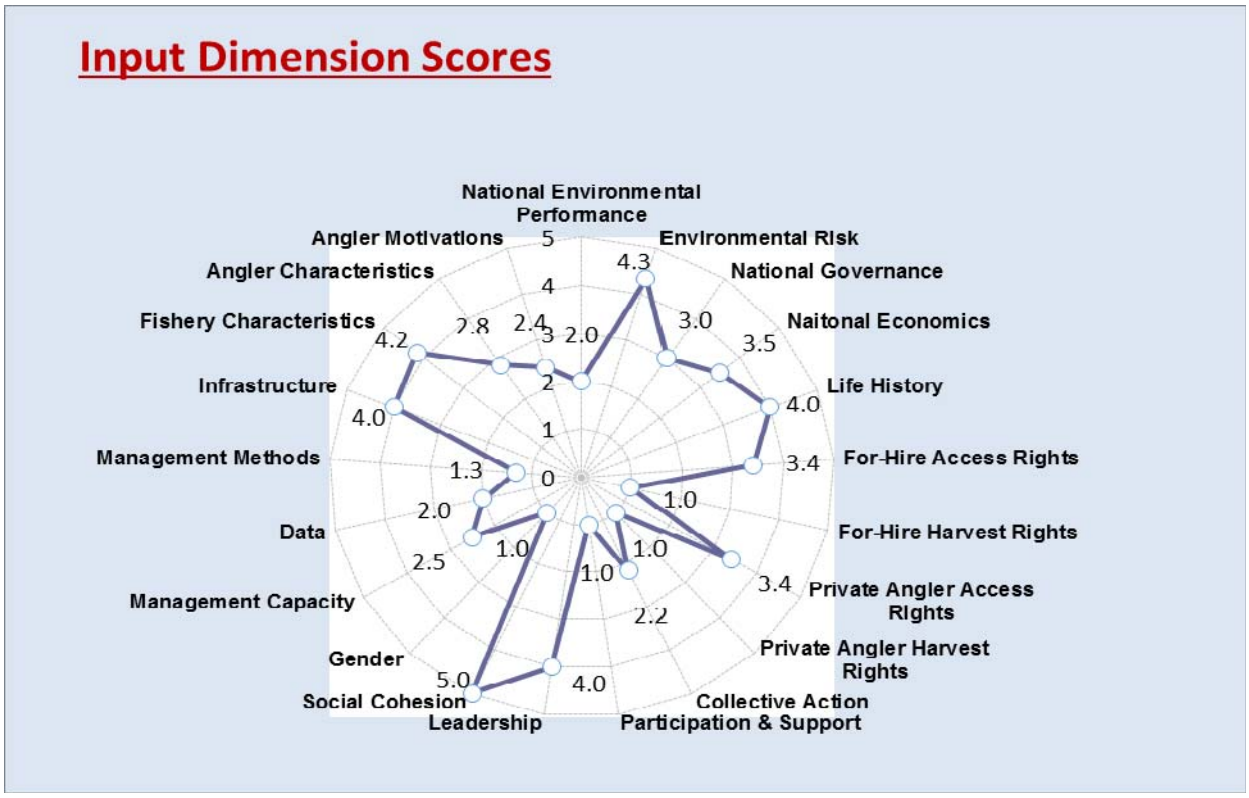


Figure 28 displays the input dimension scores for recreational fishing in the DR. The Macro Factors mirror the commercial sector's Macro Factors because they are fishing the same stocks from the same country. The DR scored very similar to Grenada across the Property Rights indicators. The DR scored slightly higher for For-Hire Access rights compared to Grenada, because there are some arrangements in the DR, however weak, where rights are granted to FAD access. This was discussed in detail above. The recreational fishers are paying maintenance and access fees to commercial fishers, which is organized through tournaments and marinas. While this system is partially working, it lacks transparency and, since FAD rights on the commercial side are poorly defined and insecure, it is hard to develop a successful market. However, because attenuated rights exist on both sides of this fishery and there is a burgeoning market, no matter how flawed, this may represent an excellent opportunity and one of the strongest leverage points in this fishery.

