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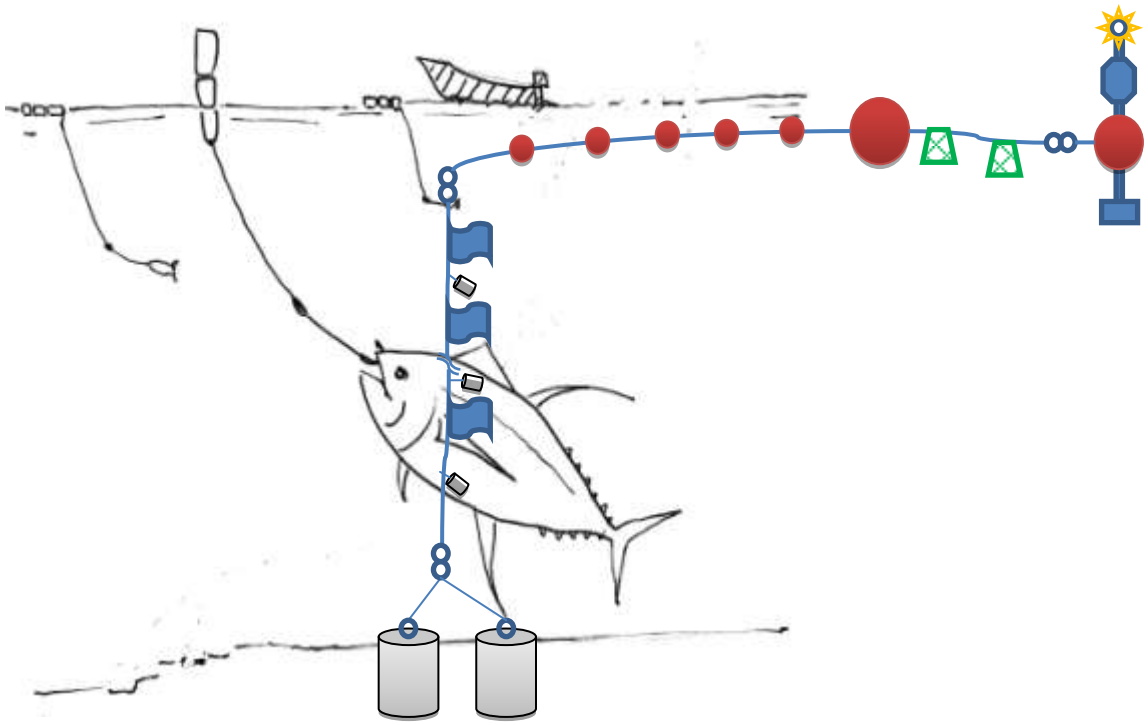
2015 DRAFT SUB-REGIONAL MANAGEMENT PLAN FOR FAD FISHERIES IN THE EASTERN CARIBBEAN (Stakeholder Working Document)



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2015 DRAFT SUB-REGIONAL MANAGEMENT PLAN FOR FAD FISHERIES IN THE EASTERN (Stakeholder Working Document)

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2015 DRAFT SUB-REGIONAL MANAGEMENT PLAN FOR FAD FISHERIES IN THE EASTERN CARIBBEAN (Stakeholder Working Document)

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EXECUTIVE SUMMARY

Fish Aggregating Devices (FADs) are moored or free-drifting (natural or artificial) floating objects deliberately placed in the ocean to attract and aggregate fish so as to facilitate their location and capture. Over the past three decades, there has been a rapid *ad hoc* development of the FAD fishery in CRFM Member States through the use of moored FADs. In light of this, there has been growing recognition of the need for a harmonized sub-regional approach to the FAD fishery, consistent with one of the main objectives of the Caribbean Community Common Fisheries Policy (CCCFP).

A Sub-regional Management Plan for FAD Fisheries in the Caribbean Regional Fisheries Mechanism (CRFM) Member States, with specific focus on moored FADs, has been drafted by reviewing the outputs of the regional workshops on FADs, CRFM scientific meetings, and technical reports and outputs produced within the CARIFICO and MAGDELESA projects.

This sub-regional management plan aims to guide specifically the fishery that is represented by the small-scale artisanal fishers whose livelihoods are significantly supported by fishing large oceanic and coastal pelagic species on moored FADs using small (<9m) un-decked vessels. These small-scale artisanal fishers represent the majority of fishers making use of moored FADs in the CARICOM region and are at the core of the rapid current development of this type of small-scale fishery.

The sub-regional management plan aims to assist the concerned stakeholders in implementing an ecosystem-based approach to fisheries management that recognizes the strong links between the coastal and oceanic environments, and to contribute to efficient fishing activities on moored FADs within an economically viable and competitive small-scale fisheries sector, providing a fair standard of living for those who depend on fish resources exploited on moored FADs. The geographic scope of the sub-regional management plan is given by the insular and continental CARICOM states which are members of the CRFM.

The overall management objective is to help small scale fishers to improve their revenues by more efficiently fishing offshore pelagic resources, whilst (1) reducing fishing pressure on coastal resources; (2) ensuring responsible, safe, and sustainable fishing practices; (3) minimizing interference with other users; and (4) rationalising the development of this fishing method across the region's shared stocks.
The management advice that ensues from this sub-regional management plan is given below:

- Any further development of the moored FAD fishery in the sub-region should commit to the application of a precautionary approach to fisheries management.
- For tunas and tuna-like species typically caught on moored FADs and which are currently actively managed by ICCAT, CRFM Member States engaged in the moored FAD fishery and not yet party to the ICCAT, should either become parties individually, or mandate CARICOM itself to become a party to facilitate their active engagement in the decision-making process for those species that are currently actively managed by ICCAT.
- For those small tuna or tuna-like species that also fall under the ICCAT mandate and are caught on moored FADs, but which are not currently actively managed by ICCAT, management will be best achieved through a formal management partnership arrangement between ICCAT and one or more Regional Fisheries Bodies (RFBs) such as CRFM.
    - The relevant RFBs within the sub-region would cooperate in the preparation of management plans for specific small tunas and tuna-like species. These species-specific sub-regional management plans will inform the sub-regional management plan for the moored FAD fishery, which would operate transversally across the range of exploited species.

