Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

Ministry of Industry, Commerce, Agriculture and Fisheries

JM-MICAF-36545-CS-CQS

Pelagic Fisheries

Management Plan

Submitted as a collaboration between

MRAG

LUMIN CONSULTING | A UWI COMPANY

MRAG Ltd is an independent fisheries and aquatic resource consulting company dedicated to the sustainable use of natural resources through sound, integrated management practices and policies.

Established in 1986, MRAG has successfully completed projects in more than 60 countries. Our in-house experts have a wide variety of technical expertise and practical experience across all aspects of aquatic resource management, policy and planning, allowing us to take a multi-disciplinary approach to every project. Our capability to service an extensive array of resource management needs is further extended through our network of associations with internationally acclaimed experts in academic institutions and private organisations worldwide.

MRAG Ltd

18 Queen Street

London

W1J 5PN

T: +44 (0) 20 7255 7755

F: +44 (0) 20 7499 5388

W: www.mrag.co.uk

Project code:	JM2736
Version:	Final
Prepared by:	John Pearce, Hannah Richardson, Pippa Howarth, Paul Medley, Karl Aiken, Danielle Kitson, Iain Pollard, Katherine Collinson and Stephen Mangi Chai
Approved by:	Stephen Mangi Chai

Table of Contents

Acronyms

Acronym	Definition
CARICOM	Caribbean Community
COVID	Coronavirus disease
CPUE	Catch per Unit Effort
CRFM	Caribbean Regional Fisheries Mechanism
EAFM	Ecosystem Approach to Fisheries Management
EEZ	Exclusive Economic Zone
FAD	Fish Aggregation Device
FAO	The Food and Agriculture Organization of the United Nations
FMP	Fisheries Management Plan
GPS	Global Positioning System
HCR	Harvest Control Rule
HORECA	Hotel, restaurant and café sectors
ICCAT	The International Commission for the Conservation of Atlantic Tunas
LBSPR	Length-Based Spawning Potential Ratio
MCS	Monitoring, Control and Surveillance
MSY	Maximum Sustainable Yield
NFA	National Fisheries Authority
OVI	Objectively Verifiable Indicator
PSA	Productivity Susceptibility Analysis
RADA	Rural Agricultural Development Agency
SFCA	Special Fishery Conservation Areas
SIDS	Small Island Developing States
SWOT	Strength, Weakness, Opportunity and Threat
USA	United States of America
USD	American Dollars

List of Tables

List of Figures

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

Executive Summary

The development of this Fisheries Management Plan (FMP), under the World Bank funded project 'Promoting Community Based Climate Resilience in the Fisheries Sector', follows the FAO Ecosystem Approach to Fisheries Management. The objective of this FMP is to help the Government of Jamaica achieve sustainable development and management of under-utilised fisheries resources. This management plan forms an adaptive framework that should be regularly reviewed and updated to incorporate findings from latest research and other sources in a timely manner to inform decision making.

This FMP focuses on developing a sustainable artisanal fishery for large pelagic species within Jamaican waters, taking into consideration the wider ecosystem impacts of a fishery including the main bycatch species and the associated baitfish fishery. The principal implementation partners for this Plan are the fishers/local communities and the fisheries authorities (the National Fishery Authority). Other stakeholders include ICCAT, the local households and hotels/restaurants (domestic market) and international market.

In order to achieve the overarching goal of this management plan '**to ensure biological, ecological and socio-economic sustainable development of the large pelagic fisheries sector in Jamaica',** four Purposes have been defined. These include:

- Purpose 1: Sustainable exploitation of offshore pelagic species;
- Purpose 2: Protection of the environment and ecosystem;
- Purpose 3: Effective governance and management; and
- Purpose 4: Sustainable development of the fishery and markets.

For each Purpose, a risk assessment was undertaken in the form of a SWOT (Strength, Weakness, Opportunity and Threat) analysis that was informed through literature review and stakeholder consultation. This assessment aimed to understand the current issues and barriers to developing a sustainable pelagic fishery in Jamaica. Following the SWOT analysis, a number of specific objectives and associated activities were defined that should be addressed in order to achieve the overall goal of the FMP. In order to provide further guidance, the key priority actions have been highlighted which include: regional collaboration through a site visit to Eastern Caribbean States to learn best practice and facilitate knowledge sharing; exploratory fishing of offshore pelagic species with good stock status; field study to determine the current conditions and facilities at landings sites that are capable of receiving pelagic catches; a data collection programme targeting all offshore pelagics that are landed; and market strategies to promote the consumption of large offshore pelagics domestically targeting households, hotels and restaurants.

To ensure effective implementation of this FMP, a Monitoring and Evaluation Plan and a Communication Plan have also been developed. The Monitoring and Evaluation plan includes proposed key results (objectively verifiable indicators), means of verification and assumptions to ensure each activity is being achieved. Although to date, a comprehensive Communication Plan could not be developed due to gaps in information, an initial plan has been provided which includes key stakeholders, messages and delivery pathways.

1 Introduction

The offshore pelagic fishery in Jamaica represents an under-utilised fishery resource. In the Draft National Fisheries and Aquaculture Policy (2014), the Government stated that it intends 'to achieve sustainable development and management of under-utilized fisheries resources with due consideration to regional and international obligations'. The Government's strategy is to develop pelagic fisheries by increasing fishing capacity and technology to the extent required to sustainably harvest the resource in a manner which is both economically efficient and socially equitable. The Government, through financing from the World Bank under the project 'Promoting Community Based Climate Resilience in the Fisheries Sector', commissioned a study to prepare a development and management plan for artisanal longline fishing for offshore pelagics.

1.1 What is a Fisheries Management Plan?

The FAO's definition of a fisheries management plan is "A formal or informal arrangement between a fishery management authority and interested parties which identifies the partners in the fishery and their respective roles, details the agreed objectives for the fishery and specifies the management rules and regulations which apply to it and provides other details about the fishery which are relevant to the task of the management authority". A fisheries management plan should contain:

- A description of the fishery especially its current status and any established user rights;
- The management objectives;
- How these objectives are to be achieved, i.e. management measures and controls; and
- A description of how the plan should be monitored and evaluated.

Essentially, a fisheries management plan is a tool to help define and then achieve objectives which help manage the fishery. The plan must ensure that the fishery is maintained in a sustainable manner and where possible meet the requirements of the ecosystem approach to fisheries management, as detailed below.

In this Fisheries Management Plan (FMP), we have included elements of an ecosystem approach to fisheries management (EAFM) framework that should be reviewed alongside findings from contemporary research and other sources, and subsequently updated in a timely manner to inform decision-making. An essential component of adopting the EAFM framework is to develop a co-management FMP that includes continued stakeholder engagement throughout the lifetime of the management plan. An initial stakeholder engagement has been conducted and the findings integrated in the Plan. In the context of this FMP, the term ecosystem is hereafter taken to include both the human and environmental components of an integrated social-ecological system, with humans being an integral part of the ecosystem. The definition also addresses both human and ecological well-being thus combining two concepts: (i) conserving biodiversity, ecosystem structure and functioning, and (ii) fisheries management for the purpose of providing food, income and livelihoods for humans (Staples and Funge-Smith, 2009).

The key principles of EAFM include:

- Fisheries should be managed to limit their impact on the ecosystem to an acceptable level;
- Ecological relationships among species should be maintained;
- Management measures should be compatible across the entire distribution of the resource;

- A precautionary approach to decision-making and actions taken is needed because the knowledge on ecosystems is incomplete; and
- Governance should ensure both human and ecosystem well-being and equity.

These EAFM principles have been used to define an overall goal for this FMP which is described in Section 2.1. Under the overarching goal, four Purposes are stated (see Section 2.2) that have been broken down into biological, ecological and socio-economic / governance activities to make sure the overall goal is achieved.

1.2 Structure of the offshore Pelagic Fisheries Management Plan

This FMP has a tree like structure. The overall goal of a plan may have many purposes, each purpose may have one or more specific objectives, each of which many have many individual activities. The branched structure allows the plan to be broken down into smaller activities that can be addressed, monitored and reported on whilst allowing managers to maintain on overview of progress. An example structure is shown in Figure 1. This follows a standard FMP structure adopted by Hindson *et al.* (2005).

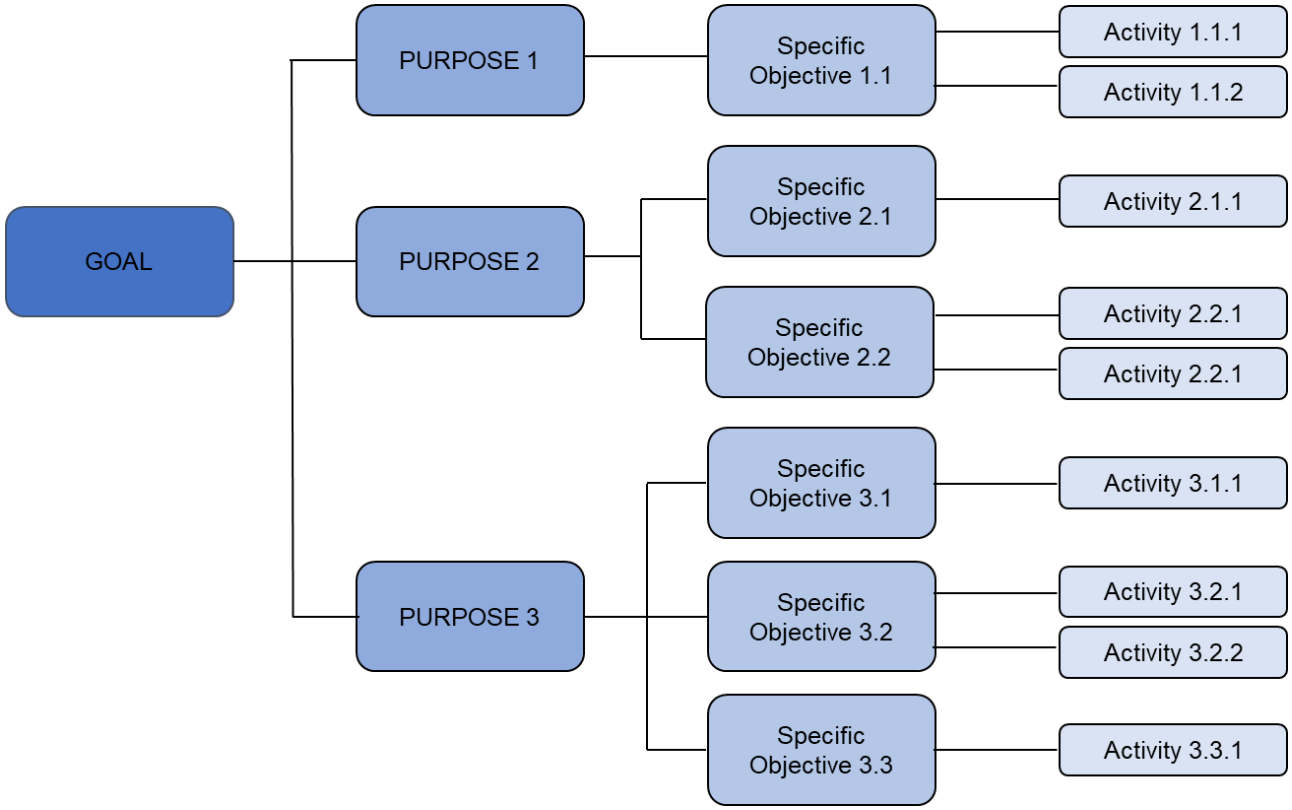

Figure 1 Example branch structure of a typical fisheries management plan.

An FMP should include three basic building blocks:

- **Fisheries management plan standards:** These are the standard elements that would be recommended to appear in any management plan and many of these would overlap with the EAFM steps above.
- **Fishery specific issues:** Any specific issues related to the species, management of the species involved and any specific processing, market, environmental or habitat related issues.
- **EAFM standards:** Those elements listed above relating to an EAFM approach.

These three elements will be able to define the goal, purposes, specific objectives and activities of the management plan. The plan will then be expanded using three sets of information:

- **Collated information:** Information from current management processes, literature on the related species and ecosystems etc.
- **Stakeholder Engagement:** Engagement with stakeholders in the fishery including the fishers, managers, control authorities, socio-economic experts and those involved in the sales and marketing of the fish.
- **Risk Assessment:** A risk assessment process identifying those areas of the fishery that are of highest risk and where these would need to be addressed and prioritised in a fishery management plan.

The goal, purpose, specific objectives and activities can then be finalised and agreed and the final elements of the management plan defined. These will include:

- **Management actions to meet objectives:** Identifying activities required to meet each of the objectives and purposes to ensure the overall plan meets the goal.
- **Monitoring and evaluation:** Identifying indicators and benchmarks for the evaluation and successful implementation of the management plan, the data required to evaluate success and how this should be done. This process will involve communicating these results to stakeholders and how best to do this for each stakeholder group.
- **Prioritisation:** Identifying any key actions that need to be prioritised in terms of timing to enable other actions to take place or that are critical for the successful implementation of the management plan. The risk assessment process is critical for prioritisation.

This development plan is shown graphically in Figure 2.

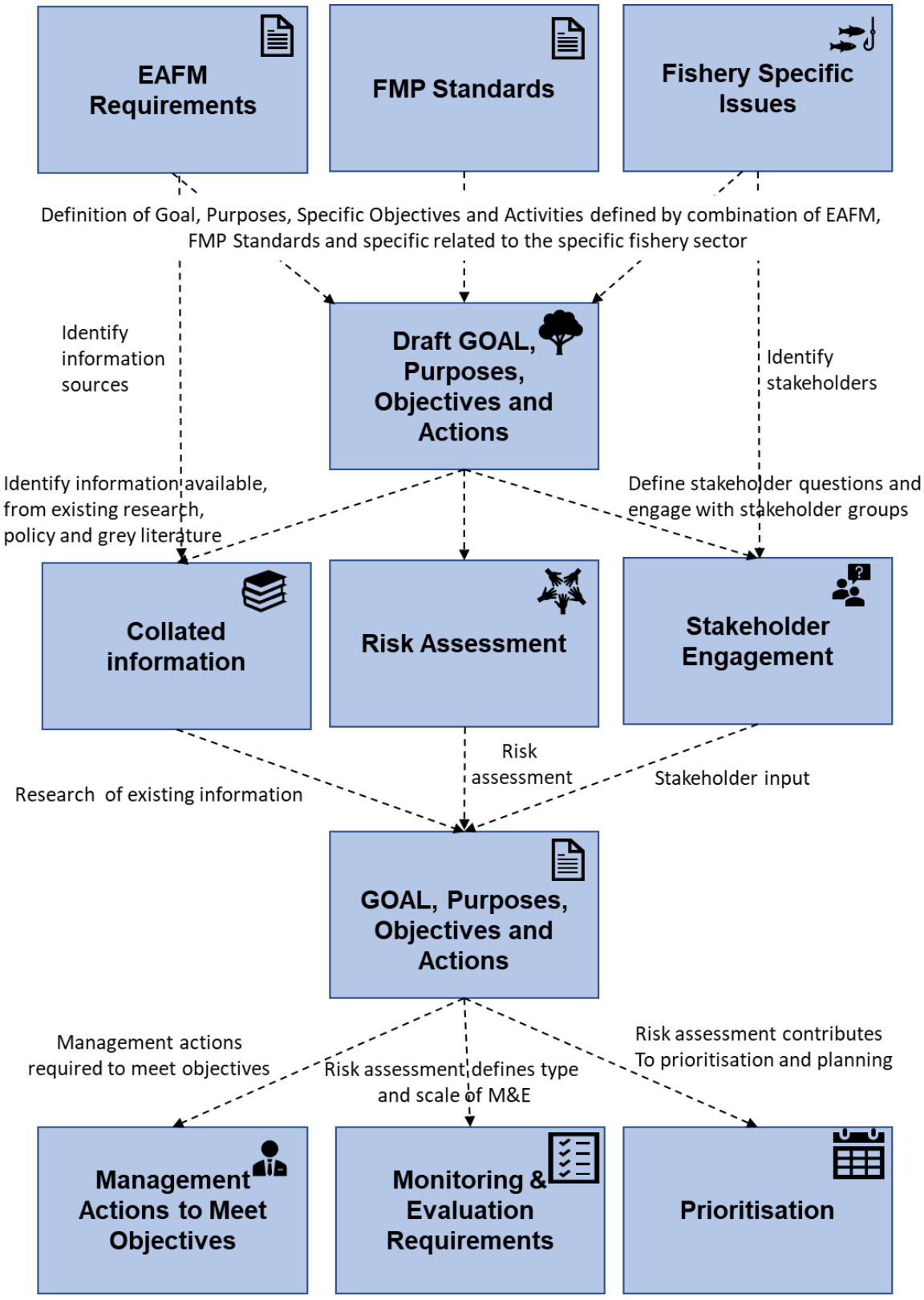

Figure 2 Fisheries management plan development process

1.3 Scope

This offshore pelagic FMP will encompass all Jamaican fisheries targeting large pelagic fish (listed in Table 1). The species taken in Jamaican territorial waters are dominated numerically by various species of tunas, sharks and marlins (Aiken 1993; Mahon 1995, 1996; Aiken & Kong 2000). However, because sharks have no commercial value as food species in Jamaica at the time of writing, these are not normally identified or assessed.

Table 1 Species of large pelagics known from Jamaican waters (various sources).

Scientific name	Common Name	Comments	Management*
Makaira nigricans	Blue marlin	Common (seasonal)	ICCAT
Tetrapterus albicans	White marlin	Rare	ICCAT
Istiophorus platypterus	Sailfish	Rare	ICCAT
Xiphias gladius	Swordfish	Rare	ICCAT
Coryphaena hippurus	Dolphin, Dorado (mahi-mahi)	Common	Jamaica
Acanthocybium solanderi	Wahoo	Common	Jamaica
Scomberomorus cavalla	King mackerel	Common	Jamaica
Scomberomorus regalis	Cero mackerel	Common	Jamaica
Thunnus albacares	Yellowfin tuna	Common (seasonal)	ICCAT
Thunnus atlanticus	Blackfin tuna	Common	ICCAT
Euthynnus allettratus	Little tuna (bonito)	Very common	ICCAT
Katsuwonus pelamis	Skipjack tuna	Common	ICCAT
Elagatis bipinnulatus	Rainbow runner	Common	Jamaica
Coastal and Rarer Species			
Caranx hippos	Crevalle jack	Coastal	Jamaica
Caranx latus	Horse-eye jack	Coastal	Jamaica
Caranx fusus	Bar jack	Coastal	Jamaica
Trachinotus falcatus	Permit	Occasional	Jamaica
Sphyraena barracuda	Greater barracuda	Common	Jamaica
Megalops atlanticus	Tarpon	Occasional	Jamaica
Centropomus undecimalis	Snook	Occasional	Jamaica
Carcharhinus longimanus	Oceanic whitetip shark	Occasional	Jamaica
Carcharhinus obscurus	Dusky shark	Occasional	Jamaica
Galeocerdo cuvieri	Tiger shark	Occasional	Jamaica
Isurus oxyrinchus	Shortfin mako shark	Occasional	ICCAT
Sphyrna lewini	Scalloped hammerhead shark	Occasional	Jamaica

*NB: Management column refers to the management regime under which the species is assessed and management measures applied including quotas and other restrictions.

Of the main species found in Jamaican waters, stakeholder consultation indicated that there is market for blue marlin, mahi-mahi (dolphinfish) and wahoo.

2 Goal and Purposes

Jamaica's nearshore waters are among the most overfished in the Caribbean[1], which has raised the need to develop other sources of marine resources. One objective of Jamaica's Government, is to manage the country's capture fisheries resources at a harvest rate that is as close as possible to their optimal sustainable yield. Indeed, it is the aim of the Government to achieve sustainable development and management of underutilized fisheries with due consideration to regional and international obligations, thereby minimizing the fishing pressure on any existing overexploited fish stocks.

This section describes the overall goal, purposes, (specific) objectives and activities that make up the overall offshore Pelagic FMP and the process used to define each of the elements of the plan. The overall goal is described in Section 2.1, the four purposes that have been identified are described in Section 2.2. The detailed objectives along with activities are described in Section 5.

2.1 Overall goal

For this FMP, the overall goal is "**to ensure biological, ecological and socio-economic sustainable development of the large pelagic fisheries sector in Jamaica**".

This goal is defined to fit in with the EAFM and would be considered to be standard for any FMP.

2.2 Purposes

In order to achieve the overall goal of offshore pelagic resources through environmentally and socio-economically balanced participatory approaches, this FMP has been divided into four purposes that can be addressed by the relevant organisations across Jamaica.

- Purpose 1: Sustainable exploitation of offshore pelagic species;
- Purpose 2: Protection of the environment and ecosystem;
- Purpose 3: Effective governance and management; and
- Purpose 4: Sustainable development of the fishery and markets.

One conflicting purpose has been identified in this management plan which relates to blue marlin and further detail is provided below. While blue marlin has been identified by stakeholders as being one of the more marketable species, the most recent stock assessment by ICCAT states that it is currently overfished and overfishing is occurring. Therefore, while this species would help contribute to Purpose 4 (development of the markets), it is not in line with Purpose 1 (sustainable exploitation). Due to the current stock status of blue marlin, it would not be advised to market or increase catches of this species. However, the status can be continually reviewed to monitor improvement in the stock.

Within ICCAT, there is also tension between a coastal State's rights to exploit its resources within the Exclusive Economic Zone (EEZ) and the state of those resources ocean-wide. It is believed that development of these fisheries is possible, but requires adequate planning as their development is risky.

[1] http://pdf.wri.org/working_papers/coastal_capital_jamaica_summary.pdf

3 Information Review

The following overview is based on information gathered through the literature review and stakeholder consultation. Further information can be found in Annex 1 and 2.

3.1 Environmental information

Jamaica has stewardship over a marine space 25 times its land space, with an EEZ of 297,637 km^2 (Mahon, 1995). More than 100,000 Jamaicans depend directly on the ocean for their livelihood and approximately 70% of the population live within 5 km of the coast. Jamaica lies within the path of north-easterly trade winds and wind speeds exceeding 15 m/sec with associated choppy seas are common (Aiken 1993). A season of relative calm usually occurs between October and February each year (Munro 1983). There is a hurricane season in the Caribbean from June to October annually during which unstable weather systems, including violent storms occur. The intensity of these hurricanes has increased significantly since around 1980.