Figure 28. Recreational fisheries input dimension scores.



The DR scored better across the Co-Management indicator dimension of Collective Action and Leadership. While the Collective Action score is relatively low for the DR, they still have at least one fishermen's organization that lobbies the government somewhat successfully for changes in regulations and the marinas have taken a pro-active stance to managing FAD conflict. The two main resort marinas, Cap Cana and Casa de Campo, have taken very proactive stances on data collection and have been maintaining catch and effort records for at least the last 5 years. The DR also has several key fisheries leaders giving them a good score for the Leadership Dimension.

Both countries scored very similarly for Management. The DR received slightly higher scores for spatial tools because there are the beginnings of spatial management being discussed and due to their heavy reliance on FADs and the proposed MPA that aims to protect billfish during spawning season. This is also a good point of leverage for future spawning harvest restrictions for billfish. If a Billfish Conservation Fund is developed and is to succeed, management and enforcement of a spawning area closure may be an additional investment for the fund to make in addition to paying for FAD maintenance and access.

The DR scored higher on the Infrastructure indicator as they have better roads and far more international flights than Grenada. That is very important for attracting and retaining tourist anglers. Many recreational vessel owners from the Southern USA bring their boats down knowing that they are a quick, non-stop flight away from high quality fishing and can cover their costs by keeping their boat fully chartered when they aren't fishing it. Finally, the DR score better across all Fishery Attribute indicator dimensions including Fishery Characteristics, Angler Characteristics and Angler Motivations. The higher scores across these dimensions are driven by the fact that the fishery is a world-class fishery for BUM and it attracts avid, high net worth, globe traveling billfish anglers that tend to be very

experienced and specialized. While it is not the place to go in search of an all-tackle world record, it is a place where a daily release record is possible or where light-tackle or fly fishing records are possible and actively sought.

3.4 Potential policy interventions

This section is not normally included in an FPI report. However, because of the nature of the funding for this study as part of the Caribbean Billfish Project and the project's need to develop bankable business plans to support triple bottom line outcomes, a brief discussion is included below about potential interventions in the fishery that could help improve its environmental, social and economic performance. The latter could include improvements associated with:

1. Stock recovery: implementation of catch and effort controls, buyouts, conservation agreements, creation of alternative livelihoods for fishing communities.
2. Operational efficiency: activities that reduces the cost of fishing or delivering seafood through the supply chain, better administrative arrangements for managing the fishery, improvement of community associations and local capacity for co-management.
3. Market gains: improvement of quality as a price differentiator, marketing of new seafood products, investment in storage facilities or distribution centers to control prices, MSC certification, engage buyers who are committed to sustainable sourcing.

The main opportunities identified in the Dominican Republic pelagic fishery, and therefore the leverage points for reform as well as some potential interventions, are summarized in Table 4.

Table 4. List of opportunities and potential interventions.

Fishery sector	Fishery deficiency	Potential fishery intervention
All sectors	Lack of fishery data	Develop standardized data collection, enumerate individual species Clear data entry backlog Develop an enumerator manual and enumerator training program Collect recreational fisheries effort and participation data
	Lack of professionalism in fishery sector	Promote the value of recreational and commercial fisheries. Professionalize both sectors.
	Not an ICCAT member	Carry out a cost-benefit assessment of ICCAT membership and participate in catch and effort data and fishery information sharing
FAD	No limited entry	Limiting entry would reduce costs and improve catch rates
	No limits on the number of FADs	Cap the number of FADs. Assign collective or individual rights