- National fisheries laws of all of the states should be reviewed to ensure that they conform to modern fisheries management standards.
- National laws should fully implement the treaty obligations assumed by each state
- National Regulations related to fisheries statutes should be enacted and implemented (as permitted by the relevant Fisheries Act), and updated where necessary.
- Fisheries management plans should be reviewed and updated, and where no such management plan exists, one should be created and brought into force as a matter of urgency.
- Principles and best practices from non-binding instruments should be formally set out in national legislation.
- National fisheries and environmental legislation should be harmonized within the region.
- Efforts should be made to delimit all maritime boundaries.
- To the extent that it is possible, national-level management measures should be aligned with those recommended by ICCAT, while being mindful that current ICCAT measures do not directly apply to the small-scale artisanal moored FAD fishery in the sub-region. As such:
    - Catches of large pelagics on FADs should be carefully monitored and that this monitoring should be done in a way that complies with the minimum data requirements requested by ICCAT.
    - CRFM Member States should prepare national level FAD fishery management plans, and put in place appropriate legislation to support the implementation of these plans:
        - Provisions specifically regulating the use of moored FADs need to be incorporated into national legal instruments and should be aligned with a clear policy stand on the use of private individual, private collective and public FADs;
        - Provisions must consider the following aspects: minimum standards for FAD design; authorization for deployment of FADs as well as reporting and disposal of unauthorized FADs; registration of FADs; reporting of FAD losses and replacement; FAD user license and license fees; required provision of catch and effort data by FAD users; fishing techniques and rules on FADs; responsibilities of the different management organizations in the FAD fishery; designations of areas closed to FAD fishing; maximum FAD deployment density; minimum distance separating moored FADs; rules governing commercial versus recreational use of FADs; vessel specifications for FAD deployment; prohibition of transshipment at sea of fish caught on FADs; composition of the catch on FADs; control of fishing pressure on nearshore/reef resources by FAD users; rules governing user access to private and public FADs; arbitration mechanisms in the case of conflicts; maximum number of private FADs per fisher.
    - A licensing system for FAD fisheries should be implemented. Fishers making use of moored FADs should register as FAD fishers at the appropriate Fishery agency and apply and pay for a license to fish on FADs:
        - The licensing system could constitute an instrument to restrict the current open access to the FAD fishery;
        - The license fee could contribute to the funding of FADs;
- Efforts should be undertaken to improve fisheries infrastructure at landing and market sites and value addition of target species, as well as to improve the access of the pelagic fisheries sector to adequate institutional credit and insurance facilities.
- Efforts should be undertaken to provide appropriate training in fish handling and sanitary and phytosanitary measures to all actors involved in the handling of target species along the chain of commercialisation associated with moored FADs.
- A co-management approach to the moored FAD fishery should be promoted:

    - The present functioning and structure of national Fisheries Advisory Committees should be revised to assure participation of all fisheries sub-sectors. Stakeholders from other sectors than fisheries, who have an impact or interest in species targeted on moored FADs and the related pelagic ecosystem, should also be represented.
    - Impact and outcomes of management decisions on fish stocks exploited on moored FADs, stakeholders and marine ecosystem should be regularly reviewed at the national and regional levels.
    - The integration and participation of fishers in the decision-making process as well as in the management activities should be improved:
        - Fisherfolk associations and cooperatives should be strengthened.
        - Fisherfolk associations should play a critical role in defining institutional roles and stakeholder rights and duties within the moored FAD fishery and in identifying and implementing best management practices.
        - Where applicable, Member States should make use of existing legal provisions for engagement of fisher organizations in the governance of fisheries.
    - During implementation of the FAD fishery management plan, consultative processes will be used to facilitate participation of stakeholders in the monitoring and adaptation or adjustment of the management plan.
- This FAD fishery management plan will be in effect for a period of 5 years from the date of endorsement by the CRFM Ministerial Council.
- Control and surveillance of moored FAD fisheries will be carried out by the national fisheries authorities in close cooperation with the Caribbean Fisheries Forum, and eventually any agreed management partnership arrangement with ICCAT.
- National fisheries authorities as well as national monitoring, control, surveillance and enforcement agencies will have to be provided with the requisite resources to facilitate effective implementation of the plan.
- Financing the implementation of this sub-regional moored FAD fishery management plan will largely be done at the national level.
- The monitoring of the plan will be coordinated initially by the CRFM through its Pelagic Fisheries Working Group, supported by the participation of States having a real interest in moored FADs, together with scientific observers and representatives of both the CRFM and WECAFC Secretariats

The sub-regional fisheries management plan encourages research aimed at strengthening the moored FAD fishery. Proposed studies include, among others, the following topics: the social and economic status of moored FAD fishers and other stakeholders; the governance structures facilitating sustainable moored FAD fisheries; the contribution of moored FAD fishery to food security and to poverty alleviation; the contribution of moored FAD fishery to fishing mortality; the factors influencing fishing strategies (private versus public FADs); the factors contributing to the variability in profitability in the moored FAD fishery; the indirect effects of the moored FAD fishery on the nearshore/reef resources; the selectivity of fishing techniques on moored FADs; the effect that handling large fishes on small vessels has on product quality and safety at sea; and the technological aspects influencing moored FAD lifespan.

SOMMAIRE

Les dispositifs de concentration de poissons (DCP) sont des objets flottants (naturels ou artificiels) ancrés ou dérivants qui sont placés délibérément dans l'océan afin d'attirer et concentrer les poissons pour faciliter leur emplacement et leur capture. Au cours des trois dernières décennies, il y a eu un développement *ad hoc* et rapide de la pêche sur DCP ancré dans les états membres du CRFM par l'utilisation. Dans ce contexte, il a été mis en évidence la nécessité d'une approche sous régionale harmonisée de la pêche sur DCP, en accord avec l'un des principaux objectifs de la politique commune de la pêche de la communauté des Caraïbes (CCCFP).

Pour ce faire, un plan de gestion sous régional pour la pêche sur DCP dans les états membres du CRFM, avec une attention particulière sur les DCP ancrés, a été rédigé à travers l'examen des résultats des ateliers régionaux sur les DCP ancrés, les réunions scientifiques du CRFM, et des rapports techniques et extrants produits au sein des projets CARIFICO et MAGDELESA.

Ce plan de gestion sous régional vise à guider spécifiquement la pêche qui est représenté par les pêcheurs artisanaux à petite échelle dont les moyens de subsistance sont nettement soutenus par la pêche de grands pélagiques océaniques et côtiers sur des DCP ancrés à l'aide de petites embarcations (<9m) non pontées. Ces pêcheurs artisanaux à petite échelle représentent la majorité des pêcheurs qui utilisent des DCP ancrés dans la région de la CARICOM, et sont au cœur du développement rapide actuel de ce type de pêche.