The branch of the North-Equatorial current which flows westwards and enters the south-eastern Caribbean Basin is the dominant surface current system affecting Jamaican waters. It exits the Caribbean Sea via the Yucatan Channel and then passes between Florida and the Bahamas as the Florida Current before re-joining the eastern Branch of the North Equatorial current to become the Gulf Stream, and eventually the upper portion of the North Atlantic Gyre (Lyons 1980; Apel 1987).

3.2 Jamaican Pelagic Fisheries

The main fisheries around Jamaica are inshore artisanal targeting reef fish (Munro 1969, 1983; Aiken & Haughton 1987; Aiken 1993; Aiken & Kong 2000) and small pelagics, with commercial fisheries for queen conch (*Lobatus gigas*) and spiny lobster (*Panulirus argus*) operating on the Pedro Bank, south of the main island (Aiken 1993; Aiken & Kong 2000; Haughton & King 1989; Mahon et al 1992). There is a limited inshore small pelagic fishery operating mainly with drifting gillnets and a limited cast net fishing for anchovies and silversides. There is also a minor nearshore large pelagic fishery, mainly trolling lines towed behind canoes off the North coast 15-20 km offshore, taking larger pelagic fish species such as billfishes, tunas, dolphinfish, Spanish mackerels and wahoo. Generally, these fishes are not as numerous as in the eastern Caribbean, even in the seasons when catch rates are higher (November and March). In addition, a significant recreational fishery exists with tournaments commonly taking place for large pelagics during the season with highest abundance. Artisanal jamalongline has been explored, but there is no current fishery.

There is no medium or large scale domestic commercial fishing in Jamaica (Mahon 1995), but foreign vessels do operate in the Jamaican EEZ. Large pelagic fishes are currently caught by artisanal fishers trolling near the island shelf and banks, and by recreational and charter fishers, including several tournaments targeting blue marlin. However, large pelagic fisheries in Jamaica have attracted limited attention because the fishery resources are seasonal and not markedly abundant. Yet, large pelagics make up 10-14% of the total pelagics landings on the North coast, 3% on the south shelf and 1% on the Pedro Bank. Previous attempts to develop these fisheries have been limited by low catch rates, relatively high fuel costs, availability of investment required for more efficient equipment (vessels and gear) and limited market access. As such, the offshore pelagic fishery in Jamaica represents an under-utilised fishery resource which the Government now intends to safely harvest in a manner which is both economically efficient and socially equitable.

There are no quantitative assessments of potential yield for large pelagics around Jamaica. Many of the stocks are shared with neighbouring countries, and several extend throughout the Atlantic Ocean; some are known to be migratory. Thus, cooperative assessment and management will be required for many species. For these stocks, potential yield will be a share of the total yield for the stock. In addition, the resource has not been exported over the years; rather, the catch goes to the local market that consists of hotels, restaurants, supermarkets, seafood retailers and households.

A qualitative evaluation of the potential for expansion of fishing on large pelagics resources was inferred from a variety of sources, such as: the UNDP/FAO Caribbean Fishery Development Project surveys; joint fishery surveys with Cuba and the USSR; ICCAT data and assessments, and assessments in the USA (Mahon 1995). These sources of information on large pelagic resources which occur in the waters of Jamaica are not adequate for a definitive assessment of the potential yield for that area. The data did indicate that the waters around Jamaica are not as rich in pelagic fishes as those in other areas of the west central Atlantic, for example the southern Lesser Antilles. However, pelagic fishes occurred there, and foreign commercial vessels did at one time fish there. On that basis, the review concluded that oceanic large pelagic fishes are probably sufficiently abundant to justify cautious expansion of fishing activities for them.

One of the severely limiting factors in the development of a large-scale commercial fishery in Jamaican waters and elsewhere is the seasonality of those species or when to catch them. More precisely, it is the timing and duration of the maximum catch rates and abundance of these species that determines commercial success along with species maximum size, fishery location and availability of fishing vessels with appropriate large pelagic fishing gear. Of all these variables, seasonality is the most significant one. It is known that the “peak” season for large pelagic catches generally occurs in the so-called “winter” period in the Caribbean. That is roughly between November and March annually. For the remaining seven months of the year, catches of these large pelagic species are reported by all reliable sources as low to very low. In terms of more precise information, there is relatively limited data on seasonality of the large pelagics which are the most valuable of the fish species in the pelagics category.

Data on large pelagic fishing resources in Jamaican waters are rather scarce. Catch data on the main species of large pelagics caught in Jamaica and surrounding waters are found in early exploratory fishing projects (Oswald, 1963, Kawaguchi 1974; Wagner 1974; Wagner & Wolf 1974; Cooper 1981; Harvey *et al.* 1986; Kelly 2001). In general, the findings of this study indicate that the longline catch in the Jamaica area consists of a similar set of species to that found in other areas of the Caribbean, and that the relative abundance of these is, for many species, comparable with other areas of the Caribbean. High catches of sharks and marlins are however, issues which should be considered when developing a longline fishery on the north coast of Jamaica.

While some information can be inferred from studies from the US, Mexico and Cuba such as growth, mortality rates, length-weight and maturity, it should form part of the fisheries development to obtain local information for Jamaica as these values may vary across a species range and the quality of information from other sources cannot be controlled (i.e. some studies are poor). Growth is difficult to study because it generally requires age information to get reliable parameter estimates. However, maturity and length-weight can be collected relatively easily, and with good length frequency data, asymptotic size and mortality can be estimated.

3.3 Stock status

Information Information was not available on the status of stocks unless an assessment had been carried out by ICCAT. Large tunas and billfish generally have status determined (Table 2), and of those caught in Jamaica fisheries blue marlin and shortfin mako shark are considered overfished. For the remaining species, a Productivity Susceptibility Analysis (PSA) was carried out pending better information to determine which species are at most risk of overfishing (Table 2). A PSA does not determine current stock status, but does help indicate which species might require priority monitoring or precautionary management action. The PSA indicated several species at higher risk of overfishing, namely redtail needlefish, greater barracuda and tarpon, as well as all sharks. For good biological reasons sharks are always found vulnerable using risk-based methods. For the finfish, to some extent high risk was the result of a lack of information, and therefore some basic monitoring data (particularly for needlefish) to determine whether catches are significant would be most useful for these.

Overall, the status did not indicate that pelagic stocks currently exploited by Jamaican fisheries are overfished. Furthermore, it is unlikely that the Jamaica fisheries are contributing to overfishing of those stocks that may be at wider risk in the Atlantic, as these species are not a primary target species for those fisheries. However, it is strongly encouraged to confirm this through a basic data collection and stock assessment program. Unless this is in place, any expansion of the fisheries cannot be recommended. A full robust monitoring program will avoid putting fisheries at unacceptable risk and avoid overfishing.

Table 2 Exploitation status for the main pelagic species catches Jamaica. PSA risk assessment scores are given, but can be disregarded where full stock assessments are available.

FAO Code	Species	Scientific Name	Jurisdiction	Status
Baitfish				
BAL	Ballyhoo	*Hemiramphus brasiliensis*	Jamaica	PSA Score was 2.645 (medium risk).
BHA	Balao	*Hemiramphus balao*	Jamaica	PSA Score was 2.839 (medium risk).
BIS	Goggleye scad	*Selar crumenophthalmus*	Jamaica	PSA Score was 2.316 (low risk).
HCG	False pilchard	*Harengula jaguana*	Jamaica	PSA Score was 2.420 (low risk).
HCU	Red-ear sardine	*Harengula humeralis*	Jamaica	PSA Score was 2.503 (low risk).
MGU	White mullet	*Mugil curema*	Jamaica	PSA Score was 2.205 (low risk).
MUF	Striped mullet	*Mugil cephalus*	Jamaica	PSA Score was 2.546 (low risk).
PTA	Redtail needlefish	*Platybelone argalus argalus*	Jamaica	PSA Score was 3.048 (high risk).
THA	Thread herring	*Opisthonema oglinum*	Jamaica	PSA Score was 2.504 (low risk).
Pelagics				
BLF	Blackfin tuna	*Thunnus atlanticus*	ICCAT / Jamaica	PSA Score was 2.752 (medium risk).
BUM	Blue marlin	*Makaira nigricans*	ICCAT	ICCAT Assessment: B_{2016} / B_{MSY} 69% (52% – 91%) and fishing mortality was 103% F_{MSY} (74% - 150%)
CER	Cero mackerel	*Scomberomorus regalis*	ICCAT / Jamaica	PSA Score was 2.743 (medium risk).
CVJ	Crevalle jack	*Caranx hippos*	Jamaica	PSA Score was 2.451 (low risk).
DOL	Dolphin (mahi-mahi)	*Coryphaena hippurus*	ICCAT / Jamaica	PSA Score was 2.694 (medium risk).
GBA	Greater barracuda	*Sphyraena barracuda*	Jamaica	PSA score was 3.136 (high risk).
KGM	King mackerel	*Scomberomorus cavalla*	ICCAT / Jamaica	PSA Score was 2.652 (medium risk).
LTA	Little tuna (bonito)	*Euthynnus alletteratus*	ICCAT / Jamaica	ICCAT data-limited assessment for the little tuna (Pons *et al.* 2019) suggested that the stock is not overfished. PSA score was 2.623 (medium risk).
NXL	Horse-eye jack	*Caranx latus*	Jamaica	PSA score was 2.441 (low risk).
RRU	Rainbow runner	*Elagatis bipinnulata*	Jamaica	PSA score was 2.559 (low risk).
RUB	Bar jack	*Caranx crysos*	Jamaica	PSA score was 2.389 (low risk).
SFA	Sailfish	*Istiophorus platypterus*	ICCAT	ICCAT Assessment: SSB_{2014}/SSB_{MSY} 1.16 (0.18-1.69) $F2014/F_{MSY}$ 0.63 (0.42 – 2.02) (Western Atlantic stock). PSA score was 3.018 (high risk).

FAO Code	Species	Scientific Name	Jurisdiction	Status
SKJ	Skipjack tuna	*Katsuwonus pelamis*	ICCAT	ICCAT Assessment: Exploitable biomass (B) in 2013 was close to 130% B_{MSY} and fishing mortality close to 70% F_{MSY} (Western Stock). PSA score was 2.579 (medium risk).
SNO	Snook	*Centropomus undecimalis*	Jamaica	PSA score was 2.867 (medium risk).
SWO	Swordfish	*Xiphias gladius*	ICCAT	ICCAT Assessment: (B_{2015}/B_{MSY}) 1.04 (0.82 - 1.39) and (F_{2015}/F_{MSY}) 0.78 (0.62-1.01) (North Atlantic stock). PSA score was 2.570 (low risk).
TAR	Tarpon	*Megalops atlanticus*	Jamaica	PSA score was 3.076 (high risk).
TNF	Permit	*Trachinotus falcatus*	Jamaica	PSA score was 2.709 (medium risk)
WAH	Wahoo	*Acanthocybium solandri*	ICCAT / Jamaica	ICCAT Assessment: ICCAT catch based data-limited assessments suggest the stock is not overfished, whereas length based assessments suggest that it is. PSA score was 2.867 (medium risk).
WHM	Atlantic white marlin	*Kajikia albida*	ICCAT	ICCAT Assessment: B_{2017}/B_{MSY} 58% (27%-87%) F_{2017}/F_{MSY} 0.65 (0.45-0.93). The PSA score was 2.602 (medium risk).
YFT	Yellowfin tuna	*Thunnus albacares*	ICCAT	ICCAT Assessment: ICCAT Assessment: SSB in 2018 was estimated to be 117% SSB_{MSY} (75% - 162%) and fishing mortality was 96% F_{MSY} (56% – 150%).
Sharks				
DUS	Dusky shark	*Carcharhinus obscurus*	ICCAT/ Jamaica	PSA score was 3.426 (high risk).
OCS	Oceanic whitetip shark	*Carcharhinus longimanus*	ICCAT/ Jamaica	PSA score was 3.083 (high risk).
SMA	Shortfin mako shark	*Isurus oxyrinchus*	ICCAT/ Jamaica	ICCAT Assessment: Spawning stock fecundity (SSF) in 2019 is likely to be below SSF_{MSY} and will continue to decline to 2035 even with no further catches (North Atlantic stock). The PSA score was 3.320 (high risk).
SPL	Scalloped hammerhead shark	*Sphyrna lewini*	ICCAT/ Jamaica	PSA score was 3.109 (high risk).
TIG	Tiger shark	*Galeocerdo cuvier*	ICCAT/ Jamaica	PSA score was 3.303 (high risk).

ICCAT uses a number of different stock assessment models for different larger tuna species, and in most cases more than one model is fitted. Jamaican scientists would not need to undertake these assessments. There is a working group involved in developing and applying the models to obtain the best scientific advice. Usually there would be a data preparation meeting which it might be useful for a Jamaican scientist to attend, at least remotely. This would provide a better understanding of what data are being requested and how they are being used. The primary role for Jamaica will be providing data to ICCAT, so that the RFMO can carry out its task and to protect Jamaica's stake in the international fishery. The main data that would be requested from Jamaica are the Task 1 and Task 2 data (Table 3), which consist of fleet definition and descriptive information, total catches (as estimates), catch and effort, and size composition. Catch and effort data should be reported by species, fleet, month and location (1x1 degree square). It should be able to infer the 1 degree square catch area from the landing site in most cases. Jamaica has no scientific observer programme, no purse seine fleet, no directed bluefin tuna fishery, so data requests related to these are not relevant at this time.

For the data limited methods, Task 2 length frequencies would be used. These should be submitted to ICCAT, but could also form the basis for a local evaluation of the stocks which have sufficient data. Other data are requested by ICCAT, but would probably mostly not apply to Jamaica. These would be tagging activities (although tag returns should be reported), and bycatch. Bycatch information (on seabirds and turtles) is highly desirable, but it is difficult to get reliable information without a scientific observer programme, which Jamaica does not have. Nevertheless, fishers can be asked at landing if any birds, turtles or bluefin were caught as a routine question. The deadline for data submission is generally the end of July each year, so Jamaica could prepare required data and estimates and submit these in future years

Table 3 Relevant ICCAT data that will need to be submitted by Jamaica if it becomes a co-operating contracting party.

Dataset	Description	Remarks
Task 1 fleet characteristics	Fleet characteristics of the active fleet (by vessel OR by fleet component) in the Atlantic Ocean and Mediterranean Sea by calendar year. Applies only to fishing vessels with positive fishing effort (actively fishing) and fishing for any of the ICCAT species in the Convention area.	If required, the list of registered vessels (ICCAT Vessel Record) can be explicitly requested to the Secretariat in advance.
Task 1 nominal catches	Yearly (calendar) total catch estimates in live weight (kg) (landings, dead discards, live discards) disaggregated by fleet, species, year, gear, sampling areas, and fishing zone.	Should contain all catches (targeted, non-target/by-catch) including the ones from recreational/sport fisheries, research and training vessels. "ZERO" catches should be explicitly reported in sub-form ST02B.
Task 2 catch & effort	Monthly catch (all species catch composition) and effort statistics, disaggregated by fleet, gear,	Preferably, observed data obtained from various sources (log-books, auction sales, port sampling, landing

Dataset	Description	Remarks
	month, and geographical squares (longline: 5x5 or higher resolution, other gears: 1x1 or higher resolution).	ports, transhipments, etc.). Could be also equivalent estimations, raised to Task I nominal catches.
Task 2 size samples	Actual size frequencies (size/weight classes) with number of fishes sampled, disaggregated by fleet, gear, sample unit, month, geographic rectangles (1x1, 5x5, 5x10, 10x10) or ICCAT sampling areas (port sampling).	Only observed size/weight frequencies (i.e. without substitution/raising procedures). Use one form per species (as many years as required).
Task 2 catch-at-size estimations	Catch-at-size: estimations of the size composition of the catch (equivalent in weight to Task-I catches) disaggregated by fleet, gear, month and 5x5 geographical squares. Only for: bluefin, albacore, yellowfin, bigeye, skipjack and swordfish.	Mandatory for CPCs with substantial catches of those species. Optional for remainder CPCs. The methodology used on those estimations (statistical inference, substitutions, raising process, etc.) should be made available to the SCRS.
Task 3 Port Sampling data	Data and information collected from domestic observer programmes (Rec.16-14, Rec.19-02, Rec.19-04)	Data by country of landing and quarter: Species composition, landings by species, length composition, and weights. Biological samples suitable for determining life history should be collected as practicable.

(Source: ICCAT 2021)The official forms (2021 version) for submitting the data requested are available online www.iccat.int/en/submitSTAT.html.

With regards to ICCAT data, there are some Task 1 catch records reported by Jamaica in the ICCAT database. Reporting has not been consistent. Data before 2017 may be related to previous projects and are probably mainly longline (gear is not recorded). However, data have been reported and included since 2017, and these are reported as handline, should reflect landings of the current troll fishery. This is clearly a surface gear, and judging by the species caught, probably much of the effort is operated nearshore. Nevertheless, there is likely an error associated with these estimates and it is unclear how strongly blank records imply zero landings. Other types of ICCAT data exist, but it is not clear how relevant these data are to Jamaica fisheries. Overall, unless large scale longline fishing is developed within Jamaica waters, ICCAT data are unlikely to be useful for Jamaica fisheries management, and therefore Jamaica will need to focus on providing its own information for monitoring and evaluation. These data should be reported to ICCAT, as available data on these types of fisheries are very limited for the Western Atlantic and their lack of representation will affect scientific advice and decision-making in ICCAT.

As noted previously there are no quantitative assessments of potential yield for pelagics around Jamaica. Small pelagics, including neritic tunas may well form populations separated to some

degree from other countries. These species can be treated as management units within Jamaican waters and can undergo management and assessment separate from ICCAT. In the longer term, it may be beneficial to co-operate with neighbouring countries to ensure no linked populations (through recruitment) become depleted. No data were available for this study apart from some data from 1980s and 1990s. It was therefore not possible to review data in detail, although various indirect sources on information were available.

3.4 Data collection

A sample-based approach of landing sites continues to be the most efficient option for fisheries monitoring in Jamaica. Sampling at landing sites would cover all fisheries, not just the pelagic fisheries. So, the same data collection procedures would apply to the other fisheries as well, except conch which is managed separately on the Pedro Bank. Random samples of the landings from the pelagic fishery on an opportunistic basis are also recommended. It is important that sampling is as efficient as possible.

A risk assessment can be used to help identify important species that need to be monitored to ensure a healthy fishery. While every effort should be made to maintain sampling to build a continuous time series, it will also be important to plan for gaps in the data series. Absent data always greatly increases uncertainty, but there are nevertheless estimation methods to help deal with this problem.

In the short term, the most effective measures for assessing stock status will be length composition data. These can be collected consistently from landings for designated species. The main task for the data collection system would be to obtain sufficient sample sizes of the fish lengths from sampled landings for the species of interest. This would require intercepting a significant number of trips at landing sites.

In addition, logbooks could be used by fishers to collect data. These logbooks could be based on the current data collection forms already utilised by the National Fisheries Authority (NFA). Logbooks could be cross checked by fishery inspectors at landing sites and submitted weekly. In order for data to be accurate, fishers should be adequately trained which includes species identification.

Even where data are collected, a database is required to manage the data and allow rapid queries so that the required information can be extracted easily. Modern software allows linkages to be developed between databases and analyses, so once analytical paths are set up, analyses and reports can be maintained easily. Although not advisable because data maintenance is made more difficult, a relational database system can be developed in MS Excel. This could be transferred to MS Access or other formal database at a later point. Most fisheries staff are familiar with Excel and most software can extract data from Excel files directly.

3.5 Fishing locations and methods

The waters surrounding Jamaica are very deep. Within 20 nautical miles of the northern coastline, the depth of the water can be between 4000 and 5000 m deep, with a very narrow shallow but steep shelf just around the coastline. Areas with steep bathymetry, such as continental slopes, often produce upwelling, which forces deep water rich in nutrients to the surface, thereby forming good tuna fishing grounds (Nishida et al., 2005). “Drop off” areas where the continental shelf falls away sharply are prime locations to catch other pelagic species such as blue marlin (Sakagawa, 1987).

Presently the gear used in the pelagic sector is handline and troll. Handlines are composed of a single vertical line with one barbed hook at the distal point. Most fishers use nylon (polyamide) for their handlines. Lines must be strong enough to hold the fish and withstand the combined force of its weight, swimming power and determination to escape. It is operated by simply dropping the baited hook into the level of the sea where tunas are found in abundance. This is ideal gear not only for the species targeted but also for the marine environment in which the fishery takes place. Trolling can be done at the surface for smaller tuna or dolphinfish (*Coryphaena hippurus*) or in deeper water for larger individuals. Trolling is also thought to have a lower bycatch of sharks compared to other gear types (e.g., longline) and so there is minimised risk of overfishing certain species.

There is also the potential to add longline gear type to the fishery, for example with short monofilament horizontal lines (Figure 3). This would provide an easier method of fishing deeper in the water column than the handline and troll fisheries but could also still be used near the surface. Longline, although less selective than handline or troll gear, provides higher catch yields (McKuin et al., 2021) and investment requirements are lower than other gears (Prado, 2002). Longlines can also be set vertically to catch large pelagic fish aggregated by FADs at multiple depths on the same line. Parameters for either horizontal or vertical longlines can be adjusted to suit the local conditions and fishing seasons (concentrations of fish, species available etc.). In addition to monofilament line, nylon can also be used which is easy to grip if hauling by hand and less liable to tangle when coiled on deck (Prado, 2002). However, in terms of bycatch, longline fishing causes greatest concern to pelagic sharks with all being at high risk of overfishing and in the case of shortfin makos, determined as overfished in the North Atlantic by ICCAT.

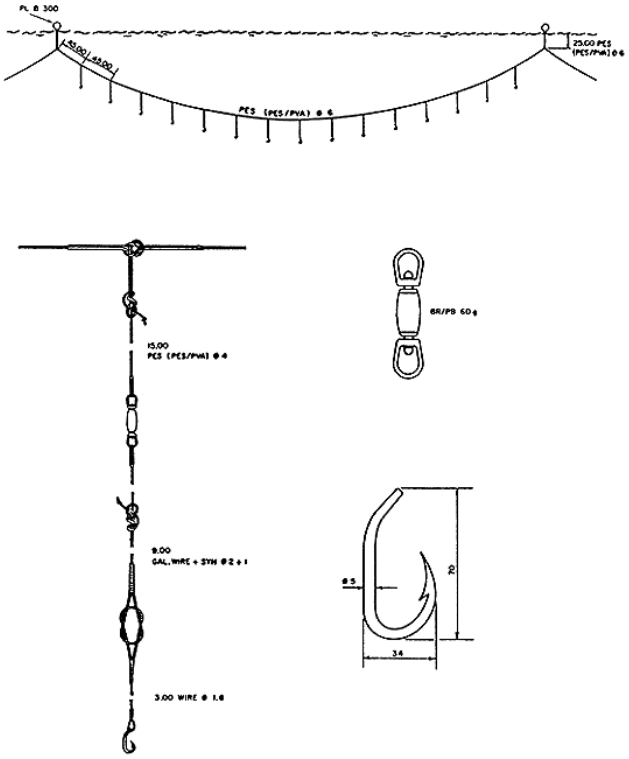

Figure 3 Horizontal and vertical longline configurations for tuna (source: Ardill, 1984).