Fishery sector	Fishery deficiency	Potential fishery intervention
	Low product Quality	Develop on-board ice holding capability and carry ice. Improve at sea handling of fish caught
	No export market channel	Improve shoreside handling Supplant imported high quality seafood for resorts and tourist restaurants with local fish Develop price premiums for quality Develop HACCP facility.
	Billfish harvests locally high	Develop small shipment relationships with US and EU markets. Develop distribution channel to airport. If stronger rights to FADs can be implemented, incomes will rise. If coupled with better access to export markets, it may be possible to leverage that to reduce billfish harvest
	No recreational fishing license	Short term and annual licenses should be introduced
Recreational fishery	Severe conflict with FAD fishers	Resident and non-resident Priced high enough to cover administration cost and generate conservation funds Use license scheme as a data collection frame
		Create a Billfish Conservation Fund. Create private non-profit with stakeholder board members.
	Unsafe charter fleet in some regions	Spend fund dollars to enhance conservation Create, manage and enforce spawning closures Incentivize FAD fishers to reduce billfish harvest and minimize conflicts
		Incentivize FAD fishers to reduce billfish harvest and minimize conflicts Separate charter fishing license nationwide
	No data on the for-hire sector	Incentivize the fleet to promote 100% release of billfish Improve vessel safety and safety at sea measures
		Institute for-hire logbook. Could be electronic via smart phone

The DR has an excellent network of data collectors called enumerators. It would benefit the data collection program greatly and the overall quality of the DR data if an enumerator training could be developed that would create a curriculum for fish identification knowledge and train the enumerators to improve data recording consistency. CODOPESCA could hire an enumerator trainer that would conduct a short training with every new enumerator. There are resources from the global community to provide for this kind of management capacity building and if those resources could be utilized, more consistent and higher quality data could be achieved very cost effectively. Additionally, because of funding issues and human resources deficiencies, the full data worksheets with fisheries statistical data have not been entered since 2011. In talking with CODOPESCA, that backlog could be cleared in 9-12 months with four additional employees and four new data entry computers. CODOPESCA estimated it would cost USD 18 000 to clear that backlog.

An interesting source of income and conflict has emerged in recent years that involve the recreational and FAD fisheries fleets. The recreational fleet fish some of the same areas where the FADs are placed. The recreational fishers like the FADs and think that the increases in billfish abundance they have witnessed are the result of the FADs holding bait year round and therefore changing the movements and migrations of billfish. Cap Cana and Casa de Campo are the two largest recreational ports in the DR. Both of those marinas fish some of the areas with the densest FAD placements. As one would expect, conflicts between recreational anglers and FADS fishers emerged that have become severe and sometimes violent. In order to ameliorate some of this conflict, both recreational marinas began collecting fees from slip holders to pay for FAD maintenance. Casa de Campo charges USD 500/boat slip per year as a FAD fee. Cap Cana charges USD 75/boat slip per month as a FAD fee. As would be expected, this raises considerable sums of money, perhaps as much as USD 100 000 between both marinas. Sometimes there are private agreements between individual boats for individual exclusive fishing rights on FADs at a cost of USD 100/day. Additionally, tournaments hosted by each marina often require FAD payments as part of the registrations and that money is used to give the tournaments exclusive access during the days of the tournaments.

Unfortunately, several problems have emerged in the implementation of the informal program. One, it appears that middlemen between the marinas and the FAD fishers are taking a substantial portion of the money. Anecdotally, USD 25 000 was raised to pay the San Pedro de Macorís fleet, but the money never made it to the fishers. This was mentioned to the study team both by a charter captain and by fishers in San Pedro de Macorís. Second, these payments have created additional “fishing” participants that are more intent on handouts than actually fishing. Some “pirate” boats will hound a recreational boat all day demanding payment in fish, cash or goods and if sufficient payoff is not received, they will motor behind the recreational vessel that is hooked up with a marlin and take that fish from them to sell.

Finally, many of the recreational slip holders in these marinas are discouraged by the lack of transparency in the wealth transfer process. It may be possible to use this albeit flawed system to lower billfish mortality while achieving livelihood goals, but the system would have to be run by an independent body with a very transparent architecture. There are conservation funds in other places in the Caribbean. These funds are managed by an independent body that is run like a corporation with a board made up of representatives of all stakeholders. In this case it would be important to have private anglers, charter captains, CODOPESCA, FAD fishermen and FAD fishing organizations all working together to set spending priorities to reduce conflict and reduce billfish harvest.