Le plan de gestion sous régional vise à aider les parties concernées à mettre en œuvre une approche fondée sur l'écosystème pour la gestion de la pêche, qui reconnaît les liens étroits entre les milieux côtiers et océaniques, et à contribuer efficacement aux activités de pêche sur DCP ancrés dans un secteur de la pêche à petite échelle qui soit économiquement viable et compétitif, en fournissant un niveau juste de vie à ceux qui dépendent des poissons comme ressources exploitées sur les DCP ancrés. La portée géographique du plan de gestion sous régional est déterminée par les États insulaires et continentaux de la CARICOM qui sont membres du CRFM.
L'objectif principal du plan de gestion sous régional est d'aider les pêcheurs artisanaux à améliorer leurs revenus en utilisant plus efficacement les ressources pélagiques du large, tout en (1) réduisant la pression de pêche sur les ressources côtières; (2) assurant des pratiques de pêche responsables, sécuritaires et durables; (3) minimisant les interférences avec d'autres utilisateurs; et (4) rationalisant le développement de cette méthode de pêche vis-à-vis les stocks de poissons pélagiques partagés de la région.
Les conseils de gestion qui découlent de ce plan de gestion sous régional sont les suivants :

- Tout autre développement de la pêche sur DCP ancré dans la sous-région devrait s'engager à appliquer une approche de précaution pour la gestion des pêches.
- Pour les thons et les espèces de thonidés généralement pêchés sur DCP ancrés et qui sont actuellement gérés activement par la CICTA, les États membres du CRFM pratiquant la pêche sur DCP ancré et qui ne sont pas encore signataire à la CITCA, devraient soit devenir signataire individuellement, ou mandater CARICOM lui-même pour devenir signataire à la CITCA, afin de faciliter leur participation active dans le processus de prise de décision pour les espèces qui sont actuellement gérés activement par la CITCA.
- Pour les petites espèces de thons ou thonidés qui font également partie du mandat de la CITCA et qui sont pêchés sur les DCP ancrés, mais qui ne sont pas actuellement gérés par la CITCA, la gestion serait mieux assurée par une entente formelle de partenariat de gestion entre la CITCA et un ou plusieurs organismes régionaux de pêche (ORP), tel que CRFM.

- Les ORP concernés dans la sous-région devraient coopérer à la préparation des plans de gestion pour les petits thonidés et les espèces spécifiques de thonidés. Ces plans de gestion sous régionaux spécifiques aux espèces informeront le plan de gestion sous régional pour la pêche sur DCP ancré, qui fonctionnerait de façon transversale à travers la gamme d'espèces exploitées.

- Les lois nationales de la pêche de tous les États devraient être revues afin de s'assurer qu'elles sont conformes aux normes de gestion des pêches modernes.
- Les législations nationales devraient pleinement mettre en œuvre les obligations des conventions assumées par chaque État.
- Les règlements nationaux relatifs aux lois de la pêche devraient être adoptés et mises en œuvre (comme le permet la Loi pertinente sur les pêches), et mis à jour le cas échéant.
- Les plans de gestion des pêches devraient être revus et mis à jour, et au cas où aucun plan de gestion n'existe, celui-ci devrait être crée et mis en vigueur de façon urgente.
- Les principes et bonnes pratiques d'instruments non contraignants devraient être formellement énoncés dans la législation nationale.
- Les pêcheries nationales et la législation de l'environnement devraient être harmonisées au sein de la région.
- Des efforts devraient être faits pour délimiter toutes les frontières maritimes.
- Dans la mesure où il est possible, des mesures de gestion au niveau national devraient être alignées avec celles recommandées par la CITCA, tout en reconnaissant que les mesures actuelles de la CITCA ne sont pas directement applicables à la pêche artisanale à petite échelle sur DCP ancré qui est pratiquée dans la sous-région. En tant que tel :
    - Les captures de grands pélagiques sur DCP devraient être soigneusement suivies et ce suivi te devrait être fait d'une manière qui respecte les exigences minimales de données requises par la CITCA.
    - Les États membres du CRFM devraient préparer des plans de gestion de la pêche sur DCP au niveau national, et mettre en place une législation appropriée pour appuyer la mise en œuvre de ces plans:
        - Les dispositions régissant spécifiquement l'utilisation des DCP ancrés doivent être incorporés dans des instruments juridiques nationaux et devraient être alignés avec une politique national claire vis-à-vis l'utilisation de DCP particuliers privés, collectifs privés et publics;
        - Ces dispositions doivent considérer les aspects suivants : les normes minimales pour la conception et construction des DCP; les formalités concernant l'autorisation pour le déploiement des DCP ainsi que le rapport et l'élimination des DCP non autorisés; les formalités concernant l'enregistrement des DCP; les formalités concernant les pertes de DCP et les remplacements; la licence d'utilisateur de DCP et le paiement de la licence; l'obligation de fournir des données de capture et d'effort de pêche par les utilisateurs de DCP; les techniques de pêche et des règles de pêche sur les DCP; les responsabilités des différents organismes de gestion de la pêche sur DCP; les désignations de zones fermées à la pêche sur DCP; la densité maximale de déploiement de DCP; la distance minimale séparant les DCP ancrés; les règles régissant l'utilisation commerciale versus l'utilisation sportive des DCP; les caractéristiques des embarcations pour le déploiement de DCP; l'interdiction de transbordement en mer des poissons capturés par DCP; la composition des captures sur DCP; le contrôle de la pression de pêche sur les ressources côtières et récifales par les utilisateurs des DCP; les règles régissant l'accès aux DCP privés et publics; les mécanismes d'arbitrage dans le cas de conflits; le nombre maximal de DCP privés par pêcheur.

    - Un système de licences pour la pêche sur DCP devrait être mis en œuvre. Les pêcheurs utilisant des DCP ancrés devraient s'enregistrer en tant que pêcheurs sur DCP avec l'agence des pêcheries appropriée et appliquer et payer pour une licence pour pêcher sur DCP.
        - Le système de licence pourrait devenir un instrument pour limiter l'accès libre à la pêche sur DCP ancré qui se pratique présentement;
        - Le paiement de la licence pourrait contribuer au financement des DCP ancrés;
- Des efforts doivent être faits pour améliorer les infrastructures de la pêche sur les sites de débarquement et de marché de poisson et pour améliorer la valeur ajoutée des espèces cibles. Des efforts doivent être faits aussi pour améliorer l'accès du secteur de la pêche pélagique aux instituts de crédit et d'assurance institutionnels adéquats.
- Des efforts devraient être entrepris pour fournir une formation appropriée sur la manipulation des poissons et sur les mesures sanitaires et phytosanitaires à tous les acteurs impliqués dans la manipulation des espèces ciblées par la pêche sur DCP ancré tout au long de la chaîne de commercialisation.
- Une approche de cogestion de la pêche sur DCP ancré devrait être encouragée :
    - Le fonctionnement actuel et la structure des Comités consultatifs nationaux des pêches devrait être révisé pour assurer la participation de tous les sous-secteurs de la pêche. Les intervenants des secteurs autres que celui de la pêche, ayant un impact ou un intérêt dans les espèces ciblées sur les DCP et liés à l'écosystème pélagique, devraient également être représentés.
    - L'impact et les résultats des décisions de gestion sur les stocks de poissons exploités sur DCP ancrés, sur les intervenants et sur l'écosystème marin devraient être régulièrement révisés aux niveaux national et régional.
    - L'intégration et la participation des pêcheurs dans le processus de prise de décision ainsi que dans les activités de gestion doivent être améliorées :
        - Les associations de pêcheurs et les coopératives doivent être renforcées.
        - Les associations de pêcheurs devraient jouer un rôle essentiel dans la définition des rôles institutionnels et des droits et devoirs des parties prenantes au sein de la pêche sur DCP et dans l'identification et la mise en œuvre des pratiques de gestion optimales.
        - En cas échéant, les États membres devraient faire usage des dispositions légales existantes pour l'implication des organisations de pêcheurs dans la gouvernance des pêches.
    - Au cours de la mise en œuvre du plan de gestion de la pêche sur DCP, les processus de consultation seront utilisés pour faciliter la participation des parties prenantes dans le suivi et l'adaptation ou l'ajustement du plan de gestion.
- Ce plan de gestion de la pêche sur DCP sera en vigueur pour une période de 5 ans à compter de la date d'approbation par le Conseil ministériel du CRFM.
- Le contrôle et la surveillance de la pêche sur DCP ancrés seront effectués par les autorités nationales de la pêche en étroite coopération avec le Forum des pêches des Caraïbes, et, éventuellement, tout accord de partenariat de gestion convenu avec la CITCA.
- Les autorités nationales de la pêche ainsi que les organismes nationaux de surveillance, contrôle et renforcement devront être équipés avec les ressources nécessaires pour faciliter la mise en œuvre efficace du plan.
- Le financement de la mise en œuvre de ce plan sous régional de gestion des pêches sur DCP ancré sera fait en grande partie au niveau national.
- Le suivi du plan sera coordonné initialement par le CRFM par le biais de son Groupe de travail sur les pêches pélagiques, appuyé par la participation des États ayant un intérêt réel dans les DCP ancrés, ainsi que des observateurs scientifiques et représentants du CRFM et les secrétariats de la COPACO.