Based on the surface longline catches from all available sources as well as known artisanal pelagic fishers the most productive fishing areas known at present are:

- Morant Bank waters (offshore)
- Southern Pedro Bank (offshore)
- Deep water near to Montego Bay, St. James, (north coast)
- Waters off Pagee (near Port Maria), St. Mary (north coast)
- Areas near several small offshore banks off St. Elizabeth (southwest coast)
- Waters near small offshore banks off Westmoreland (southwest coast) and
- Waters off Manchioneal, Portland (north-eastern Jamaica).

Hook size may also be something to potentially evaluate and modify if necessary. It is not clear what size or type of hooks are used by the pelagic fishers at this time. Based on various scientific studies, it is suggested that larger and potentially more valuable species such as yellowfin and bigeye tuna are caught on large circle hooks, rather than narrow hooks (Gilman, 2016). Results from Cortez-Zaragoza et al. (1989) found that larger hooks not only caught larger yellowfin tuna but also a wider range of sizes. A longline study in the south Pacific Ocean demonstrated that size 16/0 circle hooks provided better survivability for bigeye, yellowfin, and albacore tuna, swordfish, shortbill spearfish, dolphinfish, wahoo, and blue shark, than when smaller hooks were used (Curran and Beverly, 2012).

Bait type is the most significant gear parameter affecting the species selectivity (Kumar et al., 2016). Studies by Januma (1999, 2003, in Kumar et al., 2016) have shown that natural bait is superior to artificial bait. Bait retention on the hook is also important for fishing efficiency and squid has been found to be more successful than whole fish (Shomura, 1955; Pingguo, 1996; Ward and Myers, 2007 in Kumar et al., 2016). The use of squid is also better for reducing shark bycatch (Gilman et al., 2016). Equally, fresh bait has been found to be preferable to frozen bait. Tuna also respond quickly to live bait (Kumar et al., 2016). Of importance is to send the baited hook as quickly as possible to the depth where target fish are which may, according to season, be 100 metres, 200 metres, 300 metres or even sometimes greater depths (Prado, 2002). With respect to other physical factors affecting fishing success, the response of fishes to baited hooks has been reported to be slower when currents are strong (Lokkeborg, 1994 in Kumar et al., 2016). Trials or studies could be introduced to explore the best efficiency and economically viable options for the fishery.

Although not viable for commercial longline operations (Kumar et al., 2016), artificial lures could present a sustainable fishing method when trolling or handlining (Figure 4), which would reduce pressure on the bait fishery in Jamaican waters and are commonly used in recreational tuna and other pelagic game species. Several personnel from the NFA reported that fishers already use artificial lures to troll for pelagic species on their way back from the trap fisheries.

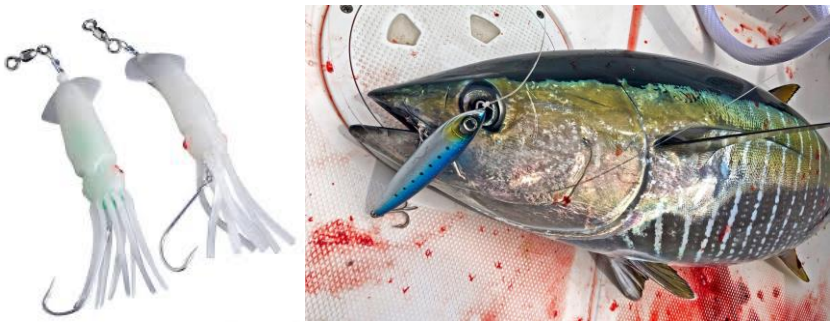

Figure 4 Examples of artificial lures used for tuna.

3.6 Fish Aggregating Devices

One way to maximise the catch per unit effort for fishers in the sector could be the installation and on-going maintenance of anchored Fish Aggregating Devices (FADs). These can create resource patches at known locations significantly reducing search time, effort and fuel costs for fishers. In many parts of the world, including the Caribbean, FADs are increasingly being used by small-scale, artisanal fishers to access fish species otherwise difficult to harvest in large numbers. FADs have played a major role in the development of artisanal fisheries. As FADs became recognised and increasingly used in artisanal and large-scale industrial fisheries in the 1980s, technical reports became available (Dempster and Taquet, 2004). The knowledge of the attraction for pelagic fish to floating objects has enhanced fisheries by increasing catch per unit effort. Anderson and Gates (1996) note that there is also evidence to suggest that FADs enable fishers to divide their time more effectively by allowing them to target a particular area instead of searching a larger open water area, with potentially lower fishing success. As a negative consequence, this has caused a significant shift in patterns of stock exploitation with the increased use of FADs in fisheries according to Dempster and Kingsford (2003). They also note Fonteneau et al., (2000) who suggests that large landings of tuna of small size ranges could lead to recruitment over-fishing of some tuna stocks.

FADs can be used by fisheries either as floating or moored structures. Fishing boats can increase their catch as fish are found in larger numbers/abundance. Behaviour of specific species also aids in their capture, for example Fréon and Dagorn (2000) note the vertical movements of yellowfin (*Thunnus albacares*) and bigeye tuna (*T. obesus*) in relation to anchored FADs. They are often found to swim closer to the surface around the FAD than if they were in an open ocean environment.

Although widely used, there are perceived advantages as well as disadvantages with using FADs. These are outlined in Table 4.

Table 4 Perceived advantages and disadvantages of the use of FADs (modified from Kingsford, 1999).

Advantages	Disadvantages
Target for fishing	Can make stock vulnerable to overfishing by aggregating individuals together
Increase fish catch	Alter migration routes
Increase biomass by addition of extra habitat	Compromise other fisheries in space and time
Enhance fishery recruitment to an area	FADs redistribute stock rather than increase numbers
Enhance and maintain fish diversity	Jeopardise recruitment to natural sites
Create productive areas from non-productive areas	Can be shipping hazard and/or perceived as litter

As a working example which may be reflective of this fishery, in Dominica FADs are now anchored in the deep water off the insular shelf by artisanal fishers who use them seasonally to target pelagic fish such as the species found in Jamaican waters, primarily tuna (*Thunnus spp.)* and marlin (*Makaira spp*.) (Alvard et al., 2015) (Figure 5a). There have also been other studies with respect to anchored FADs which were created with the design, construction and deployment of an affordable and durable deep-water subsurface FAD that could be deployed using small boats (Figure 5b) (Scheider et al., 2021). Something similar would be ideal for this fishery. By being subsurface (ten metres below the surface) the FAD deployed cannot be hit by other vessels and are less likely to be disrupted by storms or other unfavourable weather events, and therefore less likely to be lost. There of course is still some risk of loss, and given the environmental issue of abandoned, lost and discarded FADs globally, the materials used as components of the FADs should be considered.

Lost FADs can cause ghost fishing as they continue to aggregate fish schools, cause further animal entanglement and ultimately damage coastal habitats and produce marine litter (Gilman et al., 2018). Most importantly any FADs deployed should be made without the use of netting. As a replacement, bamboo, palm leaves, canvas, coconut fibres and other natural materials can be used. This has the added benefit that materials are cheap to replace, and the FAD easily retrievable. Given that the FADs would be submerged, the locations would only be given to those fishers in the pelagic fishery. This prevents unauthorised use by opportunistic fishing vessels and protects the fishers' livelihood.

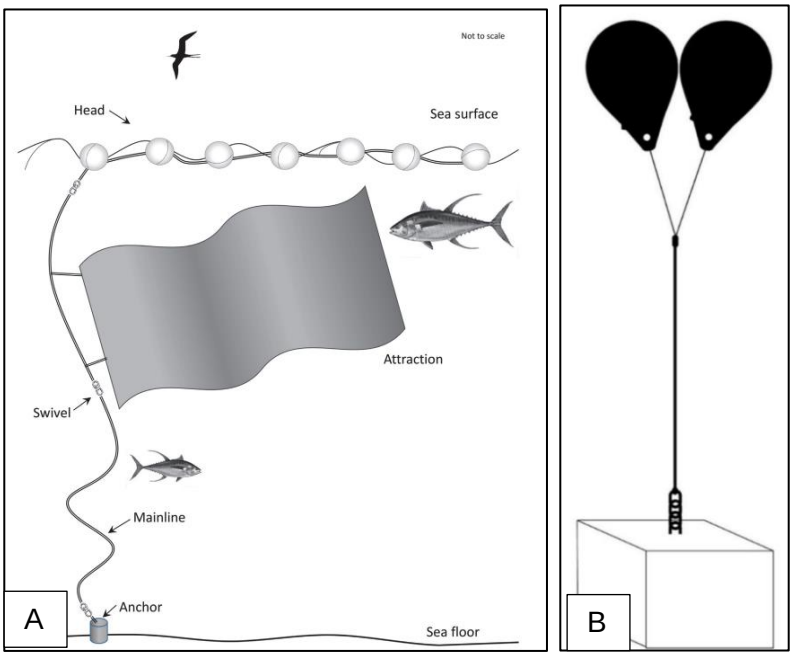

Figure 5.a. Schematic diagram of a typical anchored FAD as deployed in Dominica; and b. Schematic of the sub-surface fish aggregation device (FAD) currently being used at The Cape Eleuthera Institute, The Bahamas.

Locations for anchored FADs would be a key consideration when planning a trial study or wider ranging installation project. Figure 6 shows the bathymetry of the areas close to two of the landing sites, Ocho Rios and Pagee. These have been chosen for a number of reasons. Firstly, the continental shelf is very narrow, for example the seafloor depth is recorded at 200 metres approximately one nautical mile around the headland, north of Port Maria Bay and 0.73 nautical miles due north of Reynolds Pier, which is just to the west of Ocho Rios Bay. Secondly, both locations were the only ones to be reported by the NFA 2006 beach survey as being able to supply ice, electricity, and piped water. This is important, as these may also prove optimal locations for onshore sale, storage or processing facilities developments as highlighted in an earlier section of the report. Additionally, there are also several hotels in the area either side of Turtle Beach in Ocho Rios, which may present an immediate domestic commercial market should quality and supply demands be met.

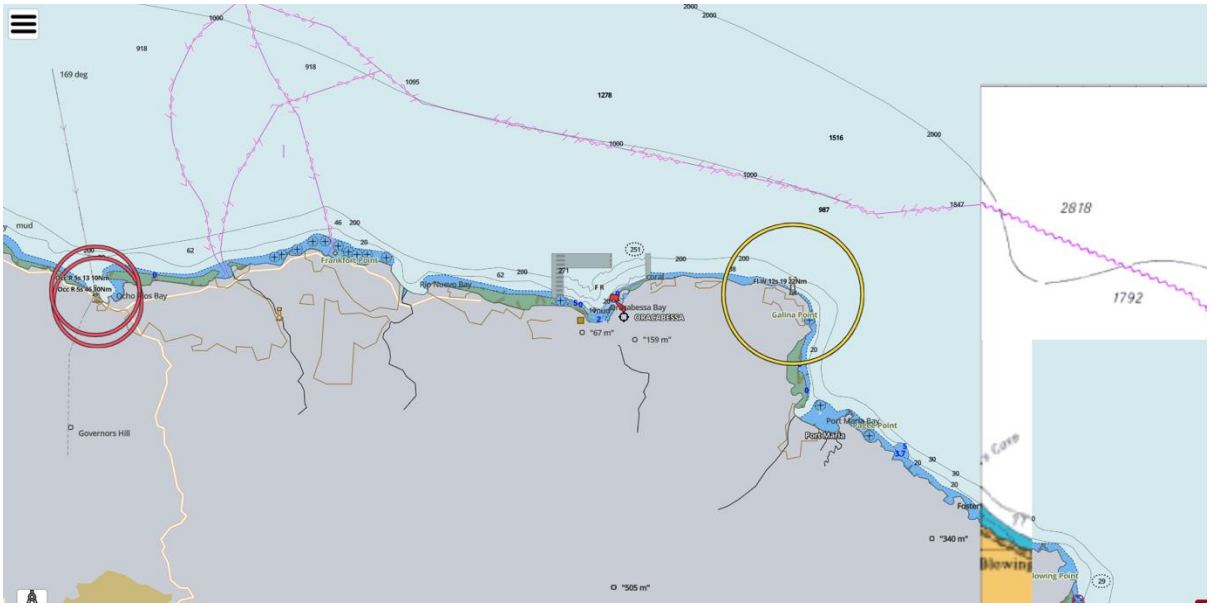

Figure 6 Nautical chart of north coast of Jamaica, showing bathymetry around Ochos River and Pagee (depth in metres) (source: gpsnauticalcharts.com)

A further consideration for FAD installation (and the fishery in general), is that monitoring should take place in order to collect data such as catch and effort statistics and observations of biological associations with the FADs to aid the collation of the NFA's information base for the pelagic sector.

Data collection undertaken as part of a monitoring programme should be representative of the entire fishery. For this to be possible, data should be illustrative of the species caught, fishing vessels and methods used, as well as time spent by vessels at the FADs (Anderson and Gates, 1996). This would allow calculation of daily, weekly, monthly, yearly, or seasonal variations for future predictions of fishing yields. Catch per unit effort is then also calculable, which is a good indication of fishing efficiency (Anderson and Gates, 1996). Kingsford (1999) also emphasises the importance of control sites when monitoring FADs especially with regard to large pelagic species such as tuna, to demonstrate environmental impacts of FADs to the affected area. Ideally surveys should be carried out prior to and in addition to subsequent FAD deployment.

Lastly, it would be beneficial to have a legal framework for FAD installation. For example, regulatory authorisation which declares the device and its proposed location would not be conflict with other water users, such as clear of shipping lanes (Diaz et al., 2006). With respect to the right to exploit resources associated with the FAD, a working example is demonstrated in Guadeloupe, where a FAD owner has priority of exploitation within a radius of a quarter of a nautical mile around a FAD. In the absence of an owner, for example if installed and maintained by the NFA, any commercial fisher would be entitled to exploit the FAD (Guyader et al., 2013).

3.7 The local bait fishery

Jamaica has limited information and documentation about the local bait fisheries. Murray and Kenward (2020) reported that not all the catch is brought ashore as fishers supply the bait to others who were actively fishing at sea during that period. In some instances, weights were recorded based on what the fisher reported. Hence, the true status of the fishery may be

underestimated and is based on qualitative information rather than analytical or empirical evidence.

The baitfish species used for large pelagic fishing are listed in Table 5 below. Omitted from this list of baitfishes are the *Engraulidae* (anchovies), which are useful as bait for hook-and-line fishing, but which are too small for use as larger pelagic bait. Table 5 lists the various species used and those which may have potential for use as bait for larger pelagic fishery development.

Table 5 Baitfish species used for larger pelagics known from Jamaican waters (various sources*)

Scientific name	Common name	Distribution	Specific locations	Gear used	Bait potential
Opisthonema oglinum	Thread herring	Coastal	Kingston Harbour, Old Harbour. Bay	Floating gill net	Good
Harengula humeralis	Red-ear sardine	Coastal	As above	As above	Fair
Harengula jaguana	False pilchard	Coastal	As above	As above	Fair
Hemiramphus brasiliensis	Ballyhoo	Coastal	As above	Hook & line & nets	Good
Hemiramphus balao	Balao	Coastal	All island	As above	Good
Platybelone argalus argalus	Redtail needlefish	Coastal	All island	As above	Good
Selar crumenophthalmus	Goggleye scad	Coastal near deep water	Western north coast	Hook & line	Fair
Mugil cephalus	Striped mullet	Bays & harbours	All island	Cast and gill nets	Fair
Mugil curema	White mullet	As above	As above	As above	Fair
Caranx latus	Blue runner jack	As above	As above	Hook and line	Fair

* Harvey, 1986, Harvey *et al.*, 1986, Kelly, 2001, Humann & Deloach, 2008

Of considerable value to the development of large pelagic fishing is the use of the largest and most common clupeid species, the thread herring, (Atlantic threadfin herring *Opisthonema oglinum*), as a useful bait in trolling, possibly along with artificial lure deployment. Understanding the biology of the thread herring would therefore be impactful. If *O. oglinum* is selected as the primary baitfish species for large pelagic development then Harvey (1986) identified that Port Royal Harbour as producing highest catches of this species. Using traditional floating gill nets, Harvey (1986) found that off Port Royal Point and Green Bay at the mouth (entrance) of Kingston Harbour, were the two locations where “reasonable” catches could always be secured by local fishers.

Although not uncommon for these types of fisheries, stocks of small pelagic species targeted as bait are prone to large interannual and interdecadal variation of abundance as well as to collapse (Fréon et al., 2005). Population effects may be anthropogenically exacerbated by fish being caught in large volumes as target and non-target species due to their aggregating shoaling behaviour and physical characteristics. For example, fragile, soft tissue and thin skin, which

leaves individuals vulnerable to mortality even upon escape from fishing gear (Fréon et al., 2005). Additionally, several species of similar size and body shape quite often gather in a single school (Fréon and Misund, 1999). As broadcast spawners, eggs and larvae of pelagic species are very vulnerable to predation. They additionally have typically short life spans (two to five years for anchovy-like species and five to eight years for sardine-like species), with one or two cohorts significantly contributing to the respective fishery under favourable environmental conditions (Fréon et al., 2005). Their reliance on high productivity regions, for example the areas of upwelling from deep, nutrient-rich waters, constrains their population distributions to a large if not unknown extent, i.e., coastal areas. Stocks tend to be migratory in order to follow food sources or for spawning purposes, typically along coastlines (Coetzee et al., 2010). The whole distribution area of a pelagic fish stock can vary from year to year, not only with changes in productivity but also with species abundance (Fréon et al., 2005).

Population studies globally suffer from poor data collection, resulting in poor understanding of catch volumes in both targeted fisheries and as bycatch and stock structures and dynamics. Few small pelagic species survive tagging (Blaxter and Hunter, 1982). Building on the work already conducted by Murray and Kenward (2020), more investigation into the health and productivity of the bait fishery outside of Kingston Harbour is required and should form part of part of development work if the offshore pelagic sector intends to continue to use locally caught bait. This includes identifying the number of vessels in the fishery, an understanding of conflicts or disputes with other water users. For example, Kingston Harbour is also used for tourism, shipping and recreation in addition to fishing. This increases the threat of pollution and other negative impacts to the health of the fishery.

Within Kingston Harbour and other bait collection areas, improved and standardised data collection needs to be implemented in order to create accurate analyses to be used in the development of a bait fishery management plan. Data collection and analyses would include landings, fleet composition, gear-types, length frequency, CPUE and use of bait by species and acoustic surveys. Regular and consistent monitoring would allow for adaptive management techniques to be employed which can respond on a short- to medium-term basis through changing levels of exploitation in relation to its current and fluctuating stock statuses. Adaptive or predictive approaches reduce the risk of collapse due to consistent and frequent monitoring, responsive decision-making leading to rapidly implemented changes to conservation management measures. This would allow fishers to take advantage of good fishing when conditions were favourable. Mechanisms to regulate fishing pressure in relation to data could be but may not limited to quotas (total allowable catch (TAC)), controlling over fleet capacity or standardised effort or time/area closures, for example in relation to spawning seasons or grounds.

3.8 Landing sites

According to the NFA records, there are approximately 126 catch landing sites around Jamaica. Yet, only 13 of the landing sites have mooring sites which cater for offshore pelagic fishing vessels. Of the sites suitable for landing large pelagics, 13 were surveyed in 2006 and found to lack amenities. For example, only three out of 13 had ice available for sale, five had access to electricity and six had piped water available. Only at Pagee and Ocho Rios were all three resources (i.e., ice, electricity and water) available. Ownership of sites ranged from private, government and cooperative-managed. In general, fish are landed directly onto the beach, where fish are sold to local consumers and vendors. Onward transport of fish from the landing sites is typically by passenger vehicle in ice chests and there is little to no longer-term storage facilities for pelagic products. With respect to onward sale, storage, or processing facilities, these are limited for the pelagic sector.

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

3.9 Fisheries legislation and regulation

At the international level, Jamaica is a member of a number of Regional Fisheries Management Organisations (RFMOs) and Regional Fisheries Bodies (RFB) including the Caribbean Community (CARICOM) and the Caribbean Regional Fisheries Mechanism (CRFM). In addition, Jamaica is a member of the Western Central Atlantic Fishery Commission (WECAFC) and the Commission for Small-Scale and Artisanal Fisheries and Aquaculture of Latin America and the Caribbean (COPPESAALC). Jamaica is also signatory to several international conventions such as, United Nations Convention on the Law of the Sea (UNCLOS), the Cartagena Convention and the FAO Code of Conduct for Responsible Fisheries.

At the national level, the NFA, situated within the Ministry of Agriculture and Fisheries (MoAF), is responsible for the conservation and sustainable utilisation of fisheries resources that ensure promotion of social and economic benefit. This is achieved through research, education and training, enforcement, legislation and registration, data collection and community outreach.

Some of the main legislation in place, which is important to consider in the pelagic FMP are detailed below.

3.9.1 Fisheries Act No. 18 of 2018

The Fisheries' Act (2018) repeals the Fishing Industry Act, 1975 and provides the rules for the effective management and sustainable development of fisheries, aquaculture and other related activities in accordance with the ecosystem approach and the precautionary principle. This Act established the NFA and mandates that it is responsible for the management and development of fisheries and aquaculture. Responsibilities of the NFA include:

- The conservation of fisheries;
- The assessment of aquaculture and fisheries;
- The collection, compilation, analysis and interpretation of statistics on fisheries, aquaculture and related activities;
- The determination and allocation of allowable fishing rights and quotas;
- Where applicable, determining the total allowable catch for a fishery or species of fish;
- The monitoring, control, surveillance and enforcement of any activity relating to fisheries, aquaculture and any related activity;
- The imposition of measures to prevent, deter and eliminate illegal, unreported and unregulated fishing; and
- The preparation and periodic review of fishery management plans and aquaculture management plans

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

3.9.2 Ministry of Industry, Commerce, Agriculture and Fisheries Strategic Business Plan 2019/2020 – 2022/2023.

The main aim of this business plan is to achieve innovative, inclusive, sustainable and internationally competitive Jamaican industries in agriculture, fisheries, manufacturing and services sectors. In regards to the fisheries division, by 2030, '*the National Fisheries Agency will become the model of excellence in capture fisheries and aquaculture management and development, recognized for its fairness and valued for its professionalism, expertise and high standards'*. This will be achieved through improvement of management, expansion of inland and marine fisheries and increased earnings from the fisheries industry.