3.4.1 FAD fishery

Changing the commercial FAD fishery will be very difficult. Poverty is prevalent among the FAD fishers in some locations in the DR, more so than in Grenada. The FAD fishery is considered to be the employer of last resort. As a result, any talk about limiting entry or restricting commercial access is met with resistance from ministry officials even though there is likely too much fishing effort on the water as very few fishers make a good living and daily catch rates are very low. Generally, when conducting an FPI study, there is a lot of curiosity from the participants regarding what the information will be used for and if there is any potential for their participation to improve their livelihoods. There was no curiosity expressed in any of the interviews. Additionally, there appears to be a lot of economic satisficing driving decisions instead of being motivated strictly by profits.[17] Many of the fishers are nearly constantly in-debt to their fish buyer giving them very little ability to change their vocation and their financial situation.

Limiting entry into the FAD fishery would be a good start, although one that will be difficult to achieve. If a conservation fund can be established as described above, perhaps that money can be used to improve their fisheries business through education or through improving product quality. Since there is no need to maintain fish quality for export and because the local DR markets seem to be very tolerant to low quality product, it may be very difficult to improve value in the supply chain. Developing supply chain pathways towards export markets or through import substitution into higher end domestic markets would improve livelihoods. However, the supply chain would need investments in infrastructure and the fishers would have to start carrying ice and handling their fish better at sea.

3.4.2 Recreational fishery

There is a real issue with unsafe, low cost charters in the recreational fisheries sector, which cater to the all-inclusive package tourists. These boats undercut the more traditional charter prices by offering low quality service, low quality gear and barely serviceable boats. Part of their low fees are offset by selling all the fish they catch. It may be worth exploring how to professionalize this fleet and increase passenger safety. It would be a good idea to require a charter license that required safety-at-sea training and vessel licensing that required annual boat inspections. It may be possible to run the kinds of trips the inclusive hotels demand with smaller, less expensive craft, although the seas are quite rough in the Mona Passage, the area fished by this fleet. Professionalizing this fleet would improve safety, incomes and improve the reputation of recreational fishing in the Punta Cana area. It would allow the local captains that serve these tourist responsibly and ethically to raise their prices to keep up with inflation. The current professional charter captains worry that, once tourists have participated in fishing operated by these low budget charters, tourists will leave with a bad taste in their mouth regarding sport fishing and they may not pursue sport fishing as a recreational activity next time they visit the DR.

[17] Economic satisficing describes a violation of the typical profit maximizing assumption for businesses. Under this type of behavior, a business, in this case a fisherman, will work to earn a return that is satisfactory but not one that maximizes profits.

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Appendix 1. Commercial and recreational, output and input indicators.

Table 1. Commercial output indicators.