Le plan de gestion de la pêche sous régionale encourage des lignes de recherche visant à renforcer la pêche sur DCP ancré. Les études proposées incluent, entre autres, les thématiques suivantes : le statut social et économique des pêcheurs et des autres acteurs impliqués dans le pêche sur DCP ancré; les structures de gouvernance facilitant la pêche durable sur DCP ancré; la contribution de la pêche sur DCP ancré à la sécurité alimentaire et à la lutte contre la pauvreté; l'impact de la pêche sur DCP ancré sur la mortalité des espèces ciblées et en relation aux autres types de pêche; les facteurs qui influencent l'adoption de différentes stratégies de pêche (DCP privés versus DCP publics); les facteurs qui contribuent à la variabilité de la rentabilité de la pêche sur DCP ancré; les effets indirects de la pêche sur DCP ancré sur les ressources côtières et récifales; la sélectivité des techniques de pêche sur DCP ancrés; l'effet que la manipulation de grands poissons sur de petites embarcations a sur la qualité des produits et la sécurité en mer; et les aspects technologiques qui influencent la durée de vie des DCP.

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LIST OF ACRONYMS

ACS	Association of Caribbean States
CARICOM	Caribbean Community and Common Market
CARIFICO	Caribbean Fisheries Co-Management Project
CCCFP	Caribbean Community Common Fisheries Policy
CDB	Convention on Biological Diversity
CFO	Chief Fisheries Officer
CIA	Central Intelligence Agency
CITCA	Commission Internationale pour la Conservation des Thonidés de l'Atlantique
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLME	Caribbean Sea Large Marine Ecosystem
COPACO	Commission des Pêches pour l'Atlantique Centre-Ouest
CPC	Contracting parties and Cooperating non-Contracting Parties, Entities or Fishing
CPUE	Catch Per Unit Effort
CRFM	Caribbean Regional Fisheries Mechanism
CRPM	Comité Régional des Pêches Maritimes
EC	Eastern Caribbean
EEZ	Exclusive Economic Zone
EU	European Union
FAC	Fisheries Advisory Committees
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization
FAOSLC	Food and Agriculture Organization Subregional Office for the Caribbean
FL	Fork Length
FMP	Fisheries Management Plan
GPS	Global Positioning System
ICCAT	International Convention Commission for the Conservation of Atlantic Tuna
ICRW	International Convention for the Regulation of Whaling
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer
ILO	International Labour Organization
IOCARIBE	Regional subsidiary body of UNESCO Intergovernmental Oceanographic
IUCN	International Union for Conservation of Nature and Natural Resources
IUU	Illegal, Unreported and Unregulated
IWC	International Whaling Commission
JICA	Japan International Cooperation Agency
LBS	Land-Based Sources and Activities Protocol
LJFL	Lower Jaw Fork Length
LPWG	Large Pelagic Fish Resource Working Group
MAGDELESA	Moored fish AGgregating DEvice in the LESser Antilles project
MARPOL	International Convention on the Prevention of Marine Pollution from Ships
MCS	Monitoring, Control and Surveillance
MEA	Multinational Environmental Agreements

MFC	Mission Française de Cooperation
MOU	Memorandum of Understanding
NAFCOOP	National Association of Fisherman Cooperatives
NBC	North Brazil Current
NFO	National Fisherman Organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OECS	Organisation of Eastern Caribbean States
OSPESCA	Organización del Sector Pesquero y Acuícola del Istmo Centroamericano
PP	Polypropylene
PVC	Polyvinyl chloride
RAMSAR	Convention on Wetlands of International Importance especially as Waterfowl Habitat;
RFB	Regional Fishery Body
SAP	Strategic Action Programme
SCRS	Standing Committee on Research and Statistics
SIDS	Small Island Developing States
SLASPA	Saint Lucia Air and Sea Ports Authority
SPAW	Protocol for Specially Protected Areas and Wildlife
SPS	Sanitary and Phytosanitary
UK	United Kingdom
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environmental Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCC	United Nations Framework Convention on Climate Change
US	United States
UWI	The University of the West Indies
WCR	Wider Caribbean Region
WECAFC	Western Central Atlantic Fishery Commission
WG	Working Group
WSSD	World Summit on Sustainable Development

1. PREFACE

One of the objectives of the Caribbean Community Common Fisheries Policy (CCCFP) is the development of harmonized measures and operating procedures for sustainable fisheries management, post-harvest practices, fisheries research and fisheries trade and the administration of the fishing industry. The CCCFP is guided by the principle of applying internationally recognized standards and approaches, in particular the ecosystem approach and the precautionary approach to fisheries management. With the aim of harmonizing the management of shared fishery resources across the CARICOM region, a sub-regional management plan for the flyingfish fishery in the Eastern Caribbean has recently been adopted and a sub-regional management plan for blackfin tuna in the Eastern Caribbean has already been drafted.