3.9.3 Fishing Industry (Special Fishery Conservation Area) Regulations, 2012.

These regulations define the boundaries of Special Fishery Conservation Areas (SFCA) and prohibits fishing accept in accordance with a licence or the provisions of the directions issued by the Minister under these Regulations. However, the 2012 Regulation was promulgated under the 1975 Fishing Industry Act. That Act has been repealed by the 2018 Fisheries Act and therefore the 2012 SFCA Regulation now needs to be revised to bring it in line with the new parent Act.

3.9.4 The Aquaculture, Inland and Marine Products and By-Products (Inspection, Licensing and Export) Act

The objective of this Act is to advance public health and safety standards for any marine, inland or aquaculture products intended for human consumption. This includes monitoring the hygiene and sanitary conditions of vessels and establishments engaged in processing and also specifying and maintaining international standards.

3.10 Training

With respect to training for fishers or those associated with either the pelagic or bait fisheries, no information was available. The fishing licence application process through Section 28 of the Fisheries Act (2018) requires the Authority to consider training undertaken by fishers applying for a fishing licence, but it is unknown whether fishers have undertaken any such training under the revised Act. Training should be offered to fishers for a number of practices or reasons which will benefit the fishers and fisheries. Fishers indicated that they would be open to training in any aspect as long as this was followed up by the NFA subsequently (D. Wynter, NFA, pers. comms.).

4 Risk assessment process to inform purposes and objectives

This section outlines the risk assessment process conducted to inform the development of management measures and activities to be conducted under each purpose. A SWOT (Strength, Weakness, Opportunity and Threat) analysis was undertaken across the four different purposes to ensure that all potential impacts are considered in the development of the pelagic fishery and to aid the prioritisation of potential developments. In a SWOT analysis, weaknesses and strengths are internal (i.e., within Jamaica), whereas threats and opportunities are external (i.e., outside of Jamaica) and often harder to influence. The SWOT analysis was informed through stakeholder consultation and collated literature. SWOTs in the following tables have been colour-coded for ease of reference as per the key in Table 6.

Table 6 Key to interpret SWOT table shading.

	Internal	**External**
Positive	Strength	Opportunity
Negative	Weakness	Threat

Each table under the four purposes has the following structure:

- **Element**: A description of a part of the proposed pelagic fisheries management plan.
- **Current**: A description of the current state of the element as determined from stakeholder engagement and collated information.
- **Target**: The target column identifies what would be the ideal state for the element in the future. The objectives and actions identified in section 5, have been outlined to allow each element of the plan to move from the current situation to the target situation. Indicators have been outlined in section 6 to determine if the target has been reached for each element. N.B: The level of investment needed will often be determined by the results of the investigatory activities. For example, the cost of upgrading vessels will be dependent on how many boats will need to be upgraded to safely fish offshore once a capacity assessment has been undertaken. Without this information is it not possible to predict the level of investment required at this stage. Depending on the investment required it will be up to the Government to determine if this activity should go forward based on priorities and where/how funding could be secured.
- **Risk:** This column details the level of risk (low, medium and high) if the element did not happen. For example, if stock assessments for pelagic species could not be conducted this would be considered high risk, as the potential impacts of managing a stock and implementing a management regime without a clear assessment of the stock status and potential sustainable yield would be dangerous. Risks in the following tables have been colour-coded for ease of reference as per the key in Table 7. In regards to processing, this has been listed as ‘low’ priority as, based on expert opinion, it should not be the focus of this plan as it has historically not been a successful activity. Therefore, more emphasis has been given to other activities that may increase the chance of supporting a successful offshore fishery.

Following completion of the SWOT analysis, specific objectives and activities were determined to mitigate against any weakness or threats, while building on existing strengths and opportunities.

Section 5 provides details on the activities required to help reach the targets stated in Table 8 – Table 11.

Table 7 Key to interpret risk rating.

Risk Level	Colour
Low	
Medium	
High	

4.1 Purpose 1: Sustainable exploitation of offshore pelagic species

Table 8 SWOT analysis for Purpose 1

Element	Current	SWOT	Target	Risk
Data availability (within Jamaica)	For species that underwent a risk assessment the main limitation was a lack of information to adequately inform the assessment. NFA was unable to provide data to this project due to limits on their technical capacity. This indicated that available data were inaccessible.	**S:** A data collection system exists which works if supported by adequate resources. **W:** Limited resources (e.g. staff, budget) means that there are gaps in data collection. There has been an inability to maintain a consistent data collection programme, so approaches that depend on continuous data time series may be compromised. **W:** For greater barracuda and tarpon the higher risk was partly driven by limited information. Risk may be reduced by better data from stakeholders and scientific observation. **W:** Data are not held in a database and therefore, it is unclear how limited the data are. **W:** Available data were inaccessible	Data will be available to support stock assessment. Data will be held in a database to enable easy access and analysis. Database and stock assessment skills are required.	High
Stock assessment (within the wider stock, e.g., does assessment fit the stock?)	For species which have not had a stock assessment, a risk assessment was conducted to identify species that might be most at risk from the Jamaican fisheries.	**S:** There are some good options for stock assessments for data limited species (e.g., Length-Based Spawning Potential Ratio (LBSPR)). **W:** There is no working database and staff are untrained in using R. Tasks could be automated which would release time and make the process more efficient.	Automate data collection / management as much as possible taking advantage of free open-source software (e.g., R statistical software). This could include the use of tablets/phones to collect the data electronically in the field.	Medium

Element	Current	SWOT	Target	Risk
		W: Capacity limits - understaffed and experts are overworked.	A working database is established and staff are sufficiently trained in its use. Tablets/phones are linked to the database to allow for automatic upload of data. Use risk assessments to identify key stocks where data collection should be prioritised to reduce burden on staff. For key stocks, data are collected on length (backed up by maturity-at-length, length-weight) and length-based stock assessment are used to monitor status of primary species	
		O: If we indicate through a risk assessment (e.g., Productivity Susceptibility Analysis (PSA)) that a stock is at-risk, it provides an early warning to allow for introduction / strengthening of management measures.		
		O: PSA could be used as a filtering system to work out where data collection should be prioritised. This would make tasks manageable with limited capacity.		
		O: R statistical software and relevant packages are freely available.		
Stock status	Based on the limited information available, the status of pelagic stocks is generally good. Stock assessments by ICCAT for larger pelagics indicate, of the main large pelagic species caught in Jamaica, only marlins are of current concern.	**S:** The status of large pelagics in ICCAT are generally good	Data are sufficient to determine stock status. Stock status of pelagic species are at or above MSY. Plans and appropriate management measures put in place to recover stocks to MSY.	High
		W: Blue and white marlin are thought to be below MSY and are primarily caught by the recreational fishery.		
		W: For the species most likely to be caught by troll, greater barracuda and tarpon were of most concern but improved data are required.		

4.2 Purpose 2: Protection of the environment and ecosystem

Table 9 SWOT analysis for Purpose 2

Element	Current	SWOT	Target	Risk
Environmental impacts (including bycatch and habitat impacts)	In terms of bycatch, pelagic sharks are of greatest concern with all being at high risk of overfishing and in the case of shortfin makos, determined as overfished in the North Atlantic. There is no local market for sharks. Trolling is thought to have a lower incidence of interaction with sharks, especially in comparison to longline (Dr A. Aiken pers.comms)	**S:** Trolling catches relatively few sharks and so there is minimised risk of overfishing certain species.	Reduction of bycatch (especially elasmobranchs) in the longline fishery. Appropriate management measures e.g., ban on wire trace to reduce bycatch. Focus on enhancing the current troll fishery. In contrast to the longline fishery, trolling is more appropriate to a seasonal fishery being more opportunistic and requires little investment.	High
Data availability	Baitfish species include a variety of smaller schooling pelagic species such as those in the family *Clupeidae* (sprats, herrings and sardines), *Carangidae* (smaller jacks, scads and bumpers), *Mugilidae* (sea mullets), *Scombridae* (small kingfish mackerel), *Hemirhamphidae* (needlefish) as well as halfbeaks, and barracuda. All of these are caught by gill nets, beach seines and Chinese (tangle) nets set in bays, mangroves and seagrass beds in coastal inlets. For species that underwent a risk assessment the main	**S:** Quite a few baitfish species are also used as food fish, so are landed and data can be collected on them. **W:** Lack of information for several taxa e.g., needlefish	Increased information available on baitfish to determine status.	Medium (as some bait and artificial lures used), could rise to High if bait needs increase

Element	Current	SWOT	Target	Risk
	limitation was a lack of information to adequately inform the assessment.			
Stock assessment	For species which have not had a stock assessment, a risk assessment was conducted to identify species that might be most at risk from the Jamaican fisheries.	**S:** Risk assessments (PSA) have been conducted. Further information may be able to demonstrate some vulnerable species may not be at risk (e.g. estimate them as a proportion of the catch). Length based methods are probably a reasonable option where fish are landed. **W:** Needlefish were of concern but primarily due to a lack of even basic information on the species. As needlefish are not commonly caught, studying them would be difficult. **S:** Artificial lures are commonly used by fishers in the pelagic fishery which will reduce pressure on bait species. **W:** Artificial lures are expensive.	Data are sufficient to conduct PSA or other appropriate risk assessment.	Medium
Ecological impacts (including bycatch and habitat impacts)	The small inshore pelagic fishery for baitfish for the large pelagic fishery uses mainly floating gill nets and hook and line.	**S:** Artisanal gear types are more commonly used which may have less environmental impacts compared with large trawlers. **S:** Bait fish are low trophic which exhibit short life span, are robust to high mortality and usually exhibit rapid recovery from depletion if the depletion is not sustained.	Support usage of artificial lures to reduce impact on bait fishery. Ensure proper management and data collection of bait fish fisheries.	Low

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

Element	Current	SWOT	Target	Risk
		W: Bait fish are low trophic species, so local depletion could impact other species that depend on bait resources for their food.		

4.3 Purpose 3: Effective governance and management

Table 10 SWOT analysis for Purpose 3

Element	Current	SWOT	Target	Risk
International and domestic agreements/regulations related to the management of the offshore pelagic fishery	Jamaica, although not a member, has a responsibility to submit data to ICCAT. Many of the species that form the basis of the fisheries are not managed by ICCAT and will need local management. For these species in particular, the fishery will need a fishery management plan (FMP) that sets out how management will work currently and how the fishery will be developed.	**S:** Although not a Member, Jamaica has a responsibility to submit data to ICCAT which is important for management. Even though this is currently happening, it could be made more efficient to reduce burden on the NFA. **W:** Jamaica is not a Member of ICCAT. **W:** Many of the species that form the basis of the fisheries are not managed by ICCAT and so need local management. **W:** No FMP for pelagic fishery **O:** Regional cooperation on pelagic fisheries possible through Caribbean Regional Fisheries Mechanism (CRFM).	Jamaica becomes a Contracting Party of ICCAT. Species not managed under ICCAT are managed locally under an FMP. Incorporate stock assessment outputs into fishery management plan and harvest strategy. Incorporate ICCAT recommendations in Jamaica's FMP (including data obligations). Establish quota for Jamaica for ICCAT managed stocks.	High

Element	Current	SWOT	Target	Risk
		T: ICCAT can make decisions which might affect Jamaica without consultation. Registering Jamaican fisheries in an international context helps protect Jamaica's international rights and share of the international pelagic resources.	Implement regulatory framework within Jamaica for ICCAT quotas as local managed quotas.	
International and domestic agreements/regulations related to the management for the bait fisheries	No baitfish management plan is linked to the offshore pelagic fishery management at the moment.	**S:** Baitfish can probably be treated as local stocks. There is likely some movement/connectivity, but these are small fish and migrations within a generation would be limited.	Management of baitfish species should be incorporated into an FMP for the offshore fishery.	Low
		W: Limited information and documentation about the local bait fisheries		Medium

4.4 Purpose 4: Sustainable development of the fishery and markets.

Table 11 SWOT analysis for Purpose 4

Element	Current	SWOT	Target	Risk
Location of fishing areas known	The seasonal large pelagic fishery operates mostly in the area off the north-eastern coastline. This fishery is markedly seasonal in the so called 'winter months'. It operates not more that 15-20km offshore.	**S:** Fishing areas well known.	Fishing locations updated for offshore fishing if expansion occurs.	Low
Number of landing sites used by the fishery	There are 13 landing sites for the pelagic fishery (NFA, pers.	**S:** These sites are sufficient for a slightly enlarged fishery	There are thought to be sufficient landing sites if the pelagic fishery were to be	Low

Element	Current	SWOT	Target	Risk
	comm.). These sites also act as moorings for the vessels.		developed. If required, improvements should be focused on these existing landing sites rather than investing into developing new ones. The sites most likely to be used are those on the north coast.	
Location of landing sites in relation to fishing areas	Seven of the 13 landing sites are located on the more northernly side of the island (NFA, pers. comm.). The other landing sites are mainly situated in Port Royal, which is where the main bait fishery is conducted.	**S:** Landing sites are always close to fishing areas. **S:** 13 landing sites are sufficient to support an enlarged seasonal pelagics fishery. Most successfully operate in the annual seasonal fishing.	The locations of the existing landing sites are thought to be adequate to serve an offshore pelagic fishery. If required, improvements should be focused on these existing landing sites rather than investing in developing new ones. The sites most likely to be used are those on the north coast.	Low
Distance to market	There is no "market" *per se*. Sales of fish are made from the landing site itself and are generally for domestic / local consumption. Pelagic product is rarely bought by local hotels due to issues with supply and quality of fish. There are occasions if a large fish is landed, for example a marlin, that fishers may try to sell directly to a hotel, but this is not commonplace (pers. comm.)	**W:** Catches from an enlarged pelagic fishery will have to be arranged e.g., with hotels as they will overwhelm existing small market.	A market for pelagic fish is established, whether this be domestic and / or international.	Medium
Physical condition of landing site (i.e. is it fully functioning or in need of repair, weighing (scales)	There is no up-to-date information on the physical conditions of the landing sites. The NFA last visited the sites in	**W:** Only five out of the 13 offshore pelagic landing sites had access to electricity in 2006. Six out of the 13 offshore pelagic	A new survey is undertaken of landing sites to establish current condition.	High (Higher risk established due to missing

Element	Current	SWOT	Target	Risk
facilities on-site, where appropriate)	2006. Due to COVID-19, though it would have been useful, this has not been possible in person during this study. It was noted in the NFA beach survey of 2006 that the facilities at “Black River” were not being kept clean, but further than that, there is no information.	landings sites had access to piped water. Only two landing sites had access to ice, electricity and piped water (Pagee and Ocho Rios). **W:** Organic and inorganic waste appeared to be an issue. **W:** Last survey undertaken in 2006, therefore information may not be reflective of current capacities. **W:** It was raised by fisheries officers and fishers that the provision of jetties to land fish and moor boats would contribute towards the development of the offshore pelagic sector. **W:** It was raised by fisheries officers and fishers that the lack of lighting at existing landing sites is an issue limiting the development of the offshore pelagic sector. **W:** It was raised by fisheries officers and fishers that the provision of shower and restroom facilities at landing sites would contribute towards the development of the offshore pelagic sector. **T:** Issues with wastewater / pollution from proximal anthropogenic sources e.g., sewage, zinc and plastics. **T:** Issues with animals on beach e.g., chickens and dogs.	Landing sites are of adequate condition to receive pelagic catches. This should include sufficient access to ice and electricity/solar and a high hygienic standard maintained. The sites most likely to be used are those on the north coast.	information at this time)

Element	Current	SWOT	Target	Risk
Capacity of landing site to receive vessels	The Kingston Harbour is reputed to be the seventh deepest natural harbour in the world (Rose and Webber, 2019) and extends 16.5 km from the west to east and 6.5 km north to south. It is known to support shipping and fisheries amongst other activities (Murray and Kenward, 2020). The 13 landing sites for the pelagic fishery are thought to be sufficient to support a slightly enlarged fishery,	**S:** Kingston Harbour is reputed to be the seventh deepest natural harbour in the world, and will be an adequate depth to support offshore pelagic vessels and larger shipping / cargo vessels.	Kingston harbour has already been identified as a sufficient harbour to receive larger pelagic vessels. Other pelagic landing sites are thought to be sufficient for a slightly enlarged fishery but this should be confirmed through an up-to-date site visit. It is important to note that the landing sites most likely to be used are those on the north coast.	Low
Distance to supporting operations (or *in situ*) e.g., ice plant / storage	There are not currently any ice plants or storage facilities available to the pelagic sector. Any storage available in Jamaica is utilised by the lobster and conch fisheries in the southern part of Jamaica (pers. comm.).	**S:** In some areas, people make and sell ice out of their homes for fishers to use on their boats. **W:** Only three out of the 13 offshore pelagic landing sites had ice available for sale.	Availability of ice is sufficient to meet demand.	Medium
Information on landing sites structure e.g. jetties or other facilities to secure vessels	At the time of the NFA beach survey (2006), Port Royal, Black River, Whitehouse and Ocho Rios were reported as having docks, wharfs or jetties. There was no detailed information on these. It is likely that these are the only landing sites with such structures. More up-to-date information is needed for this development work, this may be gained through information from NFA or other stakeholders.	**S:** Eight of the 13 offshore pelagic landings sites have gear sheds available. **W:** It was raised by several fisheries officers and fishers that gear theft from landing sites is an issue limiting the development of the offshore pelagic sector **W:** Four of 13 offshore pelagic landing sites do not have gear sheds available or availability is unknown. Only two of 13 offshore pelagic landing sites have docks,	Landing sites have adequate infrastructure to support an enlarged pelagic fishery. This should include gear sheds for storage to reduce larceny. The sites most likely to be used are those on the north coast.	High (Higher risk established due to missing information at this time)

Element	Current	SWOT	Target	Risk
		wharfs or jetties (Port Royal and Ocho Rios).		
Accessibility – from sea	No information has been provided, but given fish sales occur from the beach, it is expected that vessels will all have accessibility from the sea.	N/A	N/A	N/A
Accessibility – via road	According to the NFA beach survey (2006), several landing sites have access via roads. For example, Port Royal, Rae Town, Cousin's Cove, Ocho Rios, White River and Manchioneal. All known pelagic landing sites have good access by roads.	**S:** All known pelagic landing sites have good access to roads (although the condition of the road may vary).	All landing sites are thought to have good access to roads. If required, improvements should focus on the existing road network which already serve landing sites.	Low
Appropriateness for development. Details of any unutilised space in the vicinity of the landing sites that may be used for further development	There is no information on this attribute. Ownership of sites ranged from private, government and cooperative-managed.	**W:** Differences in ownership across 13 offshore pelagic landing sites may present challenges in the event of development due to potential conflicts in interest e.g., Port Royal.	Areas suitable for development are identified, if required.	Medium
Appropriateness for fleet by vessel size and gear types	For the gear types used, the vessel size is appropriate. Some of the larger vessels may be able to be fitted with small-scale longline equipment as an alternative gear option.	**S:** Vessel size is appropriate for gear types used.	Vessel size is already thought to be appropriate for the gear types used but if vessels are required to be upgraded to fish further offshore, they should be appropriate to support a safe fishery. This should include space for onboard storage and ice facilities.	Low

Element	Current	SWOT	Target	Risk
Number of vessels	There are 18 vessels in the offshore pelagic fishery (island-wide) at the time of writing this analysis. A further 68 vessels are utilised in the coastal pelagic fishery.	**W:** The 18 vessels listed under the offshore pelagic fishery may not represent fishers involved in the offshore pelagic fishery whom do not list it as their main target. **W:** The majority of vessels are dedicated to the small pelagic fishery. These vessels would be unable to participate in an expanded large pelagic fishery as the gear is different.	Fishers involved in the offshore pelagic fishery should be registered and licensed. Determine investment required to ensure vessels are able to engage in offshore fishing safely with onboard facilities for storage and ice.	Low
Size of vessel (endurance) vs. size of gear	Vessels in the offshore pelagic fishery range from 4 m to 8 m in length. All of which are made from fiberglass. The gear used is a mix of troll and handline, which is a light and selective gear type. Artificial lures are predominately used by fishers although in some areas bait fish are also used.	**S:** Vessels in the offshore pelagic fishery range from 4 m to 8 m in length. Predominant gears used include a mix of troll and handlines, which are light in weight and relatively small in comparison to other less selective gears. **S:** Artificial lures dominate the baits employed. **W:** The size and type of hook used by fishers is unclear.	Determine investment required to ensure vessels are able to engage in offshore fishing safely with onboard facilities for storage and ice. Size and type of hook used reduces likelihood of catching juveniles and turtles. Wire trace banned on longline to reduce catch of shark. Improved use of trolling gear. Promote use of artificial lures.	Medium
Motorized vs. unmotorized	Out of the 18 offshore pelagic vessels, one uses oars, and another an inboard motor. Otherwise, the others utilise outboard motors with most fishers using 40 hp motors.	**S:** All but one offshore pelagic vessel uses a motorized vessel (e.g., inboard or outboard engine). **W:** Vessels are not equipped for longer distance voyages although the offshore pelagic fishery is largely 15-20 km from port. However, some of the small open 15-18 m canoes do go 100	Determine investment required to ensure vessels are able to safely engage in offshore fishing safely with onboard facilities for storage and ice.	Low