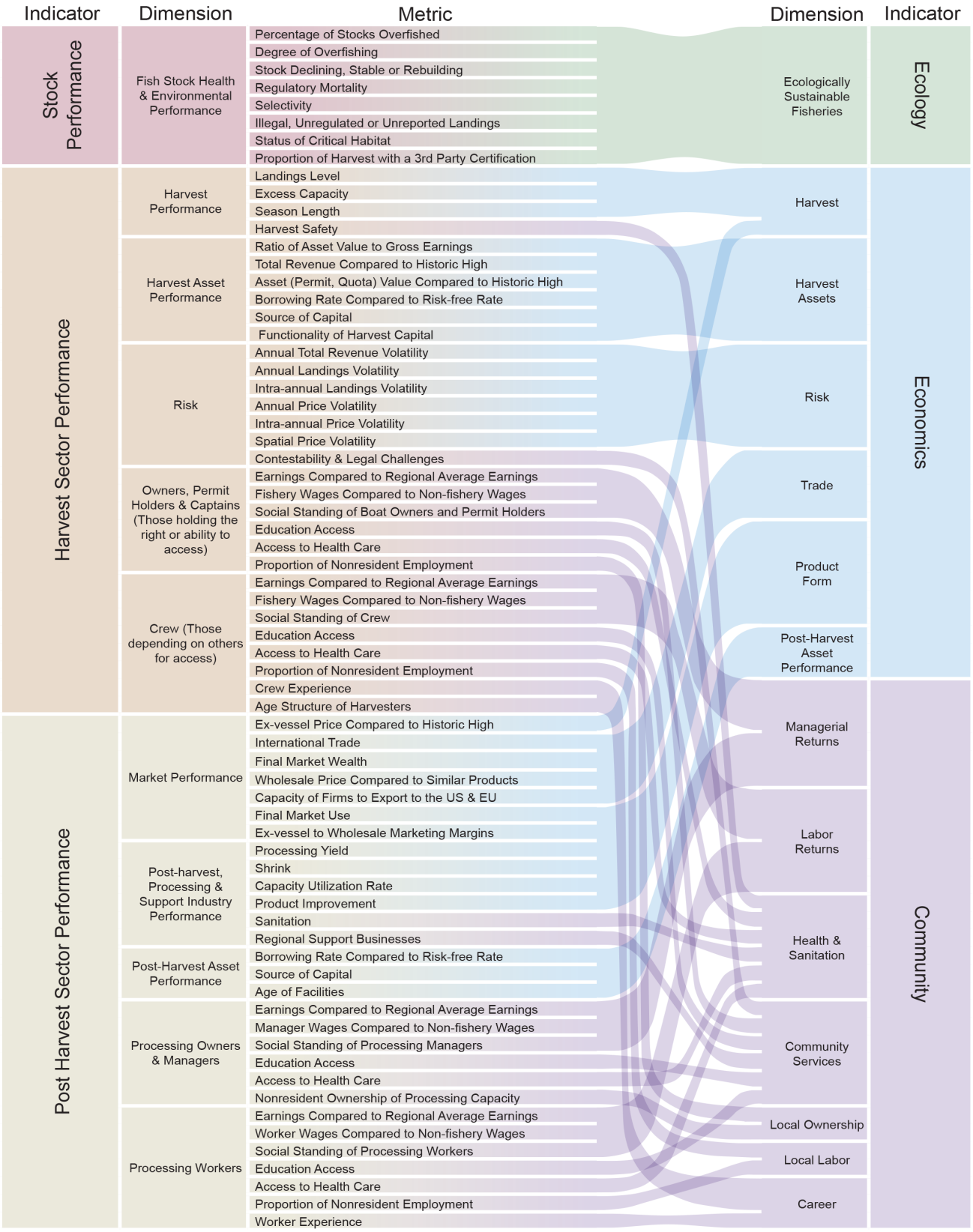

Figure: Anderson et al. 2016

Table 2. Commercial input indicators.

Component	Dimension	Measure
Macro Factors	General Environmental Performance	Environmental Performance Index (EPI)
	Exogenous Environmental Factors	Disease and Pathogens
		Natural Disasters and Catastrophes
		Pollution Shocks and Accidents
		Level of Chronic Pollution (Stock effects)
		Level of Chronic Pollution (Consumption effects)
	Governance	Governance Quality
		Governance Responsiveness
	Economic Conditions	Index of Economic Freedom
		Gross Domestic Product (GDP) Per Capita
Property Rights & Responsibility	Fishing Access Rights	Proportion of Harvest Managed Under Limited Access
		Transferability
		Security
		Durability
		Flexibility
		Exclusivity
	Harvest Rights	Proportion of Harvest Managed with Rights-based Management
		Transferability
		Security
		Durability
		Flexibility
		Exclusivity
Co-Management	Collective Action	Proportion of Harvesters in Industry Organizations
		Harvester Organization Influence on Fishery Management & Access
		Harvester Organization Influence on Business & Marketing
	Participation	Days in Stakeholder Meetings
		Industry Financial Support for Management
	Community	Leadership
		Social Cohesion
	Gender	Business Management Influence
		Resource Management Influence
		Labor Participation in Harvest Sector
		Labor Participation in Post-Harvest Sector
Management	Management Inputs	Management Expenditure to Value of Harvest
		Enforcement Capability
		Management Jurisdiction
		Level of Subsidies
	Data	Data Availability
		Data Analysis
	Management Methods	MPAs and Sanctuaries
		Spatial Management
		Fishing Mortality Limits
Post-Harvest	Markets & Market Institutions	Landings Pricing System
		Availability of Ex-vessel Price & Quantity Information
		Number of Buyers
		Degree of Vertical Integration
		Level of Tariffs
		Level of Non-tariff Barriers
	Infrastructure	International Shipping Service
		Road Quality
		Technology Adoption
		Extension Service
		Reliability of Utilities/Electricity
		Access to Ice & Refrigeration

Figure: Anderson et al. 2016

Table 3. Recreational output indicators.