In light of the rapid *ad hoc* development of the moored FAD fishery in the region, there has been growing recognition of the need for a harmonized sub-regional approach to the moored FAD fishery. As such, CRFM issued terms of reference for the development of a draft sub-regional management plan This plan has been drafted by reviewing the outputs of the regional workshops on FADs as well as various CRFM annual scientific meetings and technical reports and draft national—level FAD management plans produced within the CARIFICO project and research outputs from IFREMER and WECAFC (Le Gall et al. 1999, FAO 2002a, b, 2007, CRFM/JICA 2011, CRFM 2013d, c, Guyader et al. 2015, Reynal et al. 2015a, Reynal et al. 2015b).

The plan is to be reviewed by the full range of stakeholder in CRFM Member States for which the fishery is a real interest, to review the issues and proposed management measures, and to agree on the specific management objectives, indicators and reference points in keeping with the EAF approach to fisheries management.

This sub-regional management plan is not a legally binding instrument. The plan can be modified at any time and does not restrict the national authorities' discretionary powers set out in the national Fisheries Acts of the participating countries. The national authorities can, for reasons of conservation or for any other valid reasons, propose modifications of any provision of this plan. The Sub-regional Management Plan for FAD Fisheries in the Caribbean Regional Fisheries Mechanism (CRFM) Member States, once adopted, will be in effect for 5 years from the date of endorsement by the CRFM Ministerial Council.

This document has been drafted by Henri Vallès, with editorial assistance from Anne Desrochers. Throughout its different versions it has received inputs from Hazel Oxenford (UWI-Cave Hill), Elizabeth Mohammed, Peter Murray and Susan Singh-Renton (CRFM Secretariat), Crafton Isaac (Grenada's Fisheries Division), Jullan Defoe and Derrick Theophille (Dominica's Fisheries Division), Raymon vanAnrooy and Nikola Simpson (FAOSLC), Seon Ferrari (Saint Lucia's Fisheries Department), Cylena Andrews (Saint Vincent and the Grenadines' Fisheries Division), and Lionel Reynal (IFREMER).

2. SCOPE AND MISSION

Fish Aggregating Devices (FADs) are moored or free-drifting (natural or artificial) floating objects deliberately placed in the ocean to attract and aggregate fish so as to facilitate their location and capture. This sub-regional management plan aims to guide specifically the fishery that is represented by the small-scale artisanal fishers whose livelihoods are significantly supported by fishing large oceanic and coastal pelagic species on moored FADs using small (<9m) un-decked vessels. These small-scale artisanal fishers represent the majority of fishers making use of moored FADs and are at the core of the rapid current development of this type of small-scale fishery in the CARICOM region.

Nevertheless, this plan will also be of relevance to other fishing activities targeting tuna and tuna-like species that can make use of moored FADs, such as sports fishing and the long-line fishery. It will also be of relevance to the fisheries that make use of drifting FADs such as the small-scale flyingfish fisheries of the Lesser Antilles (CRFM 2014c) as well as the semi-industrial and industrial scale fisheries for tunas, including the purse-seine and bait-boat fisheries, even though the former is restricted geographically to the area around Venezuela and not used by CRFM Member States, and the latter is not well developed in the Caribbean region (FAO 2004).

The geographic scope of the sub-regional management plan is given by the insular and continental CARICOM states which are members of the CRFM, although considerable documentation and experience has been drawn from the French Antilles and other non-CRFM Member States within the Caribbean region. Thus, this plan will be of general relevance to all States and overseas territories within the Caribbean region making use of moored FADs.

The sub-regional management plan aims to assist the concerned stakeholders to implement an ecosystem-based approach to fisheries management that recognizes the strong links between the coastal and oceanic environments, and to contribute to efficient fishing activities on moored FADs within an economically viable and competitive small-scale fisheries sector, providing a fair standard of living for those who depend on fish resources exploited on moored FADs.

3. GUIDING PRINCIPLES AND VISION FOR THE FUTURE

This plan is based on the following guiding principles:

1. The fundamental principles of the Caribbean Community Common Fisheries Policy (CCCFP), as described in Article 5 of the Agreement establishing the CCCFP:
    a. use of the best available scientific information in fisheries management decision-making, taking into consideration traditional knowledge concerning the resources and their habitats as well as environmental, economic and social factors;
    b. application of internationally recognized standards and approaches, in particular the precautionary approach to fisheries management and the ecosystem approach to fisheries management;
    c. the principle that the level of fishing effort should not exceed that commensurate with the sustainable use of fisheries resources;
    d. the participatory approach, including consideration of the particular rights and special needs of traditional, subsistence, artisanal and small- scale fishers;
    e. principles of good governance, accountability and transparency, including the equitable allocation of rights, obligations, responsibilities and benefits; and
    f. the principle of subsidiarity, in particular that the Competent Agency will only perform those tasks which cannot be more effectively achieved by individual Participating Countries.

2. The guidelines from the 1995 FAO Code of Conduct for Responsible Fisheries, and especially Article 7 of the Code on Fisheries Management.

3. National Authorities responsible for fisheries management in the participating countries carry the main responsibility for implementing this sub-regional management plan within their national jurisdictions and for monitoring the status of implementation against the objectives and indicators agreed upon. However, it is recognized that a successful implementation of the sub-regional

management plan will require the full participation of all stakeholders during the decision-making processes and during the implementation of the ensuing management actions.

In line with the vision outlined for the sub-regional management plan for the blackfin tuna fishery, and as an integral part of the larger fishery for oceanic and coastal pelagics, the overall vision for the moored FAD fishery of the CARICOM Region "*encompasses healthy marine ecosystems that are adequately valued and protected through robust, integrative and inclusive governance arrangements at local, national, sub-regional and regional levels, which effectively enable adaptive management and which maximize, in a sustainable manner, the provision of goods and services in support of enhanced livelihoods and human well-being*" (Tietze and Singh-Renton 2012).

Consistent with the Caribbean Community Common Fisheries Policy, this vision will be achieved through an effective cooperation and collaboration among participating countries in the conservation, management and sustainable utilization of oceanic and coastal pelagic resources in the Caribbean so as to ensure the maximum benefits from those resources for the people and for the Caribbean region as a whole.

The sub-regional management plan aims to promote the responsible use of moored FADs to maximise benefits to fishers whilst not compromising their safety; or the sustainability of the pelagic stocks targeted; or the associated ecosystems. The objective of the sub-regional plan for the moored FAD fishery is aligned with the general objectives for the pelagic fisheries ecosystem for the CLME, which can be divided into ecosystem quality and societal benefit objectives (CLME 2013). These general objectives are related to three key trans-boundary issues, i.e. unsustainable fisheries, habitat degradation and community modification, and pollution (Table 1).