Element	Current	SWOT	Target	Risk
		km offshore around the Pedro cays and Morant cays (50 km) but these are multi-day trips where they go ashore for a day or 2 on the cays. Only a very few do this. **W:** It was raised by fisheries officers and fishers that the high price of fuel for motorised vessels is an issue limiting the development of the offshore pelagic sector. Fuel prices have risen sharply since 2021 in particular.		
Suitability of boat maintenance and repair	The companies that sell/distribute engines will often repair them, if the damage is beyond the scope of the fisher/local mechanics, etc.	**S:** The companies that sell/distribute engines will usually often repair, if the damage is beyond the scope of the fisher/local mechanics, etc. **W:** Engines that have to be taken to agents for repair, is expensive.	Ensure facilities and training are available to enable boat repair and maintenance.	Low
Suitability to repair gear	Given the gear types reportedly used, repair of gear is thought to be cheap. With respect to loss of gear, Richardson et al., 2019 estimated 23% of handlines are lost, 22% of trolling lines and longlines 20%, 17% of which is constituted by hook loss.	**S:** Gear repair / replacement for small scale pelagic fisheries is usually simple and inexpensive. **S:** Most fishers can repair their own trolling gear. Some longline hauling gear may be rarer but should be simple to maintain and repair.	Ensure facilities and training are available to enable gear repair and maintenance.	Low
Catch and storage type (ice, frozen, brine etc.)	Most vessels take some ice on board so that catches can be stored, even temporarily.	**S:** Nearly all vessels take some ice to sea so catches can be even temporarily stored.	Determine investment required to ensure vessels are able to engage in offshore fishing	Low

Element	Current	SWOT	Target	Risk
and limit (volume) onboard vessel	In theory there would be capacity onboard for insulated storage boxes for ice (flaked, slurry etc.) to store catch for transportation back to shore and potentially to buyers. Capacity with respect to volume of catch that can be transported on vessels is not known but expected to fluctuate given the range in vessel size.	**W:** It was raised by fisheries officers and fishers that the provision of larger vessels in order to store catch onboard would contribute towards the development of the offshore pelagic sector.	safely with onboard facilities for storage and ice.	
Capacity for processing facilities onboard	No processing is currently conducted by the pelagic fishery at all, including at sea.	**W:** None of the offshore pelagic vessels have the capacity or ability for processing facilities onboard. However, historically all attempted processing has failed due to supply issues.	No additional processing planned.	Low
Number of crew appropriate to vessel size	For the vessels which have crew size information, an 8 m vessel has between one and five crew onboard. The 10 m vessel has a crew of four. Given the type of gear used (relatively small and non-mechanical) and size of the vessel, the number of crew seems appropriate, but it is not clear what determines the number of crew onboard. More information would be needed to answer this accurately.	**S:** Given the type of gear used (relatively small and non-mechanical) and size of the vessel, the number of crew seems appropriate.	Given the current vessel size, the number of crew is deemed appropriate. If larger vessels were used this would need to be revisited to ensure that fishing can occur safely.	Low

Element	Current	SWOT	Target	Risk
Ability to carry ice on board vessel	Most vessels have some ice on board so that catches can be stored, even temporarily.	**S:** Nearly all vessels have ice onboard so catches can be even temporarily stored and maintain quality.	All vessels have onboard facilities for storage and ice. Determine investment required to ensure vessels are able to engage in offshore fishing safely with onboard facilities for storage and ice.	Low
External capacity limit on effort (through enforcement of legislation)	There are currently no capacity limits with respect to effort in the pelagic fishery.	**W:** There are no capacity limits with respect to effort in the pelagic fishery	An FMP is adopted which includes management measures to control effort or quota based on ICCAT Recommendations.	Medium
Capacity for large pelagics (tonnes/day)	There are no processing facilities for large pelagics in Jamaica at this current time.	**W:** There are no processing facilities made available to the offshore pelagic sector.	Improve ice supply to ensure catch are able to be stored appropriately.	Low (as none planned)
Hygiene certifications (or relevant certifications) both for local consumption and export, plus safety certifications/consideration	Through Section 35 of the Aquaculture, Inland and Marine Products and By-Products (Inspection, Licensing and Export) Act, the Inspection and Certification of Fishery Facilities Regulations (2002) were made. These regulations provide minimum requirement checklists to be used by the competent authority to licence processing facilities (interior, exterior, water supply equipment), carrier vessels, factory vessels and freezer vessels.	**S:** Regulations provide minimum requirement checklists to be used.	Regulations in regards to hygiene are adhered to, to support an export market (if required) as well as an increased domestic market to hotels and restaurants.	Low for domestic (High for export as approval needs to be gained).
Value addition products (i.e. smoking)	There are no processing facilities for large pelagics in Jamaica at this current time, this includes for value added products.	**W:** There are no processing facilities made available to the offshore pelagic sector, which includes value added products.	Improve ice supply to ensure catch are stored appropriately. No current recommendation for large scale processing as not worked in the last 40 years.	Medium

Element	Current	SWOT	Target	Risk
Value chain (i.e. traders, marketing)	Not applicable. See above.	**W:** There are no market or auction sites, with fish being sold on the beach at the offshore pelagic landing sites, which are predominantly for domestic consumption.	Improve ice supply to ensure catch are stored appropriately along supply chain.	Medium
Availability of trained staff (may also be fishers)	Not applicable. See above.	**O:** There is an old link with Grenadian (Eastern Caribbean) fishers who are expert trolling fishers for large pelagics. This link could potentially be resuscitated and Grenadian fishers could visit Jamaica and advise local fishers.	Training conducted by Eastern Caribbean states to improve the use of trolling gear.	Medium
Appropriateness of processing equipment	Not applicable. See above.	**W:** There are no processing facilities made available to the offshore pelagic sector.	Low probability of success of development of processing onshore.	Low
Suitability of repair	Not applicable. See above.	**S:** Most fishers can repair their own trolling gear **W:** Engines have to be taken to agents to repair which is expensive or to the NFA.	Gear repair possible where replacement costs are high. Ensure facilities and training are available to enable repair engines and perform required regular maintenance. Local training institutions to support training in engine repair to support the development of an offshore pelagic fishery	Medium
Availability of unutilised buildings / areas for conversion	This is not yet clear. The NFA provided information on 11 of the 13 landing sites, which were last visited in 2006. This states whether there are other buildings in the close proximity to the landing site. At five of the sites, there either were no additional buildings, or the information was not known/collected. At three of	**W:** Information on availability of unutilised buildings unknown. Where buildings are identified, current usage and or state of repair is unknown. Most buildings are also derelict and of uncertain strength which should be considered due to annual hurricanes in the region.	Survey conducted to understand current state of repair, usage and availability of landing sites. If required, improvements should be implemented to support an enlarged offshore pelagic fishery. The sites most likely to be used are those on the north coast.	Medium

Element	Current	SWOT	Target	Risk
	sites, there were restaurants. At the other three sites, buildings were reported, but no details as to what the buildings are used for. Most importantly, the sites have not been visited since 2006 according to the NFA, therefore the state of repair, usage and availability of those recorded buildings or adjacent areas was not known at the time that this project was conducted.			
Packing materials	Not applicable. See above.	**W:** There are no processing facilities made available to the offshore pelagic sector.	N/A	N/A
Availability of ice to vessels	According to the beach survey (2006), three of the landing sites (Hunt's Bay, Pagee and Ocho Rios) has ice selling available. The last remaining ice plant is no longer operational (pers. comm.).	**W:** Only three out of 13 offshore pelagic landing sites have ice supply nearby. However, some fishers simply buy ice at the nearest petrol station in bags (10 kg or smaller).	Ice supplies are available and sufficient to meet demand.	High
Availability of ice to processing/packing facilities	There are no processing or packing facilities identified to be available for offshore pelagic product.	**W:** There are no processing or packing facilities identified to be available for offshore pelagic product.	N/A	Low
Capacity freezing (tonnes/day, type of freezing)	Not applicable. See above.	**W:** There are no processing or packing facilities identified to be available for offshore pelagic product.	N/A	Low
Independent power provision (off-grid) if required e.g. generator	Not applicable. See above.	**W:** There are no processing or packing facilities identified to be available for offshore pelagic product.	N/A	Low

Element	Current	SWOT	Target	Risk
Suitability of repair	Not applicable. See above.	**W:** There are no processing or packing facilities identified to be available for offshore pelagic product.	N/A	Low
Frozen storage capacity (tonnes)	There are no storage/transport facilities available for the offshore pelagic fishery.	**W:** There are no storage/transport facilities available for the offshore pelagic fishery.	Frozen storage is adequate for the size of the fishery.	Low
Temperature of storage freezing (e.g. sashimi grade tuna)	Not applicable. See above.	**W:** There are no processing or packing facilities identified to be available for offshore pelagic product.	Frozen storage is adequate for the size of the fishery.	Low
Transport capacity, fresh (tonnes)	With respect to transport, fishers transport their fresh catch in plastic storage containers. These are transported via domestic vehicle.	N/A	N/A	N/A
Transport capacity, frozen (tonnes)	Not applicable. See above.	N/A	N/A	N/A
Connectivity to market / onward chain	Product from the pelagic fishery is reportedly sold predominantly for domestic consumption from the landing site itself. Very little pelagic product is purchased by hotels and restaurants due to issues in consistent supply and quality. There are no auction sites (pers. comm.).	**W:** Most fish are sold to locals and vendors. Onward transport of fish from the landing sites is currently typically by passenger vehicle in ice chests. There is little to no longer-term storage facilities for pelagic products, for example the last ice plant is now no longer in use. **W:** There is no information on export route outside of Jamaica. **O:** Japan does buy tuna from several eastern Caribbean countries.	Frozen storage is adequate for the size of the fishery and available along the supply chain.	Low

Element	Current	SWOT	Target	Risk
		O: If exports were explored then it would likely utilise existing routes for lobster, conch and sea cucumber exports.		
Duration of transport	Not applicable. See above.	N/A	N/A	N/A
Suitability of repair	Not applicable. See above.	N/A	N/A	N/A
Training of fishers in gear handing	No information is available on training received.	**W:** No information is available for crew training for fishers, gear handling, species handling or safety at sea training or previous attempts to strengthen and enhance capabilities of national fishers.	Study conducted to understand level of training on gear handling. Where gaps exist, further training should be provided, utilising knowledge from the region (e.g. Grenada).	Medium
		W: No funds for in-country travel to many of the beaches to train fishers. Fisheries instructor interviews are intended to replace fisher interviews.		
		O: It was raised by fisheries officers that improved knowledge of gear use may contribute towards the development of the offshore pelagic sector. Grenadian fishers could come to Jamaica and train fishers at bigger landing sites.		
		T: Utilising knowledge from other countries will require an international / regional cooperation agreement document.		
Training of fishers in species handling	There have been trainings conducted for fishers by NGOs under various projects but little information is available beyond this.	**W:** No information is available for crew training for fishers, gear handling, species handling or safety at sea training or previous attempts to strengthen and	Study conducted to understand level of training on species handling. Where gaps exist, further training should be	Low (Fishers have extensive experience already).

Element	Current	SWOT	Target	Risk
	No information is available on training received.	enhance capabilities of national fishers. **W:** It was raised by fisheries officers that the provision of fish ID guides would contribute towards the development of the offshore pelagic sector. **O:** Could use the Coast Guard to assist in trainings which has been done before.	provided and supported by a fish ID guide.	
Training of fishers' safety at sea	No information is available on training received.	**S:** The fishers typically have life jackets, paddles, flares, fire extinguisher and cell phones and some use GPS. **S:** Section 28 of the Fisheries Act (2018) does require the Authority to have regard as to whether the applicant has undergone any training, for example safety at sea or has considerable experience in seamanship when considering granting a licence application to fish. **W:** No information is available for crew training for fishers, gear handling, species handling or safety at sea training or previous attempts to strengthen and enhance capabilities of national fishers. **W:** It is unlikely that fishers undertake any such training **W:** The NFA has a list of required equipment but this is not strictly enforced. The equipment is also not standardised and so varies by fisher.	Study conducted to understand level of training on fisher's safety. Where gaps exist, further training should be provided. Safety equipment should be standardised across the fishery. Reduces costs and increases availability.	Medium (Always highlighted as an important part of any FMP).

Element	Current	SWOT	Target	Risk
Training of crew in processing facilities	There are no processing facilities for the pelagic fishery at the present time, so not applicable.	**W:** There are no processing or packing facilities identified to be available for offshore pelagic product	If additional processing facilities are deemed necessary, ensure adequate training and safety of staff.	Low (Due to low likelihood of this occurring)
Training of crew in ice generation / freezing facilities	There are no ice/freezing facilities for the pelagic fishery at the present time.	N/A	N/A	N/A
Training of crew in storage methods and transport facilities	No information is available on training received but interviews suggested that training is needed.	**W:** Training of crew in storage methods and transportation is required.	Study conducted to understand level of training on storage and transportation. Where gaps exist, further training should be provided.	Low (Due to low likelihood of this occurring)
Availability of training facilities (or just based on experience)	There is no information on this attribute.	N/A	N/A	N/A
Number of vessels	There is no information on this attribute.	**S:** As most fishers use artificial lures there is a reduced need for baitfish. **W:** Not enough fishers catch bait fish for regular supply. **W:** There is limited information and documentation on the local bait fisheries. Not all catch is landed as some fishers supply the bait to active fishers and so the true catch is unknown. **T:** Weather affects the availability of bait for the fishery.	Promote usage of artificial lures.	Low (Due to low likelihood of this occurring)

Element	Current	SWOT	Target	Risk
Market size	Consumption of fish is significant in Jamaica but a large proportion of pelagic species are imported into the country despite some being present in the national waters.	**W:** Although there is a large market for fish in Jamaica, not many people consume tunas. Many people also like to eat whole fish not slices.	Arrange for sale of the big fish that are caught by fishers. NFA could collaborate with RADA (Rural Agricultural Development Agency) to assist with the marketing of the catch	Low
	The global market for non-canned tuna (mainly fresh/chilled) massively expanded between 2000 and 2019, particularly for semi-processed products such as fresh yellowfin tuna loin and whole dressed. In 2019, there was an estimated 255,500 tonnes of non-canned tuna traded internationally, with a value of USD 2.7 billion (Infofish, 2021). The top importers were Japan, the USA, and the European Union (EU).	**S:** Jamaican waters hold high-value species that are popular on the international market. **O:** The USA is the obvious target for an international market for Jamaican longline caught tuna. **T:** Due to the COVID-19 pandemic and the resulting closure of many food service outlets the demand for fresh/chilled tuna has reduced. This has further been compounded by the disrupted air freight supply chain as planes were grounded.	Understand international market demand for pelagic fish from Jamaica. Depending on market size, determine improvements necessary to meet demand.	Low
Local supply and demand	Supply to local hotels is small as they prefer to purchase larger fish and they do not always trust the handling processes to ensure a safe product. They also need a consistent supply and the	**W:** As hotels have a preference for larger fish, this market is limited by supply. **W:** Limited training in handling and hygienic practices limits demand from hotels and restaurants that want safety guaranteed.	Ensure adequate supply and volumes of pelagics to meet hotel demand. Training conducted on handling and hygiene practices.	Low

Element	Current	SWOT	Target	Risk
	current volumes are not adequate.	**W:** Distance from the fishing ground to the hotel is too far.	Adequate routes to market are identified if hotel and restaurant trade increases.	
	Market demand is highest for coastal demersal fish	**W:** Market demand is mainly for coastal demersal fish	Increase local demand for larger pelagic species, domestic and HORECA sector	Medium
	Most fish are sold to locals and vendors, though the Rainforest Seafood Outlet does sometimes also purchase catch and is partnered with some local hotels.	**S:** Opportunities for sale of catch to vendors that are partnered with local hotels.		Low
Global export market	There is thought to be support for an increased export market.	**S:** If markets are developed (especially to Japan or China) it is thought that most fisher groups would be interested in participating in an expanded pelagic fishery. **W:** This is a seasonal fishery.	Determine most suitable export markets for large pelagics.	Low
	Longline caught tuna supplies the fresh, fillet and other markets. Considering that the Jamaica offshore fishery will consist of longlining and trolling the targets will be the fresh and fillet markets.	**O:** The global market for non-canned tuna (mainly fresh/chilled) massively expanded between 2000 and 2019, particularly for semi-processed products.	Determine most suitable export markets for large pelagics.	Low
	To target the export market, products must be the correct size and colour in order to be accepted by the buyer. For yellowfin tuna this means that individual fish should be at least 10 kg or larger with prepared loins ranging from 3-	**W:** Limited ice and training is available for fishers to ensure that fish are of a high quality. **O:** The use of carbon monoxide is not banned in US markets and therefore could be used to ensure frozen tuna does not discolour.	Adequate training is provided to ensure safe handling practices and to maintain quality. Adequate supply of ice for fishers to maintain quality.	Low

Element	Current	SWOT	Target	Risk
	6 kg each. Fresh yellowfin must be of a red colour and without brown or white shades. Discolouration can be caused by many factors but handling during and immediately after capture ensuring bleeding and chilling is carried out properly is the most important.	**T:** Carbon monoxide can be injected or packaged with the tuna to induce the pink colour but this practice is banned in the EU and Japan and so may restrict access to international markets.		
	Other longline tuna companies / countries facilitate international trade via branch offices in the USA.	**O:** Some examples of this in practice can be found online for example from central America or the Pacific Islands where similar species and products as found in Jamaica are exported to the USA via a branch office located in the market.	Trade routes developed for pelagic species.	Medium
	Jamaica has an approved competent authority.	**S:** Export from Jamaica to the EU is possible due to the approved competent authority.		
		W: Reaching EU markets (or further afield e.g. Japan) by airfreight could be more costly than the USA from Jamaica and further investigation of the costs as well as auction prices would be needed.		Low
	The current regulations necessary for the fishery's operations as well as import and export of seafood products in Jamaica are detailed in the Fisheries Act (2018), the Aquaculture, Inland and Marine Products and By-Products (Inspection, Licensing and Export) Act is relevant to the	**S:** In Jamaica there are already the necessary regulations to support import and export of seafood products.		Low

Element	Current	SWOT	Target	Risk
	infrastructure within the fishery supply chain. Section 35 of the Act led to the creation of Inspection and Certification of Fishery Facilities Regulations (2002). These regulations provide minimum requirement checklists to be used by the competent authority to licence processing facilities (interior, exterior, water supply equipment), carrier vessels, factory vessels and freezer vessels.			
Market data	Price of fish is variable depending where on the island they are being sold. In Portland for example, fish can sell for J$600/lb (~US$4/lb (1.8 kg)), whilst in hotel areas this can be as much as J$1,000/lb (US$6.7/lb).	**W:** Huge variation in price depending on the specifications and at which stage in the supply chain the sale is made so spot prices can be misleading. **O:** Hotels could be approached directly in season for purchasing large pelagics.	Data collection system and database developed.	Medium
	Import/export data available were not always listed by species. For example, dolphinfish imported were mixed with demersal reef species such as snapper, grouper, and croaker, so it was not possible to ascertain the actual volume of the dolphinfish in those shipments.	**W:** Import/export data by pelagic species is unknown.	Determine import/export data by species to identify current trends.	Low
Supply chain	Considering the facilities available in Jamaica the most likely initial opportunity is to export fresh whole fish.	**W:** Due to current limitations in processing facilities in Jamaica, the possibility of value addition is limited.	Further research is required to determine extent of the market and profit potential (for both domestic and international markets).	Medium (more information is required

Element	Current	SWOT	Target	Risk
	To estimate international prices (and costs) more accurately for species caught in the Jamaica pelagic longline fishery it will be necessary to better define the sizes of species caught, the volumes of catch, costs of packaging & transportation and expectations of customers for the products delivered from Jamaica. Further research is needed in these areas and outreach to those potential customers to find out their specifications and interest in the fish caught in Jamaica. Fish buyers could be contacted directly, surveys conducted, or seafood trade shows visited to meet them in person.		Future key markets need to be identified before investment in expanding the offshore pelagic fishery.	
	Limited information was gained due to the COVID pandemic which prevented interviews with a range of stakeholders. Therefore, the extent to which the supply chain currently exists could not be verified and engagement with restaurants and hotels to identify potential marketing opportunities was not undertaken.	N/A	N/A	N/A

5 Objectives and Activities

In this section the individual specific objectives and activities are defined to meet the purposes and overall goal. To maintain consistency these are arranged by purpose as in previous sections. As well as the individual activity, the main stakeholder(s) responsible for implementation have been listed and an indication of priority (high, medium or low).

5.1 Purpose 1: Sustainable exploitation of offshore pelagic species

Data collection in Jamaica has struggled to maintain a consistent long term sampling programme and findings indicate that there was a lack of information on the stock status of species, unless an assessment had been carried out by ICCAT. Large tunas and billfish generally have their status determined and of those caught in Jamaica fisheries, blue marlin and shortfin mako shark are considered overfished. For the remaining species, a Productivity Susceptibility Analysis (PSA) was carried out pending better information to determine which species are at most risk of overfishing. Overall, the status did not indicate that pelagic stocks currently exploited by Jamaican fisheries are overfished. Furthermore, it is unlikely that the Jamaica fisheries are contributing to overfishing of those stocks that may be at wider risk in the Atlantic, as these species are not a primary target species for those fisheries. However, it is strongly encouraged to confirm this through a basic data collection and stock assessment programme. Unless this is in place, any expansion of the fisheries cannot be recommended. A full robust monitoring programme will avoid putting fisheries at unacceptable risk and avoid overfishing.

Table 12 Management measures and activities for Purpose 1.