Indicator	Dimension	Measure
Ecology	Fish stock health	Percentage of Stocks Overfished or Undergoing Overfishing
		Stock Status
		Stock Declining, Stable, or Rebuilding
		Effect of Stocking on Wild Stock
		Wild fish Baseline
		Regulatory Mortality
		Voluntary Catch-and-Release Mortality
	Environmental Performance	Effet of Fishery on Habitat
		Non-native Species
		Effect of Stocking on the Ecosystem
		Status of Critical Habitat
		Selectivity
		Non-target Stock Status
Economic	Aggregate Angler Utility	Number of Trips compared to Historic High
		Catch per Trip compared to Historic High
		Catch compared to Historic High
		Landings compared to Historic High
		Number of Participants compared to Historic High
		Enhanced Catch Opportunity
	For-Hire Performance	Total Revenue compared to Historic High
		For-Hire Asset Value compared to Historic High
		Ratio of For-Hire Asset Value to Gross Earnings
		For-Hire Borrowing Rate Relative to Risk-free Rate
		Source of For-Hire Capital
		Functionality of Fishing Capital
		Trip Price compared to Historic Price
		Degree of Vertical Integration
		Number of Guiding Businesses compared to Historic High
	Risk	Annual Total Revenue Volatility
		Annual Landings Volatility
		Intra-annual Landings Volatility
		Season Length
		Annual Trips Volatility
		Annual Catch Volatility
		Contestability and Legal Challenges
		Intra-annual Catch Volatility
		Intra-annual Trip Volatility
		Catch per Trip Volatility
	Supporting Industry Performance	Proportion of Nonresident Anglers
		Lodging Grade
		Travel Cost
		Length of Trip
		Ratio of Fishing Days to Non-fishing Days
		Capacity Utilization
		Gear and Tackle Expenditures
		Boat Type
		Proportion Fishing from Private Boats
Community	For-Hire Returns	Captain Earnings Compared to Regional Average Earnings
		Captain Wages Compared to Non Fishery Wages
		Social Standing of Captains
		Mate Earnings Compared to Regional Average Earnings
		Mate Wages Compared to Non-fishery Wages
		Social Standing of Mates
	Health and Education	Captain's Education Access
		Captain's Access to Health Care
		Mate's Education Access
		Mate's Access to Health Care
	Local Labor in Fishing Sector	Proportion of Nonresident Captains
		Proportion of Nonresident Mates
	Career	Mate Experience
		Age Structure of For-Hire Sector
	Local Labor in Supporting Industries	Proportion of Nonresident Owners
		Proportion of Nonresident Labor
		Proportion of Local Gear Expenditures
		Proportion of Local Boat Expenditures

Figure: Andereson et al. 2017

Table 4. Recreational input indicators.