Table 1- Objectives and Strategic Directions for the Pelagic Fisheries Ecosystem for the Strategic Action Plan of the CLME (CLME 2013)

	Objective	Trans-boundary issue		
		Unsustainable fisheries	**Habitat degradation and community modification**	**Pollution**
Ecosystem Quality	Conservation, and restoration where necessary, of the health of the pelagic ecosystem within the WCR.	Protection, and restoration where necessary, of the health and natural balance of exploited fish populations occurring within the marine ecosystem, adopting a precautionary management strategy, as needed.	Conservation, and restoration where necessary, of the natural structure and function of the ecosystem, biological diversity, and ecosystem resilience, adopting a precautionary management strategy, as needed.	Conservation, and restoration where necessary, of the health of the aquatic environment, with emphasis on guaranteeing agreed standards of water and habitat quality.
Societal Benefit	Provision of goods and services by the pelagic ecosystem such that it contributes to societal development needs of the WCR, and to preservation of the associated aesthetic, traditional, health, educational and scientific values.	Sustainable and optimal use of living marine resources, for meeting the region's food and nutrition security needs, and other social and economic benefits associated with such exploitation.	Responsible and sustainable management of pelagic ecosystem goods and services, for fulfilling social and economic development needs, while also preserving the full aesthetic, traditional, cultural, health, educational and scientific values of such goods and services.	Fulfillment of social and economic development objectives, through responsible management of environmental health, necessary for preventing risks to human health and well-being.

4. GEOGRAPHY

4.1 PHYSICAL GEOGRAPHY, CLIMATE, AND OCEANOGRAPHY IN THE CARIBBEAN LARGE MARINE ECCOSYSTEM (CLME)

The Caribbean Large Marine Ecosystem (CLME) is a tropical semi-enclosed sea located between the Lesser and Greater Antilles island chain (eastern bound), South and Central America (southern and western bounds, respectively) and the Florida Keys and the Bahamas archipelago (northern bound) (Figure 1). The CLME covers a total area of approximately 3,300,000 km^2, of which approximately 250,000 km^2 represent shelf area[1]. This region is also known as the Wider Caribbean Region (WCR) and represents the second largest sea in the world. The CLME includes four deep basins, i.e. the Venezuelan Basin, the Colombian Basin, the Cayman Trough and the Yucatan Basin.

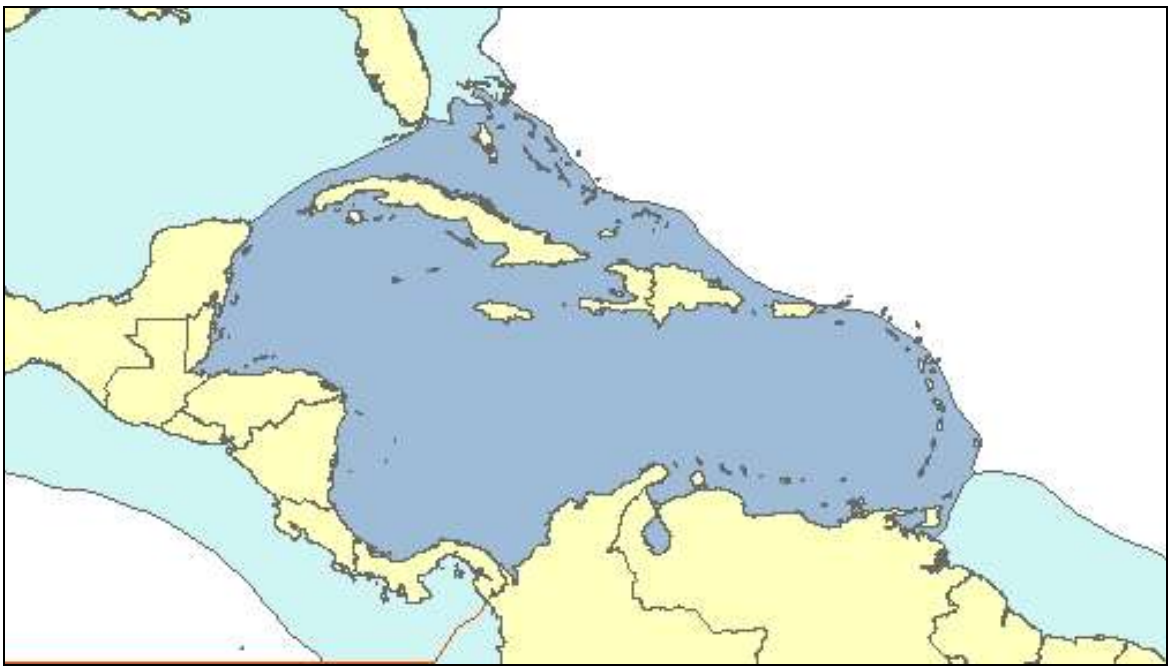


Figure 1 – Boundaries of the Caribbean Large Marine Ecosystem

[1] Sea around us project website at http://www.seaaroundus.org/lme/12.aspx

The region exhibits tropical climate, with a wet (roughly from June to November) and a dry season (December to May), a moderate range of air temperature, and persistent trade winds (Heileman 2011). Annual precipitation varies between 50 and 1,250 mm and a distinctive hurricane season takes place between June and November (Heileman 2011). Seasonal variations in meteorological conditions are due to the north-south migration of the Inter-tropical Convergence Zone (Heileman 2011).

Gyory et al. (2013) provide a review and summary of the key hydrographical features of the Caribbean Sea. Some of these key features are as follows:
The island chain of the Antilles Islands Arc separates the Caribbean from the Atlantic Ocean and acts as a sieve for the inflow of Atlantic water and impedes the flow of deep water into the Caribbean (Andrade and Barton 2000). As a result, the Caribbean Sea is highly stratified in the upper 1200 m of the water column, weakly stratified between 1200 and 2000 m; and nearly homogeneous below 2000 m (Gyory et al. 2013).

Water flows into the Caribbean Sea from the equatorial Atlantic Ocean via the North Equatorial, North Brazil, and Guiana Currents and does so mostly through the Grenada, Saint Vincent, and Saint Lucia passages in the southeast; it then continues westward as the Caribbean Current, which is the main surface circulation in the Caribbean Sea (Gordon 1967, Fratantoni 2001) (Figure 2). The Caribbean Current accounts for the strongest flow in the Caribbean sea, particularly in the southern third of the sea (Gordon 1967), where surface velocities along the coast of Venezuela can reach up to 70 cm s^{-1} along the coast of Venezuela (Fratantoni 2001). There exists a strong and large (>200km wide) recirculation gyre in the southwest corner of the Colombian Basin (Fratantoni 2001) (Figure 2). Most of the remaining flow of the Caribbean Current is channeled through a trough southwest of Jamaica and then turns westward as it crosses the Cayman Basin, entering the Gulf of Mexico as a narrow boundary current along the Yucatan Peninsula (Fratantoni 2001) (Figure 2).

The circulation in the Caribbean experiences much variation in both space and time (Molinari et al. 1981, Kinder 1983, Carton and Chao 1999). Some of this variation manifests itself in the form of mesoscale eddies and meanders operating at a range of spatial scales (e.g. varying from 100km to 200-500 km wide in the eastern Caribbean (Kinder 1983)). Researchers have proposed several physical processes to explain this variation including interactions with bottom topography, wind forcing, current width and shear, and the collision of North Brazil Current (NBC) rings with the Antilles (Fratantoni 2001, Gyory et al. 2013).