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
1.1 Improve data collection for ICCAT assessed species	**1.1.1** Identify and ensure key data are collected for species stock assessments. These data should match and exceed the requirements of ICCAT. Data collected should include, but is not limited to, fleet definition and descriptive information, total catches (as estimates), biological data, catch and effort, species composition and size composition. This should also include detailed geospatial and temporal (seasonal) records.	High	NFA
	1.1.2 Develop a standard operating procedure for data collection which will allow for sufficient sampling. Data collection could be conducted both by fisher self-sampling and through fishery inspectors at landing sites. Design and equip fishers with logbooks to collect data during fishing operations, including catch, effort, locations and gear during fishing activities. Ensure fishers are sufficiently engaged and trained to accurately record species.	High	NFA Fishers

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
	On land, logbooks should be cross-checked by fishery inspectors. In addition, a sample-based approach of landing sites continues to be the most efficient option for fisheries monitoring in Jamaica. Random samples of the landings from the pelagic fishery are also recommended. A routine question should also be asked if birds, turtles or bluefin were caught.		
	1.1.3 Jamaica should collaborate with neighbouring countries to undertake data collection and assessment to ensure harmonisation across shared stocks.	Medium	NFA
1.2 Improve data collection for non-ICCAT assessed species	**1.2.1** For non-ICCAT assessed species that are found locally, the results of the PSA should be used to identify key stocks where data collection should be prioritised to reduce burden on staff.	High	NFA
	1.2.2 Identify and ensure data are collected for locally managed species. For data-limited species data should be collected on length for a sufficient sample size (backed up by maturity-at-length, length-weight. Short-term this data could be extracted from e.g., FishBase). This should include detailed geospatial and temporal (seasonal) records and biological data.	High	NFA
	1.2.3 Develop a standard operating procedure for data collection which will allow for sufficient sampling. Data collection could be conducted both by fisher self-sampling and through fishery inspectors at landing sites. Design and equip fishers with logbooks to collect data during fishing operations, including catch, effort, locations and gear during fishing activities. Ensure fishers are sufficiently engaged and trained to accurately record species. On land, logbooks should be cross-checked by fishery inspectors. In addition, a sample-based approach of landing sites continues to be the most efficient option for fisheries monitoring in Jamaica. Random samples of the landings from the pelagic fishery are also recommended.	High	NFA Fishers
	1.2.4 Jamaica should collaborate with neighbouring countries to undertake data collection and assessment to ensure harmonisation across shared stocks.	Medium	NFA
1.3 Conduct stock assessments for ICCAT and non-ICCAT assessed species	**1.3.1** Data collected are used to inform stock assessments. Where necessary, stock assessment methodologies should be reviewed to determine the most appropriate and may consist of data-limited models (e.g., length-based spawning potential ratio (LBSPR)).	High	NFA

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
	1.3.2 Peer review methodology and results of stock assessment.	Medium	NFA, University of West Indies, Mona Campus
1.4 Establish biological reference points for fisheries management	**1.4.1** Using results of the stock assessment, determine limit and target reference points for key target species based on MSY. These biological reference points should be used to inform a harvest control rule (HCR) that will need to be pre-agreed with the fishers. The HCR should be based on a precautionary and ecosystem-based approach to fisheries management. The control rule will be used to translate scientific data into a management measure. HCRs consist of monitoring indices linked to pre-agreed management actions. For species where there is no concern of overexploitation, a reasonable HCR would be to regularly monitor the length composition and trigger further research (data collection) only if exploitation levels become detectable and Spawning Potential Ratio falls below 60%.	High	NFA, University of West Indies, Mona Campus
1.5 Regular monitoring of the pelagic stocks	**1.5.1** Regular and consistent monitoring should be conducted to allow for adaptive management techniques to be employed, including application of the HCR in relation to current and fluctuating stock statuses.	Medium	NFA, University of West Indies, Mona Campus
1.6 Review feasibility of sub-merged Fish Aggregating Devices (FAD)	**1.6.1** Conduct a feasibility study on the use of sub-surface biodegradable FADs and identify suitable locations (e.g., Ocho Rios and Pagee).	Low	NFA
	1.6.2 Implement a FAD management scheme to ensure best practice approaches are adopted and to reduce competition between fishers. This should include monitoring in order to collect data such as catch and effort statistics and observations of biological associations with the FADs to aid the collation of the NFA's information base for the pelagic sector.	Low	NFA
1.7 Automate data collection and collation	**1.7.1** Automate data collection and collation/management as much as possible taking advantage of free open-source software (e.g., R statistical software). This should include ensuring data collectors/fishers are equipped with phones/tablets to collect data electronically.	Medium	NFA
1.8 Development of a working database	**1.8.1** Ensure data are held in an accessible database to facilitate analysis and development of management measures. This should allow for rapid queries so that required information can be extracted easily. Phones/tablets should be linked to the database to allow automatic upload of data.	Medium	NFA
1.9 Capacity building	**1.9.1** Training of fishers and data collectors in fish identification and provision of ID guides for pelagic species.	High	NFA

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
	1.9.2 Training is required to improve the database and stock assessment skills within the NFA.	Medium	NFA
1.10 Establishment of a National Working Group	**1.10.1** Establish an expert working group to review quality and quantity of available fisheries-independent and fisheries-dependent data on a routine basis. It is recommended that the group meets at least once per year and reviews *inter alia* progress on data collection, changes to data collection programmes and data requirements (locally and to ICCAT).	High	NFA
1.11 Attendance of Jamaican stakeholders at the ICCAT preparatory meeting	**1.11.1** Ensure attendance of Jamaican scientists at ICCAT data preparation meetings to allow for a better understanding of what data are being requested and how they are being used.	High	NFA
1.12 Ensure adequate human and capital resources relevant to resource management	**1.12.1** With the increased need for stock assessment and assessment of locally managed species, the capacity internally in NFA for stock assessment will need to be reviewed and where required additional staff or retraining of existing staff may be required. This is a long-term process as stock assessment scientists cannot be trained in a short time scale so shadowing of regional processes would be of benefit.	High	NFA

5.2 Purpose 2: Protection of the environment and ecosystem

Jamaica has limited information and documentation on the local bait fisheries. Quantities used are not currently available, nor is the stock status of these species. It is also not clear how many vessels operate within the bait fishery in Jamaica. Artificial lures, although considered expensive by the fishers, could present a sustainable fishing method with trolling or handlining which would reduce pressure on the bait fishery in Jamaican waters. Artificial lures are commonly used in recreational fisheries for tuna and other pelagic game species. Currently no information on ecosystem issues were available to evaluate the impact on fisheries. As such, it would be beneficially for management to incorporate ecosystem considerations, such as predator-prey interactions, habitat protection and minimising harm to protected species. For example, any increased use of longlines will also need to be properly managed to ensure no detrimental impacts to bycatch species such as sharks and turtles.

Table 13 Management Measures and Activities for Purpose 2.

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
2.1 Identify and document range of bycatch species in the offshore pelagic fishery	**2.1.1** All species in the catch should be documented and reported either as target or bycatch species. All species to be recorded in the catch for an initial period so that every common species is reported. Some species may be aggregated if they form a very limited part of the catch of a fishery. Provide ID guides as necessary. This should also include detailed geospatial and temporal (seasonal) records.	High	NFA, University of West Indies, Mona Campus
2.2 Determine impact of fishery on bycatch species	**2.2.1** Review impact of the fishery on vulnerable bycatch species (such as sharks, rays, turtles, cetaceans and birds).	High	NFA
2.3 Develop management strategy to reduce impact on vulnerable bycatch species (e.g., Endangered, Threatened or Protected species, ETP)	**2.3.1** If needed, increase gear selectivity and implement management measures to reduce unwanted catch. For example, introduce a ban on wire leaders to reduce shark bycatch in the longline fishery, use of bird scaring devices, use of circle hooks in longlines and implement species handling practices. Closed seasons or areas could also be used to protect areas of key importance (e.g., spawning or breeding).	Medium	NFA
	2.3.2 Establish appropriate monitoring of bycatch species.	Medium	NFA
2.4 Increase use of trolling gear	**2.4.1** Determine feasibility of enhancing the trolling fishery as it is more appropriate to a seasonal fishery, is more opportunistic and requires little investment.	High	NFA
2.5 Increased information on baitfish fisheries	**2.5.1** Increase quality and quantity of data collection on baitfish fisheries to determine stock status. Data collection and analyses should include landings, fleet composition, gear-types, length frequency, CPUE and use of bait by species and acoustic surveys as well as biological data. The results of the PSA can be used to prioritise baitfish species for data	Medium	NFA

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
	collection, although Atlantic Threadfin Herring (*Opisthonema oglinum*), should be included as it is of considerable value to the development of large pelagic fishery.		
2.6 Determine stock status of key baitfish species	**2.6.1** Determine the most appropriate stock assessment models which may consist of data-limited models (e.g., length-based spawning potential ratio (LBSPR)).	Medium	NFA
	2.6.2 Peer review of methodology.	Medium	NFA
2.7 Regular monitoring of the baitfish stocks	**2.7.1** Regular and consistent monitoring should be conducted to allow adaptive management techniques to be employed which can respond on a short- to medium-term basis through changing levels of exploitation in relation to current and fluctuating stock statuses.	Medium	NFA
2.8 Support use of artificial lures	**2.8.1** Provide monetary support (e.g., grants) and training to fishers to increase use of artificial lures.	Low	NFA

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

5.3 Purpose 3: Effective governance and management

Although not currently a member of ICCAT, Jamaica does have the responsibility to submit data to ICCAT. However, it would be beneficial for Jamaica to become a Contracting Party of ICCAT, to secure Jamaica's stake in these pelagic resources. In addition, as many of the species that form the basis of the fisheries are not managed by ICCAT, local management plans should be implemented to control fishing and ensure the long-term sustainability of the resource. Due to the shared nature of offshore pelagic species, Jamaica should collaborate regionally to develop harmonised management plans and support the use of best available science.

Table 14 Management Measures and Activities for Purpose 3.

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
3.1 Jamaica becomes a Contracting Party of ICCAT	**3.1.1** Jamaica should become a Contracting Party of ICCAT.	Medium	Government of Jamaica NFA
3.2 Clear identification of harvest strategy and control rules for (i) ICCAT assessed species and (ii) locally assessed species	**3.2.1** Development of harvest strategy for ICCAT assessed species is based on stock assessments. Once Jamaica becomes a member of ICCAT, it will need to adhere to catch limits and set up a division process internally within Jamaica. When catches reach an agreed limit reference point all fishers will need to stop fishing (HCR). The harvest strategy could also include the use of licensing, closed seasons and areas and gear restrictions. For ICCAT managed species, the harvest strategy would need to respond to ICCAT recommendations and conservation measures. Due to a lack of data the details of a harvest strategy are unclear. It will be important to determine a reasonable potential yield by species and notify ICCAT of Jamaica's intentions to increase yield. At this moment, this data is thought to be missing and recorded data from the original exploratory fisheries would have been necessary to provide detailed advice.	High	NFA
	3.2.2 Species not managed under ICCAT should be managed locally following an ecosystem-based approach to fisheries management and include a robust harvest strategy based on national stock assessments. When catches reach an agreed limit reference point all fishers will need to stop fishing (HCR). The harvest strategy could also include the use of licensing, closed seasons and areas and gear restrictions.	High	NFA Fishers

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
	Due to a lack of data the details of a harvest strategy are unclear. It will be important to determine a reasonable potential yield by species. At this moment, this data is thought to be missing and recorded data from the original exploratory fisheries would have been necessary to provide detailed advice.		
	3.2.3 Implement a robust monitoring and evaluation programme to ensure management measures are reviewed and remain effective. Setup standard notifications to fishers for start of season, end of season, regular monthly outputs and notifications when limits are reached.	High	NFA Fishers
3.3 Annual review	**3.3.1** Establish an annual review process to identify if harvest strategy and control rules have worked and where improvements can be made.	Medium	NFA University of West Indies, Mona Campus
3.4 Ensure effective Monitoring, Control and Surveillance (MCS)	**3.4.1** Review roles and responsibilities of current MCS as well as level of sanctions and number of infringements in pelagic fisheries with national authorities and fishing communities. National MCS systems should allow for the effective monitoring of catch and effort and comparison against catch limits on a monthly reporting basis, but should be available to high-level managers immediately.	Medium	NFA
	3.4.2 Strengthen MCS where needed. Control of fishers may need to be increased with port visits, at sea inspections, effective sanctions, but associated with a communication plan to encourage responsible management.	Medium	NFA, Jamaica Constabulary Marine Police, Jamaica Defense Force Coast Guard
	3.4.3 Coordinate MCS activities with national and regional authorities, where necessary.	Medium	NFA
3.5 Review national legislation and regulations	**3.5.1** Review of the current set of laws and regulations that are in place that combined set out the regulatory framework for fisheries management. These should be reviewed in conjunction with the FMP to ensure all aspects of the legal system are up to date and fit for purpose. This should include the installation of FADs and the fishing rights associated with them.	Medium	NFA
3.6 Actively participate in regional and international fora	**3.6.1** Take part in regional stock assessments.	Medium	NFA
	3.6.2 Promote national and support regional decisions based on the best scientific information and the precautionary approach. Where possible,	High	NFA

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
to enhance sustainable resource management	collaborate with international and national research institutes on pelagic resources and their management.		
	3.6.3 Exchange data with neighboring States and submit data to ICCAT above and beyond base level requirements.	Medium	NFA

5.4 Purpose 4: Sustainable development of the fishery and markets.

There are approximately 126 landing sites around Jamaica, 13 of which are for offshore pelagic vessels. Most have road access according to the survey records, although the condition of the roads may vary and the landing sites are generally lacking in amenities. With respect to onward sale, storage, or processing facilities, there is nothing available at this time for the pelagic sector. There are no market or auction sites, with fish being sold on the beach at the landing site for predominantly domestic consumption. Generally, maximising profits in the fishery can be achieved with the provision of better fish handling, hygiene and processing. This will increase the standard of produce in the market and therefore hopefully gain a larger domestic (hotels mainly) and export market. This ideally will be achieved through the adequate provision of ice, maintaining hygienic conditions, training stakeholders in proper fish handling techniques and safety-at-sea. Before large investments are sought to improve the onshore infrastructure, there is a need to understand the potential for an international export market as well as an increased domestic market. Depending on the market size, improvements necessary to meet demand can be identified and prioritised.

Table 15 Management Measures and Activities for Purpose 4.

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
4.1 Assess condition of landing sites	**4.1.1** Conduct a field study to determine the current conditions and facilities at landings sites that are capable of receiving pelagic catches. This will include surveying appropriate port facilities, repair, ice generation and freezer maintenance, land-based cold stores, bait management and transport infrastructure. It is important to note that the landing sites along the north coast are most likely to be used.	High	NFA
4.2 Improve quality of fish and fishery products by reducing post-harvest economic and physical losses through	**4.2.1** Where needed, ensure adequate infrastructure and conditions are available to support an enlarged pelagic fishery which can be maintained. This should include the availability of gear sheds at landing sites and sufficient access to ice for the fishing vessels, landings sites and any transportation.	High	NFA

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
improved landing sites and market infrastructure			
4.3 Determine suitability of vessels to access offshore fisheries	**4.3.1** Assess the carrying capacity and condition of the current fleet in order to determine any changes that might be required.	High	NFA
	4.3.2 Where needed, identify investment opportunities to upgrade vessels so that they are able to engage in offshore fishing safely with onboard facilities for storage and ice.	Medium	NFA
	4.3.3 Conduct feasibility of using a mother vessel fitted with ice etc. that fishers could use.	Low	NFA
4.4 Conduct needs assessment on training for fisher safety and gear handling	**4.4.1** Identify level of training on fishers' safety at sea. Where gaps exist, further training should be provided as well as the necessary equipment (safety equipment should be standardised across the fishery).	High	NFA
4.5 Improve fish-handling practices	**4.5.1** Conduct training for fishers to improve handling of pelagic catches both on the vessel and at the landing sites.	High	NFA Coast Guard
	4.5.2 Ensure adequate equipment is provided to enable proper and safe handling practices.	Medium	NFA
4.6 Set up and implement minimum hygienic standards	**4.6.1** Set minimum hygienic standards for collection, storage and selling points to enable access to the domestic tourism trade (hotels/restaurants) and/or potential international export markets that align with Codex Alimentarius or other international food standards, as appropriate. Ensure these standards are effectively applied throughout the industry,	High	Ministries of Agriculture and Fisheries Other organisations responsible for food safety
4.7 Increase ability for fishers to repair their own gear and equipment	**4.7.1** Ensure facilities and training are available and perform required regular maintenance.	Low	NFA Local training institutions
4.8 Promote regional and international collaboration	**4.8.1** Set up training programme with Eastern Caribbean States (e.g., Grenada) to learn from best practice and facilitate knowledge sharing.	High	NFA Counterparts in Eastern Caribbean States

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

Specific Objective	Measure / Activity	Priority	Stakeholder(s) responsible
4.9 Investigate transportation routes	**4.9.1** Evaluate the most cost effective and efficient forms of transport from the fishery to market. Use of mobile vans with freezers/ice facilities is recommended.	Low	NFA
4.10 Identify key export markets	**4.10.1** Identify the extent of the market and profit potential for international markets. Future key markets need to be identified before investment in expanding the offshore pelagic fishery.	High	NFA Ministry of Industry, Investment & Commerce Exporting companies
	4.10.2 Review opportunities for international trade (e.g., to the USA) including through the use of branch offices.	Medium	NFA
	4.10.3 Determine infrastructure and capacity required to support an international export market.	Medium	NFA
4.11 Increase local demand for larger pelagic species in the domestic and hotel, restaurant and café (HORECA) sectors	**4.11.1** Conduct interviews with hotels, restaurants and local stakeholders to understand how large pelagics could be better utilized and the demand for pelagic species increased.	High	NFA HORECA sector
	4.11.2 Promote value addition to meet the quality demand of medium and higher income product markets.	Medium	NFA Fishers
	4.11.3 Implement marketing strategy to promote the purchase of large pelagics domestically.	Medium	NFA HORECA sector Rural Agricultural Development Agency

5.5 Access rights

The ToR states that '*The specifications of any use or access rights to be allocated in the fishery and any conditions attached to them'* should be defined.

It is currently expected that pelagic fishing will be restricted to the north coast, where the waters are very deep and the steep bathymetry, which produces upwelling, creates good tuna fishing grounds. In addition, the main landing sites suitable to support a pelagic fishery are also based along the north coast as well as the location of fisheries for bait species (e.g., Portland and Pagee). In order to determine access rights within this fishery more data are required on specific species and their stock status. However, as the cost to upgrade and set up vessels suitable for pelagic fishing is likely to involve a large capital outlay, it will naturally limit the number of vessels initially that will be able to access the fishery. However, this could be beneficial as these initial vessels could be used to start collecting the required data that will help to inform the harvest strategy and other management decisions.

If Jamaica becomes a Contracting Party to ICCAT, it may be bound by specific management recommendations. This may include TACs for certain species and therefore quota allocations will need to be taken into account in regards to access rights to the fishery. As part of ICCAT, Jamacia would receive a defined percentage of the TAC to use and allocate as it sees fit. It then becomes an internal decision, within Jamaica, how the TAC is divided and managed.

6 Monitoring and Evaluation

A monitoring framework has been developed for each Specific Objective including proposed Objectively Verifiable Indicators (OVIs), which is the anticipated result and timeline for delivery, benchmarks for the evaluation and successful implementation of the management plan, the data required to evaluate success and how this should be done. Where necessary, assumptions are included in the monitoring framework that provide the conditions which are necessary for the success of the activity, but which are largely or completely outside of the control of the management plan. In the following tables, the Activity column refers to those activities detailed in Table 12 – Table 19.

6.1 Purpose 1: Sustainable exploitation of offshore pelagic species

Table 16 Monitoring and Evaluation Requirements for Purpose 1.

Specific Objective	Activity	OVI	Means of Verification	Assumptions
1.1 Improve data collection for ICCAT assessed species	**1.1.1** Identify and ensure key data are collected for species stock assessments. These data should match and exceed the requirements of ICCAT. Data collected should include, but is not limited to, fleet definition and descriptive information, total catches (as estimates), biological data, catch and effort, species composition and size composition. This should also include detailed geospatial and temporal (seasonal) records.	2023. Key data are identified and collected for ICCAT-assessed species including catch, effort and biological data across Jamaica for pelagic fisheries. This should include detailed geospatial and temporal (seasonal) records.	Species are described in catch reports Geo-spatial and temporal analysis	Correct species ID
	1.1.2 Develop a standard operating procedure for data collection which will allow for sufficient sampling. Data collection could be conducted both by fisher self-sampling and through fishery inspectors at landing sites. Design and equip fishers with logbooks to collect data during fishing operations, including catch, effort,	2023. A standard operating procedure is developed. Logbooks with key variables Number of logbooks filled in and return to NFA by fishers weekly	Standard operating procedure	Standard operating procedure is easy to use by Fishery Inspectors and fishers

Specific Objective	Activity	OVI	Means of Verification	Assumptions
	locations and gear during fishing activities. Ensure fishers are sufficiently engaged and trained to accurately record species. On land, logbooks should be cross-checked by fishery inspectors. In addition, a sample-based approach of landing sites continues to be the most efficient option for fisheries monitoring in Jamaica. Random samples of the landings from the pelagic fishery are also recommended. A routine question should also be asked if birds, turtles or bluefin were caught.			
	1.1.3 Jamaica should collaborate with neighbouring countries to undertake data collection and assessment to ensure harmonisation across shared stocks.	2024. Clear demonstration of regional collaboration.	Number of meetings relating to regional management	Regional partners are willing to collaborate
1.2 Improve data collection for non-ICCAT assessed species	**1.2.1** For non-ICCAT assessed species that are found locally, the results of the PSA should be used to identify key stocks where data collection should be prioritised to reduce burden on staff.	2023. Identification of the key stocks to prioritise for data collection.	List of key stocks	Correct species ID Data available for accurate PSA
	1.2.2 Identify and ensure data are collected for locally managed species. For data-limited species data should be collected on length for a sufficient sample size (backed up by maturity-at-length, length-weight. Short-term this data could be extracted from e.g., FishBase). This should include detailed geospatial and temporal (seasonal) records and biological data.	2023. Key data are identified and collected for non-ICCAT assessed species. This should include detailed geospatial and temporal (seasonal) records.	Species are described in catch reports Geo-spatial and temporal analysis	Correct species ID

Specific Objective	Activity	OVI	Means of Verification	Assumptions
	1.2.3 Develop a standard operating procedure for data collection which will allow for sufficient sampling. Data collection could be conducted both by fisher self-sampling and through fishery inspectors at landing sites. Design and equip fishers with logbooks to collect data during fishing operations, including catch, effort, locations and gear during fishing activities. Ensure fishers are sufficiently engaged and trained to accurately record species. On land, logbooks should be cross-checked by fishery inspectors. In addition, a sample-based approach of landing sites continues to be the most efficient option for fisheries monitoring in Jamaica. Random samples of the landings from the pelagic fishery are also recommended.	2023. A standard operating procedure is developed. Logbooks with key variables Number of logbooks filled in and return to NFA by fishers weekly.	Standard operating procedure	Standard operating procedure is easy to use by Fishery Inspectors and fishers
	1.2.4 Jamaica should collaborate with neighbouring countries to undertake data collection and assessment to ensure harmonisation across shared stocks.	2024. Clear demonstration of regional collaboration.	Number of meetings relating to regional management	Regional partners are willing to collaborate
1.3 Conduct stock assessments for ICCAT and non-ICCAT assessed species	**1.3.1** Data collected are used to inform stock assessments. Where necessary, stock assessment methodologies should be reviewed to determine the most appropriate and may consist of data-limited models (e.g., length-based spawning potential ratio (LBSPR)).	2023. Stock assessment methodology(ies) agreed and all (or key) species have a current stock status (i.e., updated within the last two to three years).	Published stock assessments and data submitted to ICCAT where required Stock assessment occurs every two to three years for all species of concern	Methodology agreed nationally and regionally (ICCAT)