Component	Dimension	Recreational Measure	Commercial Measure
Macro Factors	National Environmental Performance	Environmental Performance Index (EPI)	Environmental Performance Index (EPI)
	Environmental Risk	Disease and Pathogens	Disease and Pathogens
		Natural Disasters and Catastrophes	Natural Disasters and Catastrophes
		Pollution Shocks and Accidents	Pollution Shocks and Accidents
		Level of Chronic Pollution (Stock effects)	Level of Chronic Pollution (Stock effects)
		Level of Chronic Pollution (Consumption effects)	Level of Chronic Pollution (Consumption effects)
		Level of Chronic Pollution (Participation effects)	
	National Governance	Governance Quality	Governance Quality
		Governance Responsiveness	Governance Responsiveness
	National Economics	Index of Economic Freedom	Index of Economic Freedom
		Gross Domestic Product (GDP) Per Capita	Gross Domestic Product (GDP) Per Capita
	Life History	Age of Sexual Maturity to Age of Recruitment to Fishery	
		Year Classes Available to Fishery	
Property Rights	For-Hire Access Rights	Proportion of For-Hire Fishing Effort Managed Under Access Rights	Proportion of Harvest Managed Under Access Rights
		Transferability	Transferability
		Security	Security
		Durability	Durability
		Flexibility	Flexibility
		Exclusivity	Exclusivity
	For-Hire Harvest Rights	Proportion of For-Hire Fishing Effort Managed with Rights-based Management	Proportion of Harvest Managed with Rights-based Management
		Transferability	Transferability
		Security	Security
		Durability	Durability
		Flexibility	Flexibility
		Exclusivity	Exclusivity
	Private Angler Access Rights	Proportion of Private Fishing Effort Managed Under Access Rights	Proportion of Harvest Managed Under Access Rights
		Transferability	Transferability
		Security	Security
		Durability	Durability
		Flexibility	Flexibility
		Exclusivity	Exclusivity
	Private Angler Harvest Rights	Proportion of Private Fishing Effort Managed with Rights-based Management	Proportion of Harvest Managed with Rights-based Management
		Transferability	Transferability
		Security	Security
		Durability	Durability
		Flexibility	Flexibility
		Exclusivity	Exclusivity
Co-Management	Collective Action	Proportion of For-Hire participants in Industry Organizations	Proportion of Harvesters in Industry Organizations
		For Hire Organization Influence on Management & Access	Harvester Organization Influence on Management & Access
		For-Hire Organization Influence on Business & Marketing	Harvester Organization Influence on Business & Marketing
		Proportion of Anglers in Organizations	Proportion of Harvesters in Industry Organizations
		Angler Organization Influence on Management & Access	Harvester Organization Influence on Management & Access
		Ancillary Businesses/Local Government Organization and Influence on Business and Marketing	
	Participation & Support	Days in Stakeholder Meetings	Days in Stakeholder Meetings
		Financial Support for Management	Industry Financial Support for Management
	Leadership	For-Hire Leadership	Leadership
		Angler Leadership	Leadership
	Social Cohesion	For Hire Social Cohesion	Social Cohesion
		Angler Social Cohesion	Social Cohesion
		Inter-group Social Cohesion	
	Gender	Resource Management Influence	Resource Management Influence
		Women Anglers	Labor Participation in the Harvest Sector
		Participation in For-Hire Sector	Labor Participation in the Harvest Sector

Figure: Andereson et al. 2017

Fishery Performance Indicators (FPIs) were developed to address gaps in data and information on fisheries worldwide and in recognition that to be successful with fisheries investment, development or conservation projects measurable outcomes are needed. The focus of the tool and its indicators is to evaluate the effectiveness of management systems in aligning ecosystem health and human well-being.

The Ocean Partnership Program (OPP) belonging to the Areas Beyond National Jurisdictions (ABNJ) program funded by the Global Environmental Facility (GEF) and the World Bank, supported the Caribbean Billfish Project and its development of billfish fisheries management and conservation business cases in the Caribbean. The Western Central Atlantic Fishery Commission (WECAFC), Conservation International and the fisheries authorities in the Dominican Republic and Grenada teamed-up to develop business cases at national level.

The FPIs studies in both countries were conducted on the commercial and recreational pelagic fisheries. For Grenada, the commercial pelagic longline fishery, the commercial fish aggregating device (FAD) fishery and recreational fishery for billfish and other pelagics were assessed. For the Dominican Republic, the pelagic FAD fishery and the recreational billfish fishery were assessed. This circular details the information discovered during the FPI field work and discusses the resulting FPI scores. The information collected and analysed is used for the development of the business cases in both countries.

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WESTERN CENTRAL ATLANTIC FISHERY COMMISSION

ISBN 978-92-5-1300416-7 ISSN 2070-6065

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I8833EN/1/04.18