The Orinoco and Amazon freshwater river plumes flow into the Caribbean via the Guyana and North Brazil Currents and have a significant influence on the seasonal productivity and hydrology of the Caribbean Sea (Muller-Karger et al. 1988, Hu et al. 2004, Chérubin and Richardson 2007) (Figure 2). Another mechanism further contributing to the dispersal of fresh, nutrient-rich outflow from the Amazon River towards the eastern Caribbean is the formation of large anticyclonic rings which are shed from the retroflecting North Brazil Current (NBC) near 8°N in the tropical western Atlantic. These NBC rings subsequently move northwestward toward the Caribbean Sea, roughly paralleling the South American coastline (Fratantoni et al. 1995, Fratantoni and Glickson 2002, Fratantoni and Richardson 2006) (Figure 3). These NBC rings constitute the largest source of episodic oceanic variability in the region east of the Lesser Antilles (Fratantoni and Richardson 2006), and upon encountering the Lesser Antilles, they episodically disrupt regional circulation patterns and impact the distributions of near-surface salinity and icthyoplankton (Kelly et al. 2000, Cowen 2003). After colliding with the Lesser Antilles passages, the NBC ring fragments drift westward into the Caribbean and result in mesoscale eddies and meanders travelling along the Caribbean Current axis (Carton and Chao 1999, Andrade and Barton 2000, Gyory et al. 2013).

The CLME is considered an ecosystem of moderate productivity (150-300 $gCm^{-2}yr^{-1}$), with such productivity varying considerably in space and time (Heileman and Mahon 2013). Localised upwelling areas, freshwater plumes from the discharge of the Orinoco and Amazon rivers, the distribution of highly productive near-shore habitats such as coral reefs (Heileman and Mahon 2013), as well as the presence of multiple ocean fronts separating water masses with different physical, chemical and biological properties (Belkin et al. 2009), all contribute to shape spatio-temporal patterns of productivity.

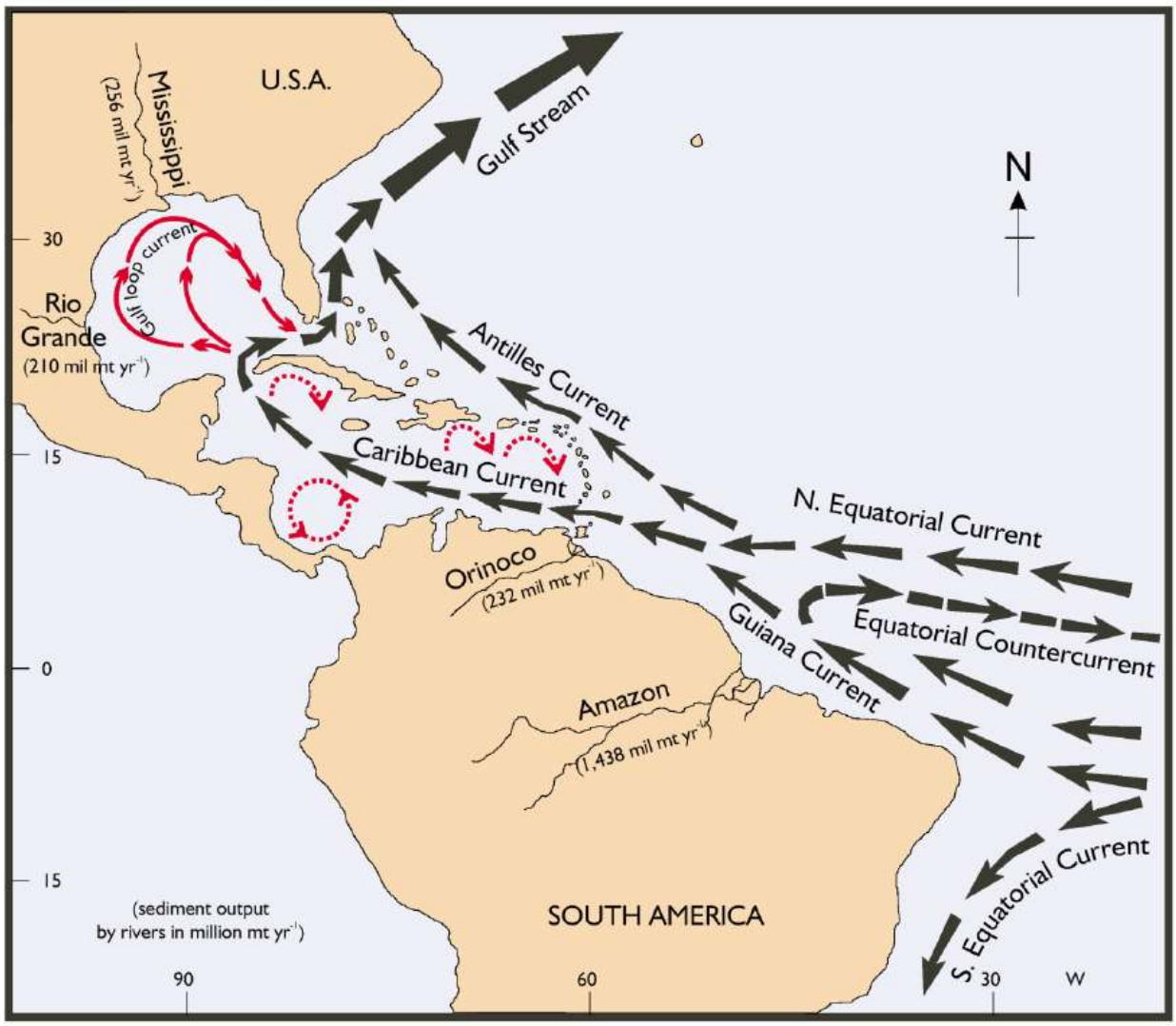


Figure 2 - Major currents affecting the CLME. Adapted from Oxenford (1985).