Specific Objective	Activity	OVI	Means of Verification	Assumptions
	1.3.2 Peer review methodology and results of stock assessment.	2024. Peer review conducted.	Peer review results published	Adequately experienced peer-reviewers can be engaged
1.4 Establish biological reference points for fisheries management	**1.4.1** Using results of the stock assessment, determine limit and target reference points for key target species based on MSY. These biological reference points should be used to inform a harvest control rule (HCR) that will need to be pre-agreed with the fishers. The HCR should be based on a precautionary and ecosystem-based approach to fisheries management. The control rule will be used to translate scientific data into a management measure. HCRs consist of monitoring indices linked to pre-agreed management actions. For species where there is no concern of overexploitation, a reasonable HCR would be to regularly monitor the length composition and trigger further research (data collection) only if exploitation levels become detectable and Spawning Potential Ratio falls below 60%.	2023. Biological Reference Points established for each stock, where required.	Biological Reference Points published	An adequate sampling program is achieved to derive reference points from
1.5 Regular monitoring of the pelagic stocks	**1.5.1** Regular and consistent monitoring should be conducted to allow for adaptive management techniques to be employed, including application of the HCR in relation to current and fluctuating stock statuses.	2024. Monitoring process developed.	Process in place and data collected	Funding is available to sustain data collection
1.6 Review feasibility of sub-merged Fish	**1.6.1** Conduct a feasibility study on the use of sub-surface biodegradable	2025. Suitability of FADs assessed and locations, if required, selected.	Study report published	Sustainable FADs will be

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

Specific Objective	Activity	OVI	Means of Verification	Assumptions
Aggregating Devices (FAD)	FADs and identify suitable locations (e.g., Ocho Rios and Pagee).			selected and properly managed
	1.6.2 Implement a FAD management scheme to ensure best practice approaches are adopted and to reduce competition between fishers. This should include monitoring in order to collect data such as catch and effort statistics and observations of biological associations with the FADs to aid the collation of the NFA's information base for the pelagic sector.	2025. FAD Management Plan developed and implemented.	FAD Management Plan published	
1.7 Automate data collection and collation	**1.7.1** Automate data collection and collation/management as much as possible taking advantage of free open-source software (e.g., R statistical software). This should include ensuring data collectors/fishers are equipped with phones/tablets to collect data electronically.	2024. Adoption of automated data collation/management software. Data collectors equipped with necessary tools (e.g., mobile phones with data or tablets).	Software installed Number of data collectors with electronic devices to collect data	Suitable software is available
1.8 Development of a working database	**1.8.1** Ensure data are held in an accessible database to facilitate analysis and development of management measures. This should allow for rapid queries so that required information can be extracted easily. Phones/tablets should be linked to the database to allow automatic upload of data.	2024. Data are held in a suitable and easy access database. Database has been linked with electronic data collection devices.	Database developed and evidence of use	Suitable software is available
1.9 Capacity building	**1.9.1** Training of fishers and data collectors in fish identification and provision of ID guides for pelagic species.	2023. Training conducted. Use of fish ID guides on pelagic stocks by fishers and data collectors.	Training manuals published ID guides published	Stakeholders are receptive to training

Specific Objective	Activity	OVI	Means of Verification	Assumptions
			Correct identification of pelagic species	
	1.9.2 Training is required to improve the database and stock assessment skills within the NFA.	2024. Correct candidates selected for training. Stock assessment workshop. Staff are sufficiently trained in data collection, database and stock assessment methodologies (including R).	Training manuals published Participants lists	
1.10 Establishment of a National Working Group	**1.10.1** Establish an expert working group to review quality and quantity of available fisheries-independent and fisheries-dependent data on a routine basis. It is recommended that the group meets at least once per year and reviews *inter alia* progress on data collection, changes to data collection programmes and data requirements (locally and to ICCAT).	2023. Annual review of data quality and quantity from national Expert Working Group.	Expert Working Group established Meeting minutes	
1.11 Attendance of Jamaican stakeholders at the ICCAT preparatory meeting	**1.11.1** Ensure attendance of Jamaican scientists at ICCAT data preparation meetings to allow for a better understanding of what data are being requested and how they are being used.	2023. Key staff identified and attend ICCAT preparatory meeting.	Attendance list Meeting minutes	Budget is available for attendance to meetings
1.12 Ensure adequate human and capital resources relevant to resource management	**1.12.1** With the increased need for stock assessment and assessment of locally managed species, the capacity internally in NFA for stock assessment will need to be reviewed and where required additional staff or retraining of existing staff may be required. This is a long-term process as stock assessment scientists	2023. Capacity and resource needs assessment conducted. Gaps in capacity and resources are filled.	Capacity needs report	Budget available for hiring of new staff or retraining where needed

Specific Objective	Activity	OVI	Means of Verification	Assumptions
	cannot be trained in a short time scale so shadowing of regional processes would be of benefit.			

6.2 Purpose 2: Protection of the environment and ecosystem

Table 17 Monitoring and Evaluation Requirements for Purpose 2.

Specific Objective	Activity	OVI	Means of Verification	Assumptions
2.1 Identify and document range of bycatch species in the offshore fishery	**2.1.1** All species in the catch should be documented and reported either as target or bycatch species. All species to be recorded in the catch for an initial period so that every common species is reported. Some species may be aggregated if they form a very limited part of the catch of a fishery. Provide ID guides as necessary. This should also include detailed geospatial and temporal (seasonal) records.	2023. Identification of bycatch species by gear type. Detailed geospatial and temporal (seasonal) records of bycatch species recorded and summarised.	List of species by gear type Catch records for all bycatch species Geo-spatial and temporal analysis	Correct species ID
2.2 Determine impact of fishery on bycatch species	**2.2.1** Review impact of the fishery on vulnerable bycatch species (such as sharks, rays, turtles, cetaceans and birds).	2023. Impact of the fishery on key vulnerable bycatch species identified (both spatially and temporally).	Bycatch study report	
2.3 Develop management strategy to reduce impact on vulnerable bycatch species (e.g., Endangered, Threatened or Protected species, ETP)	**2.3.1** If needed, increase gear selectivity and implement management measures to reduce unwanted catch. For example, introduce a ban on wire leaders to reduce shark bycatch in the longline fishery, use of bird scaring devices,	2024, If needed, identification and implementation of management measures/interventions.	Management strategy developed for bycatch species	These are not currently contained in fisheries policy documents. If they are, they

Specific Objective	Activity	OVI	Means of Verification	Assumptions
	use of circle hooks in longlines and implement species handling practices. Closed seasons or areas could also be used to protect areas of key importance (e.g., spawning or breeding).			may need strengthening.
	2.3.2 Establish appropriate monitoring of bycatch species.	2024. Catch and effort records fully document whole catch including interaction with bycatch species.	Bycatch monitoring reports	Data are collected at the required level of disaggregation
2.4 Increase use of trolling gear	**2.4.1** Determine feasibility of enhancing the trolling fishery as it is more appropriate to a seasonal fishery, is more opportunistic and requires little investment.	2023. Percentage uptake in trolling gear used from baseline.	Number of trolling gear used in the fishery compared to baseline.	Fishers are happy to use trolling more than long-lining
2.5 Increased information on baitfish fisheries	**2.5.1** Increase quality and quantity of data collection on baitfish fisheries to determine stock status. Data collection and analyses should include landings, fleet composition, gear-types, length frequency, CPUE and use of bait by species and acoustic surveys as well as biological data. The results of the PSA can be used to prioritise baitfish species for data collection, although Atlantic Threadfin Herring (*Opisthonema oglinum*), should be included as it is of considerable value to the development of large pelagic fishery.	2024. Understanding of baitfish fisheries including catch, effort and trophic models of pelagic habitats developed including impacts of trophic level disturbance.	Study report	Data are collected
2.6 Determine stock status of key baitfish species	**2.6.1** Determine the most appropriate stock assessment models which may consist of data-limited models (e.g., length-based spawning potential ratio (LBSPR)).	2024. Stock assessment methodology agreed and all (or key) bait fish species have a current stock status (i.e., updated within the last two to three years).	Published stock assessments	Species composition remains stable
	2.6.2 Peer review of methodology.	2024. Peer review conducted.	Peer review results published	

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

Specific Objective	Activity	OVI	Means of Verification	Assumptions
2.7 Regular monitoring of the baitfish stocks	**2.7.1** Regular and consistent monitoring should be conducted to allow adaptive management techniques to be employed which can respond on a short- to medium-term basis through changing levels of exploitation in relation to current and fluctuating stock statuses.	2024. Monitoring process developed.	Process in place and data collected	
2.8 Support use of artificial lures	**2.8.1** Provide monetary support (e.g., grants) and training to fishers to increase use of artificial lures.	2025. Percentage increase of artificial lures useage.	Study report on quantifying use of artificial lures	Funding is available

6.3 Purpose 3: Effective governance and management

Table 18 Monitoring and Evaluation Requirements for Purpose 3.

Specific Objective	Activity	OVI	Means of Verification	Assumptions
3.1 Jamaica becomes a Contracting Party of ICCAT	**3.1.1** Jamaica should become a Contracting Party of ICCAT.	2024. Jamaica is a Contracting Party to ICCAT.	Membership documentation	Funds are available for membership
3.2 Clear identification of harvest strategy and control rules for (i) ICCAT assessed species and (ii) locally assessed species	**3.2.1** Development of harvest strategy for ICCAT assessed species is based on stock assessments. Once Jamaica becomes a member of ICCAT, it will need to adhere to catch limits and set up a division process internally within Jamaica. When catches reach an agreed limit reference point all fishers will need to stop fishing (HCR). The harvest strategy could also include the use of licensing, closed seasons and areas and gear restrictions.	2023. Clear harvest strategy and control rules established.	Harvest strategy and control rules published	An adequate sampling program is achieved

Specific Objective	Activity	OVI	Means of Verification	Assumptions
	For ICCAT managed species, the harvest strategy would need to respond to ICCAT recommendations and conservation measures. Due to a lack of data the details of a harvest strategy are unclear. It will be important to determine a reasonable potential yield by species and notify ICCAT of Jamaica's intentions to increase yield. At this moment, this data is thought to be missing and recorded data from the original exploratory fisheries would have been necessary to provide detailed advice.			
	3.2.2 Species not managed under ICCAT should be managed locally following an ecosystem-based approach to fisheries management and include a robust harvest strategy based on national stock assessments. When catches reach an agreed limit reference point all fishers will need to stop fishing (HCR). The harvest strategy could also include the use of licensing, closed seasons and areas and gear restrictions. Due to a lack of data the details of a harvest strategy are unclear. It will be important to determine a reasonable potential yield by species. At this moment, this data is thought to be missing and recorded data from the original exploratory fisheries would have been necessary to provide detailed advice.	2023. Clear harvest strategy and control rules established.	Harvest strategy and control rules published	

Specific Objective	Activity	OVI	Means of Verification	Assumptions
	3.2.3 Implement a robust monitoring and evaluation programme to ensure management measures are reviewed and remain effective. Setup standard notifications to fishers for start of season, end of season, regular monthly outputs and notifications when limits are reached.	2023. Monitoring process developed.	Process in place and data collected Monthly updates of catch vs catch limits for species against Harvest Control Rules (HCR) Communication plan published	
3.3 Annual review	**3.3.1** Establish an annual review process to identify if harvest strategy and control rules have worked and where improvements can be made.	2024. Annual review conducted and published.	Annual review published Improvements to processes identified and implemented	Available personnel with sufficient experience to review
3.4 Ensure effective Monitoring, Control and Surveillance (MCS)	**3.4.1** Review roles and responsibilities of current MCS as well as level of sanctions and number of infringements in pelagic fisheries with national authorities and fishing communities. National MCS systems should allow for the effective monitoring of catch and effort and comparison against catch limits on a monthly reporting basis, but should be available to high-level managers immediately.	2024. Roles and responsibilities are defined Compliance review (number of infringements, number of successful prosecutions, level of sanction etc.)	Roles verified Report on effectiveness of MCS strategy	Updates possible with budget and legal assistance
	3.4.2 Strengthen MCS where needed. Control of fishers may need to be increased with port visits, at sea inspections, effective sanctions, but associated with a communication plan to encourage responsible management.	2024. Effective MCS in place with minimal/no incidences of non-compliance.	Updated MCS strategy Reports on number of inspections (patrols), non-	

Specific Objective	Activity	OVI	Means of Verification	Assumptions
			compliance and prosecutions.	
	3.4.3 Coordinate MCS activities with national and regional authorities, where necessary.	2024. Regular review with all national authorities in the maritime domain established. Coordination of maritime domain surveillance at national level established. Coordination of maritime domain surveillance at regional level established.	Number of meetings attended regionally and nationally on MCS Meeting minutes and reports	National / regional partners willing to collaborate
3.5 Review national legislation and regulations	**3.5.1** Review of the current set of laws and regulations that are in place that combined set out the regulatory framework for fisheries management. These should be reviewed in conjunction with the FMP to ensure all aspects of the legal system are up to date and fit for purpose. This should include the installation of FADs and the fishing rights associated with them.	2024. National fisheries act and regulations updated relative to changes required by FMP.	Acts and regulations updated	Updates possible with budget and legal assistance
3.6 Actively participate in regional and international fora to enhance sustainable resource management	**3.6.1** Take part in regional stock assessments.	2024. Contribution of data to regional stock assessments.	Stock assessment results published	Budget and personnel available to complete
	3.6.2 Promote national and support regional decisions based on the best scientific information and the precautionary approach. Where possible, collaborate with international and national research institutes on pelagic resources and their management.	2023. Annual meeting attendance at scientific workshops on pelagic management. Evidence of scientifically informed decision-making on fishery matters.	Meeting attendance lists Meeting minutes Scientific papers published	
	3.6.3 Exchange data with neighboring States and submit data to ICCAT above and beyond base level requirements.	2024. Number of data exchanges (quantity of data i.e., records) that have taken place.	Summary of data exchanges (total and in the public domain) available	

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

6.4 Purpose 4: Sustainable development of the fishery and markets.

Table 19 Monitoring and Evaluation Requirements for Purpose 4.

Specific Objective	Activity	OVI	Means of Verification	Assumptions
4.1 Assess condition of landing sites	**4.1.1** Conduct a field study to determine the current conditions and facilities at landings sites that are capable of receiving pelagic catches. This will include surveying appropriate port facilities, repair, ice generation and freezer maintenance, land-based cold stores, bait management and transport infrastructure. It is important to note that the landing sites along the north coast are most likely to be used.	2023. Quantification of landing site suitability and condition of facilities.	Study report	Suitable access to landing sites
4.2 Improve quality of fish and fishery products by reducing post-harvest economic and physical losses through improved landing sites and market infrastructure	**4.2.1** Where needed, ensure adequate infrastructure and conditions are available to support an enlarged pelagic fishery which can be maintained. This should include the availability of gear sheds at landing sites and sufficient access to ice for the fishing vessels, landings sites and any transportation.	2023. Requirements implemented.	Implementation report	Funding is available and accessible
4.3 Determine suitability of vessels to access offshore fisheries	**4.3.1** Assess the carrying capacity and condition of the current fleet in order to determine any changes that might be required.	2023. Carrying capacity and condition determined.	Study report	
	4.3.2 Where needed, identify investment opportunities to upgrade vessels so that they are able to engage in offshore fishing safely with onboard facilities for storage and ice.	2024. Identification and submission of investments proposals.	Investment proposals	Funding is available and accessible

Specific Objective	Activity	OVI	Means of Verification	Assumptions
	4.3.3 Conduct feasibility of using a mother vessel fitted with ice etc. that fishers could use.	2025. Agreement is made to use mother vessel during fishing operations.	Purchase of mother vessel	Funding is available and accessible
4.4 Conduct needs assessment on training for fisher safety and gear handling	**4.4.1** Identify level of training on fishers' safety at sea. Where gaps exist, further training should be provided as well as the necessary equipment (safety equipment should be standardised across the fishery).	2023. Needs assessment for training conducted and minimum safety requirement identified for artisanal vessels. Equipment purchased. Training workshops delivered.	Training needs report Purchasing records Training materials produced and available	Funding is available and accessible Stakeholders are receptive to training
4.5 Improve fish-handling practices	**4.5.1** Conduct training for fishers to improve handling of pelagic catches both on the vessel and at the landing sites.	2023. Training conducted.	Attendance lists Training materials produced and available	Funding is available and accessible Stakeholders are receptive to training
	4.5.2 Ensure adequate equipment is provided to enable proper and safe handling practices.	2024. Equipment purchased.	Purchasing records	Funding is available and accessible
4.6 Set up and implement minimum hygienic standards	**4.6.1** Set minimum hygienic standards for collection, storage and selling points to enable access to the domestic tourism trade (hotels/restaurants) and/or potential international export markets that align with Codex Alimentarius or other international food standards, as appropriate. Ensure these standards are effectively applied throughout the industry,	2023. Identify minimum hygienic standard for collection, storage and selling points. Implement hygienic standards for collection, storage and selling points identified.	Summary of hygienic standard for collection, storage and selling points Plan for development of high-quality exportation sites Report on implementation	
4.7 Increase ability for fishers to repair their own gear and equipment	**4.7.1** Ensure facilities and training are available and perform required regular maintenance.	2025. Training and equipment provided to ensure gear repair by fishers.	Training procedures Purchasing records	Funding is available and accessible

Specific Objective	Activity	OVI	Means of Verification	Assumptions
				Stakeholders are receptive to training
4.8 Promote regional and international collaboration	**4.8.1** Set up training programme with Eastern Caribbean States (e.g., Grenada) to learn from best practice and facilitate knowledge sharing.	2023. Identification of key personnel for study visit. Study visits to Grenada undertaken.	Evaluation process showing no bias to candidates based on race, sex, etc. Evaluation process shows the most appropriate candidates are selected Field report	Funding is available and accessible Stakeholders are receptive
4.9 Investigate transportation routes	**4.9.1** Evaluate the most cost effective and efficient forms of transport from the fishery to market. Use of mobile vans with freezers/ice facilities is recommended.	2025. Transport vans with freezing facilities are used to link landing sites to market.	Purchasing records	Funding is available and accessible
4.10 Identify key export markets	**4.10.1** Identify the extent of the market and profit potential for international markets. Future key markets need to be identified before investment in expanding the offshore pelagic fishery.	2023. Identify key potential markets. Identify restricting factors for enhanced trade and marketing. Develop plan to reduce / remove restricting factors enabling enhanced trade and marketing.	Market report	Possible international markets exist
	4.10.2 Review opportunities for international trade (e.g., to the USA) including through the use of branch offices.	2024. Study completed on international trade routes.	Study report	
	4.10.3 Determine infrastructure and capacity required to support an international export market.	2024. Requirements identified and implemented, where needed.	Study report	Funding is available and accessible

Consulting services for the assessment of the potential for and development of management plan for artisanal longline fishing for offshore pelagics

Specific Objective	Activity	OVI	Means of Verification	Assumptions
4.11 Increase local demand for larger pelagic species in the domestic and hotel, restaurant and café (HORECA) sectors	**4.11.1** Conduct interviews with hotels, restaurants and local stakeholders to understand how large pelagics could be better utilized and the demand for pelagic species increased.	2023. Interview survey completed. Identify necessary requirements to increase consumption of pelagic species.	Study report	Domestic stakeholders are willing to increase consumption of pelagic species
	4.11.2 Promote value addition to meet the quality demand of medium and higher income product markets.	2024. Market research to be conducted to identity markets for products. Plan for value-added products in pelagic fisheries to be developed.	Plan developed Market research plan developed	
	4.11.3 Implement marketing strategy to promote the purchase of large pelagics domestically.	2024. Marketing strategy implemented. Increased domestic consumption of pelagic species.	Marketing strategy report and implementation report Survey to determine increase in consumption against a baseline	

7 Implementation arrangements

This FMP for offshore pelagic fishing will support Jamaica in sustainably harvesting under-utilized fisheries resources in a manner which is ecologically sound, economically efficient and socially equitable. Despite data limitations, assessments show that the status of pelagic stocks in Jamaica waters is generally good. Stock assessments by ICCAT for larger pelagics indicate that of the main large pelagic species caught in Jamaica, only marlins are of current concern. For species which have not had a stock assessment, a risk assessment was used to identify species that might be most at risk. Findings indicate that of the baitfish species, the needlefish were of concern, but this was primarily because there is a lack of even basic information on these species. Capacity assessment of onshore infrastructure including the suitability of vessels and market analysis show that these facilities are limited. Specific actions and activities have therefore been proposed to address these issues.

The principal implementation partners for this plan are the fishers/local communities and the fisheries authorities (NFA). Other stakeholders include ICCAT, the local households and hotels/restaurants (domestic market) and international market. As presented in the management plan, collaborations among these key stakeholder groups need to be strengthened to facilitate effective implementation. In the above sections, the priority level (high, medium or low) for each activity has been provided. However, the following actions have been pulled out as likely to be the most pertinent first steps in developing a pelagic fishery in Jamaica.

The following are key priority actions:

- Undertake a visit to Eastern Caribbean States (Grenada, Dominica) to learn best practice and facilitate knowledge sharing towards offshore pelagic fisheries. This visit could include NFA technical staff and fishers, and be used to examine all aspects surrounding the operations of the pelagic fishery such as existing infrastructure at landing sites, the type of vessels and gears utilized in the fishery, as well as fishing operations including the use of FADs.
- Undertake exploratory fishing targeting offshore pelagic species with good stock status. These would aim to test the suitability of vessels and gear (trolling/longlining) as well as markets for the catch and fish handling practices.
- Conduct a field study to determine the current conditions and facilities at landings sites that are capable of receiving pelagic catches. This will include surveying appropriate port facilities, repair, ice generation and freezer maintenance, land-based cold stores, bait management and transport infrastructure.
- Start a data collection programme targeting all offshore pelagics that are landed. The aim is to address the lack of data to use in stock assessments. This should focus on locally managed species but also consider those currently managed by ICCAT. For data-limited species data should be collected on length for a sufficient sample size (backed up by maturity-at-length, length-weight). Data on ICCAT-assessed species should match and exceed the requirements of ICCAT.
- Undertake market strategies to promote the consumption of large offshore pelagics domestically targeting households, hotels and restaurants.

It is not possible to identify the exact level of investment required to carry out activities stated above based on the information currently available. This would need to be reviewed once more data are collected. However, in regards to sources of funding, in many parts of the world, financial institutions play a major role in the social and economic development of nations with developing

or transitional economies. Financial support across these objectives could be provided by both domestic and foreign bodies, ranging from government bodies, large international financial institutions (e.g., the World Bank) to smaller environment funding NGOs (e.g., The Pew Charitable Trusts and WWF).

8 Climate change

As one of the largest Small Island Developing States (SIDS) in the Caribbean, Jamaica is considered particularly vulnerable to climate change due to its physical and socio-economic attributes (FAO 2019; Stennett-Brown et al., 2019). Climate associated stressors and risks threatening Jamaica include weather-related disasters such as hurricanes, rising sea levels, coral bleaching and declining fish stocks (Alexander et al., 2015), the impacts of which are felt across a wide range of sectors. The Jamaican Government regards climate change resilience and adaptation a high priority for the island and its people (Government of Jamaica, 2009).

Jamaica's coastline includes several habitats such as beach, rocky shore, sea grass beds, mangroves and coral reefs that provide a number of critical ecosystem services. Under future climate change, there is a high likelihood that these ecosystems will change due to higher frequency of intense storms, ocean acidification, sea surface temperatures and sea-level rise. Fishers are vulnerable to these events, and among other impacts, can experience substantial financial and economic losses from damage to their boats, gear, equipment and loss of income (Sainsbury et al., 2018; Tietze and Van Anrooy, 2018). Further, these marine and coastal ecosystems have an important function of coastal protection during adverse weather and extreme events, providing natural barriers to the coastline and helping to reduce wave power and erosion (Ferrario et al., 2014; Beck et al., 2018; Reguero et al., 2018). Healthy coral reefs are expected to provide greater coastal protection than those that are degraded, overexploited and in poorer condition (Reguero et al., 2018). The synergistic and cumulative effects of climate change may significantly alter the structure and function of coastal and marine environments, which in turn could influence their ability to deliver the critical ecosystem services currently supporting society. Sustainable fisheries management is therefore crucial to limit the negative impacts of fishing activities on reef systems, such as overexploitation of reef fish populations or damage from fishing gears, and it can help improve coral reef health, condition and maintain key ecosystem functions and services including shoreline protection (Darling and D'agata, 2017; Steneck et al., 2018).

By developing an offshore pelagic fishery, fishing effort will be redirected from the inshore areas and coral reefs helping to relieve pressure on these vulnerable environments. A reduction in pressure will allow reefs to recover and help strengthen their important ecosystem functions such as coastal protection. By developing an offshore fishery, Jamaica is positioning itself to maintain healthy coral reefs and promote resilience to climate change and increased coastal protection.

9 Communication Plan

A communication plan is important in the implementation of a FMP, in order to allow for an iterative and participatory process where consultation is ongoing. It is key that stakeholders are kept up-to-date with developments in the fishery, are properly consulted and that all decisions are made in a transparent manner in order for the management plan to be successful. At the time of writing, there were some information gaps that restrict a comprehensive communication strategy from being developed. This includes the identification of training and capacity building in certain areas, data collection on key species (target and bait) and further research to determine extent of the market and profit potential (for both domestic and international markets). Once more detail on these aspects have been collected, the communication plan can be further developed. This plan should be treated as a 'living' document that is constantly reviewed and revised as necessary, based on current scientific advice.

This section provides a focus on the key messages that should be included within the communication plan in an order to improve the ability of all stakeholders to work collaboratively and make decisions based on scientific evidence. By increasing transparency in decision making, it promotes the ownership of fisheries resources to local communities and stakeholders along the supply chain, thereby aiding uptake of management measures. Key stakeholders that should be included in the communication plan are included within Table 20, including the key messages and suggested methods.

Table 20 Key stakeholders and messages

Stakeholder Group	Key messages	Methods
Fishers/local communities	To raise awareness of the importance and need for a sustainably managed offshore pelagic fishery and associated baitfish fishery. To inform fishers to adopt responsible and sustainable fishing practices and encourage behavioral changes where needed. To ensure adherence and compliance to management measures. To reduce post-harvest loss and improve the quality of pelagic species caught.	Community fora Awareness and informative posters at landing sites Regular dialogue with NFA including feedback sessions Newsletters/published reports disseminated to communities Feedback of success stories e.g., video documentaries
Fisheries authorities	The need for sustainable fisheries management and decision making based on scientific evidence. Encouraging participation of stakeholders in decision-making and allowing for effective dialogue. Build awareness and support for management decisions.	Policy briefs Briefing reports Public meetings and feedback sessions Websites

Stakeholder Group	Key messages	Methods
NGOs	The need for sustainable fisheries management and decision making based on scientific evidence. The need for ecosystem approach to fisheries management to ensure protection of ETP species and vulnerable habitats.	Websites Advocacy campaigns Community fora
Domestic market (e.g., hotels and restaurants)	Support of a domestic pelagic fishery. The need for value addition and reduction in post-harvest loss.	Meetings Websites Emails Advertising/promotion campaigns Community fora
Potential international market	Increased hygiene and sanitation conditions are needed to support an international export market. Identification of possible trade routes. The need for value addition and reduction in post-harvest loss.	Meetings Websites Advertising/promotion campaigns Regional communication
ICCAT	Dissemination of latest scientific advice and research. Regional management measures for conservation of pelagic stocks.	Meetings Websites Regional communication

The FMP can be communicated to various audiences through written reports, papers, visual material (posters, pictures), oral presentations, mass media (newspapers, magazines, radio, television) and web sites. The FMP could also be discussed through various fora such as through group discussions or remote communications through online meetings. A robust communication plan should identify a series of key messages (e.g., new technical measures) and appropriate pathways (e.g., reports, radio announcement, posters, local meeting), with which to address specific target groups. This will require the maintenance of an active list of stakeholder contacts including representatives of the groups that must be kept informed of fisheries and environmental monitoring, enforcement and community development to support decision-making processes. The communication plan will identify the means and frequency of information delivery to ensure all stakeholders are kept updated. Web-based means of communication may be beneficial for some stakeholders but relies on penetration of web-based services into the community. Often for these communities, simple posters in authorised locations where people know they will be placed are the most effective, combined with word of mouth and regular scheduled community meetings.

A single communication and outreach plan should identify all stakeholders that need to understand how the pelagic FMP operates and to deliver important announcements (e.g., catch limit announcements) in a clear, well defined, timetabled fashion. The following table (Table 21)

provides an overview of the general objectives that should be included in a communication plan for an offshore pelagic fishery when more information is available. This includes why communication is needed, who it should be targeted at and how. Information to be relayed to different stakeholders will be the same for any particular area or objective, but the format and the means of delivery should be tailored according to the needs of the target audience. For example, scientific research gathered by universities or research institutes will be simplified for dissemination to fisher groups to improve ease of understanding.

It is important to also implement a monitoring and evaluation strategy, once key messages have been determined to ensure that the communication plan is achieving its objectives and intended purpose. This monitoring and evaluation plan should identify whether the plan is reaching its target audience in a timely manner, how effective are the communication tools and pathways and whether the plan needs to be updated.

Table 21 Communication Plan and Outputs

What?	Why?	Who is responsible?	Who communicated to?	How?
Disseminate latest scientific information and management measures based on the status of the pelagic and baitfish fisheries to key stakeholder groups	Stakeholders need to understand the reasons for certain decisions and management measures (e.g., implementation of a decision control rule)	NFA	ICCAT Local Fishers/Communities Supply chain actors (domestic and international market) NGOs (e.g., Caribbean Coastal Area Management Foundation, CCAM).	Scientific information and catch limit decisions to be clearly outlined to the relevant target audiences, noting that the same advice should be presented in a different fashion to high level managers and fishing communities. This should include community forums where stakeholders can provide feedback and input into management decisions.
Awareness creation on the need to effectively manage the offshore pelagic and baitfish fisheries and associated links to the ecosystem.	Stakeholders need to understand the need for long-term sustainability of the resources and ecosystem (including bycatch species)	NFA	Local fishers/Communities Research institutes NGOs	Awareness of ecosystem related issues should be highlighted to all fishing communities. This should include top predators such as tuna and shark species. All stakeholder groups that need to be informed of the ecosystem related issues should be identified in the plan, along with the announcements they should receive and when. Information could be disseminated in the form of awareness and sensitisation posters for fishers (e.g., current turtle dehooking and release posters).
Promote documentation and use of local knowledge and practices in management of the pelagic fisheries and environmental protection within them.	If there are systems to control fisheries in place locally, use and combine these with new tools. Introducing new tools or measures to replace old systems can cause friction. Combining with existing rules or systems	NFA	Local fishers/communities NGOs	Where local information on stock distribution, particularly for the locally managed species, exists in communities it is highly recommended that this information be captured and utilised in the stock description and where necessary to identify sub-stocks and boundaries. It can also be useful in participatory stock assessment processes where data are limited.

What?	Why?	Who is responsible?	Who communicated to?	How?
	may help ease their introduction.			
Changes in fisheries regulation or legislation	To ensure compliance when implementing specific management measures	NFA	Local fishers/communities Supply chain actors	Communicate changes in legislation and new regulations that are needed to facilitate implementation of the management plan.
Marketing strategy to increase demand and consumption of pelagic fish in the domestic and international market	To increase local demand from the tourist trade such as restaurants and hotels, as well as international exports.	NFA	Supply chain actors Local fishers	Communicate with potential buyers to highlight improvements in the fishery and quality of catch such as hygiene standards and gear handling practices.

10 References

Alvard, M., Carlson, D., McGaffey, E. 2015. Using a Partial Sum Method and GPS Tracking Data to Identify Area Restricted Search by Artisanal Fishers at Moored Fish Aggregating Devices in the Commonwealth of Dominica. PLoS ONE 10(2): e0115552. doi:10.1371/journal.pone.0115552

Aiken, K.A. & M.O. Haughton. 1987. Status of the Jamaica reef fishery & proposals for its management: Proc. Gulf & Carib. Fish. Inst. 39: 469-484

Aiken, K.A. 1993. Jamaica, i**In** Marine fishery Resources of the Antilles, Puerto Rico, Cuba, Jamaica and Hispaniola. FAO Fisheries Technical Paper 326:1160-1180

Aiken, KA. & G.A. Kong. 2000. The marine fisheries of Jamaica. Naga, The ICLARM Quarterly (Vol.23, No.1) January-March:29-35

Aiken, KA. & G.A. Kong. 2000. The marine fisheries of Jamaica. Naga, The ICLARM Quarterly (Vol.23, No.1) January-March:29-35

Aiken, K.A. 1993. Jamaica, In Marine fishery Resources of the Antilles, Puerto Rico, Cuba, Jamaica and Hispaniola. FAO Fisheries Technical Paper 326:1160-1180

Aiken, K.A., Kong G.A. & S. Smikle. 1997. Status of the fisheries and regulations regarding queen conch in Jamaica in 1996. Proc. Gulf & Carib. Fish. Inst. 49:485-498

Alexander, S., Armitage, D., Charles, A. (2015) Social networks and transitions to co-management in Jamaican marine reserves and small-scale fisheries. Global Environmental Change 35, 213–225. https://doi.org/10.1016/j.gloenvcha.2015.09.001

Anderson, J.; Gates, P.D. 1996. Fish Aggregation Device (FAD) Manual. Volume 1. Planning FAD Programmes. South Pacific Commission.

Apel, J.R. 1987. Principles of Ocean Physics. Int. Geogr. Series, Vol. 38, Academic Press Inc.

Ardill, J.D. Tuna fisheries in the southwest Indian Ocean.

Bakun, A. 1996. Patterns in the ocean: ocean processes and marine population dynamics. University of California Sea Grant (in cooperation with Centro de Investigaciones Biolgicas de Noroeste, La Paz, Baja California Sur, Mexico), San Diego. 323 p.

Beck, M.W., Losada, I.J., Menéndez, P., Reguero, B.G., Díaz-Simal, P. and Fernández, F. (2018) The global flood protection savings provided by coral reefs. Nature Communications, 9: 2186. https://doi.org/10.1038/s41467-018-04568-z

Blaxter, J. H. S., Hunter, J.R. 1982. The biology of the clupeoid fishes. Advances in Marine Biology. 20: 1–223.

Caribbean Natural Resources Institute (CANARI). 2020. Institutional analysis of enabling conditions for ecosystem stewardship in the fisheries sector of Jamaica. Barataria, Trinidad: CANARI

Cooper, A. 1981. Summary of FERP Troll fishing data, Cruises 0171/01-4073/02, Fisheries Ecology Research Project, UWI, Mona, Zoology Department:4pp

Coetzee, J.C., Merckle, D., Hutchings, L., van der Lingen, C.D., van den Berg, M., Durholtz, M.D. 2010. The 2005 KwaZulu-Natal sardine run survey sheds new light on the ecology of small fish off the east coast of South Africa. African Journal of Marine Science 32: 337–360.

Cortez-Zaragoza, E., Dalzell, P., Pauly, D. 1989. Hook selectivity of yellowfin tuna (*Thunnus albacares*) caught off Darigayos Cover, La Union, Philippines. Journal of Applied Ichthyology (1): 12-17.

Curran, D., Beverly, S. 2012. Effects of 16/0 circle hooks on pelagic fish catches in three south Pacific albacore longline fisheries. Bulletin of Marine Science. 88(3): 485 – 497.

Darling, E. S. and D'agata, S. (2017) Coral Reefs: Fishing for Sustainability. Current Biology, 27: 65–68. https://doi.org/10.1016/j.cub.2016.12.005

Dempster, T. and Kingsford, M.J. 2003. Homing of pelagic fish to fish aggregation devices (FADs): the role of sensory cues. Marine Ecology Progress Series. 258: 213-222.

Dempster, T. and Taquet, M. 2004. Fish aggregation device (FAD) research: gaps in current knowledge and future directions for ecological studies. Reviews in Fish Biology and Fisheries. 14: 21-42.

Diaz N., Druault-Aubin K., Frangoudes K., Guyader O., Knockaert C., Le Roy Y., Nelson L., Reynal L., Walters R., 2006. Main results from the work completed by the "Lesser Antilles" working group on the sustainable development of moored FADs, fishing and perspectives. http://www.magdelesa.eu/Documentation/ Action-1-Technologie-des-DCP

FAO 2019 - Fishery and Aquaculture Country Profiles – Jamaica

Ferrario, F., Beck, M.W., Storlazzi, C.D., Micheli, F., Shepard., C.C. and Airoldi, L. (2014) The effectiveness of coral reefs for coastal hazard risk reduction and adaptation. Nature Communications, 5: 3794. https://doi.org/10.1038/ncomms4794

Fréon, P., Misund, O.A. 1999. Dynamics of pelagic fish distribution and behaviour: effect on fisheries and stock assessment. Blackwell, Fishing News Book, London. 348 p.

Fréon, P., Dagorn, L. 2000. Review of fish associative behaviour: toward a generalisation of the meeting point hypothesis. Reviews in Fish Biology and Fisheries. 10: 183-207.

Fréon, P., Cury, P., Shannon, L., Roy, C. Sustainable exploitation of small pelagic fish stocks challenged by environmental and ecosystem changes: a review. 2005. Bulletin of Marine Science. 76(2): 385 - 462.

Gilman, E., Chaloupka, M., Swimmer, Y., Piovano, S. 2016. A cross-taxa assessment of pelagic longline bycatch mitigation measure: conflicts and mutual benefits to elasmobranchs. Fish Fish., doi: 10.1111/faf.12143.

Gilman, E.L., Musyl, M. 2018. Effects of pelagic longline hook size on species- and size-selectivity and survival. Reviews in Fish Biology and Fisheries. June 2018. DOI 10.1007/s11160-017-9509-7

Government of Jamaica (2009) Vision 2030 Jamaica: National Development Plan. Planning Institute of Jamaica, Kingston, Jamaica.

Guyader, O., Bellanger, M., Reynal, L., Demanèche, S., Berthou, P. 2013. Fishing strategies, economic performance and management of moored fish aggregating devices in Guadeloupe. Aquatic Living Resources. 26: 97 – 105. DOI: 10.1051/alr/20013044

Harvey, G.C.McN. 1986. A study of three species of clupeids (family Clupeidae) in Jamaican coastal waters. PhD thesis. Department of Zoology, Univ. of the West Indies, Mona campus, Faculty of Natural Sciences:522pp.

Harvey, G. C. McN. Aiken, K.A. & M.O. Haughton. 1986. A general overview of sportfishing and a summary of billfish data from Jamaican recreational fishery sources 1976-1986. Proc. Gulf & Carib. Fish. Instit. 39.

Haughton, M.O. & D.P.F. King. 1989. Stock assessment of spiny lobster in Jamaica. Proc. Gulf Carib. Fish. Inst.,42:119-126

Hindson, J., Hoggarth, D.D., Krishna, M., Mees, C.C., O'Neill, C., 2005. How to manage a fishery. A Simple Guide to Writing a Fishery Management Plan.

Holland, K.M., Brill, R.W., Chang, K.C. 1990. Horizontal and vertical movements of yellowfin and bigeye tuna associated with fish aggregation devices. Fishery Bulletin US. 88:493-507.

Humann, P. & N. Deloach. 2008. Reef fish identification Florida, Caribbean, Bahamas. 4th Edn.. New World Publications Inc. Fla.:547pp

Kawaguchi, K. 1974b. Handline and longline fishing explorations for snapper and related species in the Caribbean & Adjacent waters. Mar. Fish. Rev. 36(9):8-31

Kelly, R. O. 2001. An appraisal of the recreational fishery of Jamaica. Unpublished MSc. Thesis, Univ. of Hull, UK:94pp

Kingsford, M.J. 1999. Fish Aggregation Devices (FADs) and experimental designs. Scientia Marina. 63(3-4): 181-190

Kumar, K.V.A., Pravin, P., Meenakumari, B. 2016. Bait, bait loss, and depredation in pelagic longline fisheries – a review. Reviews in Fisheries Science and Aquaculture. 24(4), 295-304, DOI: 10.1080/23308249.2016.1162134

Lyons, W.G. 1980. The post larval stage of scyllaridean lobster. Fisheries, 5 (4):47-49

Mahon, R., G.A. Kong, and K.A. Aiken. 1992. A preliminary assessment of the conch fishery on the shelf and banks off the south coast of Jamaica. CARICOM Fishery Research Document No. 8.

Mahon, R. 1996. Analyses of ICCAT catch and effort data for ICCAT reporting squares which include parts of the EEZ of Jamaica. Prep. For Fisheries Div., MINAG Jamaica:4pp

Mahon, R. 1995. Fisheries for large pelagics in Jamaica: A review and options for development. Prepared for Fisheries Department, Ministry of Agriculture, Jamaica, under contract to The CARICOM Fishery Resources Assessment and Management Program: 46 pp.

Mahon, R. Rennie, J. Ryan, R. & S. Singh-Renton. 1992. Billfish catch and effort data from Barbados, Grenada, St. Lucia, & St. Vincent and the Grenadines. ICCAT SCRS/1992/68

McKuin, B., Watson, J.T., Stohs, S., Campbell, J.E. 2021. Rethinking sustainability in seafood: synergies and trade-offs between fisheries and climate change. Elementa: Science of the Anthropocene (2021) 9 (1): 00081.

Munro, J.L. 1969. The Jamaican fishing industry, Jamaica Journal, Instit. of Jamaica, Vol. 3. No.1

Munro, J.L. 1983. Coral reef fishery resources, ICLARM Studies & Reviews 7, Manila, Philippines, 276pp

Murray, A., Kenward, R. 2020. The status of bait fishery in the Kingston Harbour. National Fisheries Authority. [unpublished].

Nishida, T., Mohri, M., Itoh, K., Nakagome, J. 2005. Study of bathymetry effects on the nominal hooking rates of yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*Thunnus obesus*) exploited by the Japanese tuna longline fisheries in the Indian Ocean. Indian Ocean Tuna Commission Proceedings, 4: 191 – 206

Oswald, E.O. 1963. Developing an offshore fishery in Jamaica. Proc. Gulf & Carib. Fish. Inst. 15:134-139

Prado, J. 2002. A World Review of Fishing Techniques used in Association with Fish Aggregating Devices, in Small Scale Fisheries and Potential Interest for the Lesser Antilles Countries. Pages 121-144 in: FAO Fisheries Report N° 683, suppl. FAO, Rome, Italy. 295 pp.

Reguero, B.G., Beck, M.W., Agnostini, V.N., Kramer, P. and Hancock, B. (2018) Coral reefs for coastal protection: A new methodological approach and engineering case study in Grenada. Journal of Environmental Management, 210: 146–161. https://doi.org/10.1016/j.jenvman.2018.01.024

Sainsbury, N.C., Genner, M.J., Saville, G.R., Pinnegar, J.K., O'Neill, C.K., Simspon, S.D. and Turner, R.A. (2018) Changing storminess and global capture fisheries. Nature Climate Change, 8: 655–659. https://doi.org/10.1038/s41558-018-0206-x

Sakagawa, G.T., 1987. Effects of tropical tuna fisheries on non-target species. IPTP Coll. Vol. Work. Docs. 2: 179-194.

Schneider, E.V.C., Brooks, E.J., Cortina, M.P., Bailey, D.M., Killen, S.S., Van Leeuwen, T.E. 2021. Design, construction, and deployment of an affordable and long-lasting moored deep-water fish aggregation device. doi: https://doi.org/10.1101/2021.01.23.427792

Staples D and Funge-Smith, S., 2009. Ecosystem approach to fisheries and aquaculture: implementing the FAO code of conduct for responsible fisheries, RAP publication. Food and Agriculture Organization of the United States, Regional Office for Asia and the Pacific, Bangkok.

Steneck, R.S., Mumby, P.J., MacDonald, C., Rasher, D.B., and Stoyle, G. (2018) Attenuating effects of ecosystem management on coral reefs. Science Advances, 4: eaao5493. https://doi.org/10.1126/sciadv.aao5493

Stennett-Brown, R.K., Stephenson, T.S., Taylor, M.A., (2019) Caribbean climate change vulnerability: Lessons from an aggregate index approach. PLOS ONE 14, e0219250. https://doi.org/10.1371/journal.pone.0219250

Tietze, U. and Van Anrooy, R. (2018). Assessment of insurance needs and opportunities in the Caribbean fisheries sector, FAO Fisheries and Aquaculture Circular No. 1175. Rome, FAO. 62 pp.

Wagner, D.P. 1974. Results of live bait pole and line fishing explorations for pelagic fishes in the Caribbean. Mar. Fish. Rev. 36 (9):31-35

Wagner, D.P. & R.S. Wolf. 1974. Results of troll fishing explorations in the Caribbean. Mar. Fish. Review 36 (9):35-43