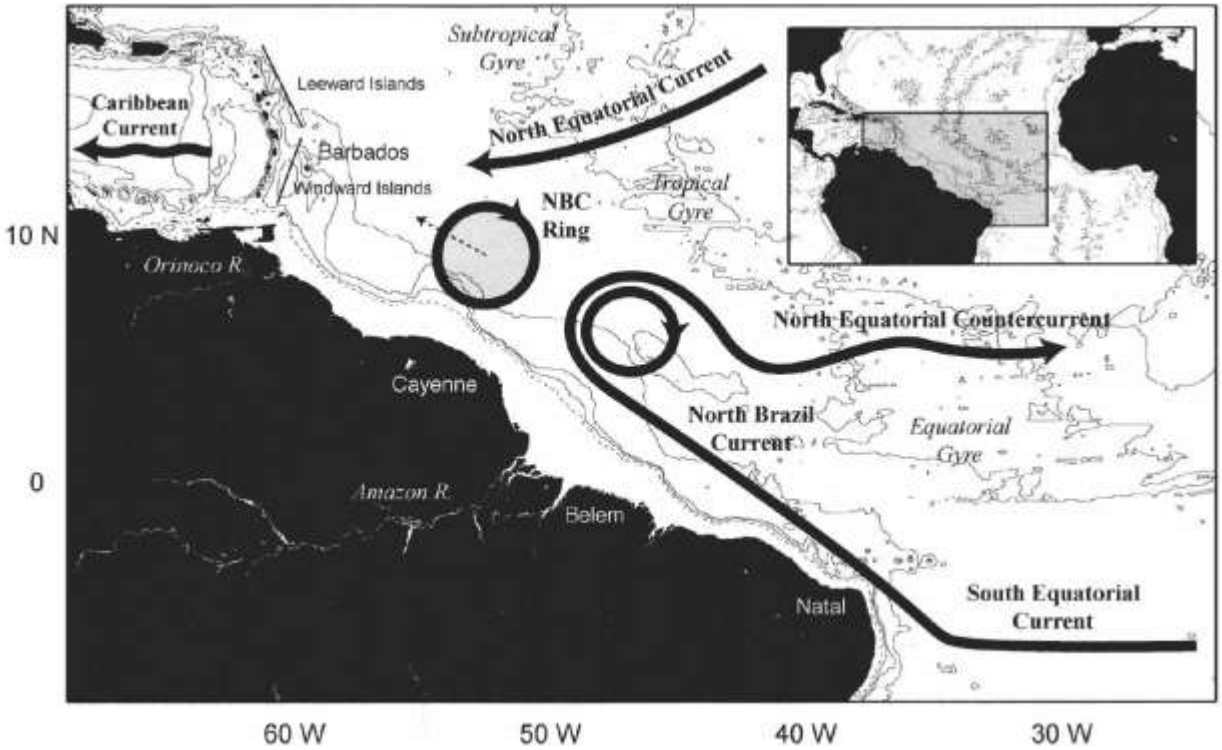


Figure 3 - Schematic representation of circulation in the western tropical Atlantic Ocean showing the North Brazil Current (NBC) retroflecting into the North Equatorial Countercurrent near 6°N. The NBC retroflection occasionally collapses upon itself, resulting in the generation of anticyclonic NBC rings that translate north-westward toward the Caribbean and the arc of the Lesser Antilles. Taken from Fratantoni and Richardson (2006).

4.2 POLITICAL GEOGRAPHY IN THE CARIBBEAN LARGE MARINE ECOSYSTEM (CLME)

The Caribbean Sea Large Marine Ecosystem (CLME) is one of the most compact multinational and diverse regions of the world. From a governance perspective, as many as 38 countries and dependencies border the CLME and need to address numerous trans-boundary issues. All of the eastern Caribbean countries have declared 200 nautical miles EEZs, although most boundaries between some neighbouring countries are still to be negotiated (Figure 4).

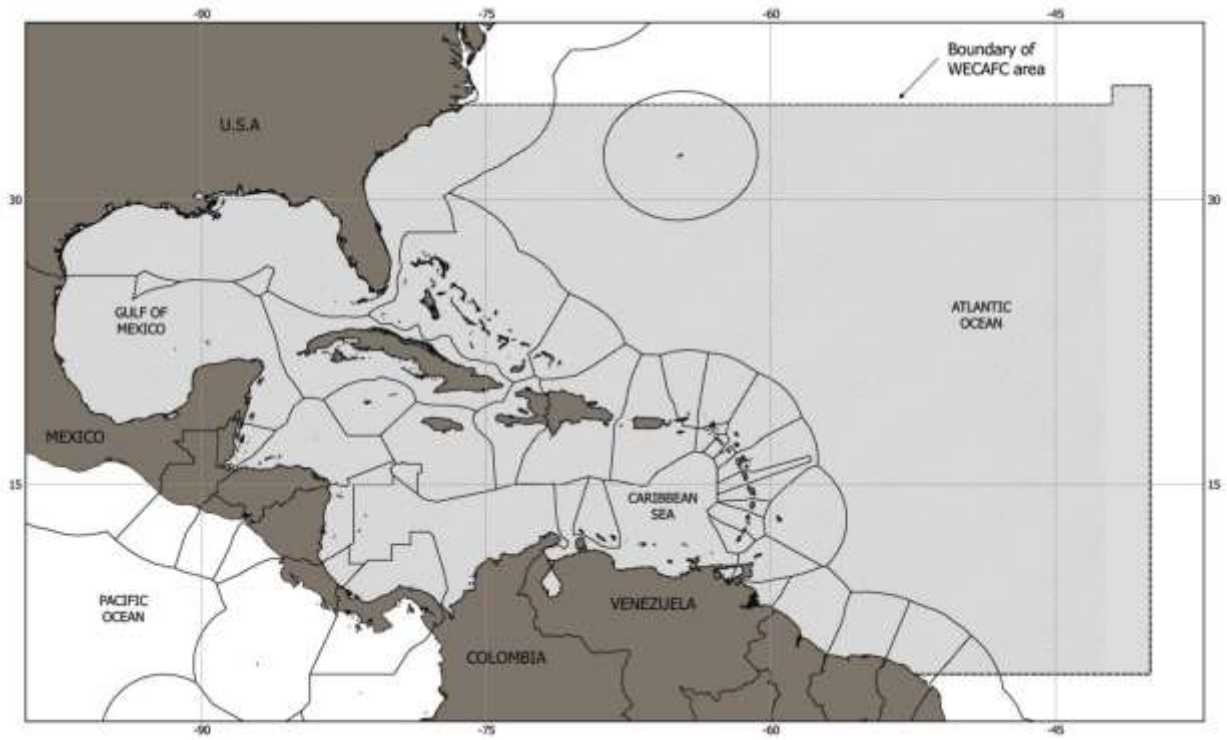


Figure 4 - Map of wider Caribbean showing potential EEZs (taken from CRFM 2014c)(Note that not all countries have accepted the proposed boundaries).

The Caribbean Sea Large Marine Ecosystem (CLME) Project has been assisting Caribbean countries to improve the management of their shared living marine resources through an ecosystem based approach since 2009[2].

Of particular relevance to the sub-regional management plan are the Member States to the Caribbean Regional Fisheries Mechanism (CRFM), along with the French Antilles, Martinique and Guadeloupe, which have a long history of moored FADs and have been influential in the region in the development of this type of fishery. Most of the CRFM members are independent countries, although some are overseas territories (i.e. Anguilla, Montserrat and Turks and Caicos are British Overseas Territories). An overview of country profiles (geography, demography and economy) for CRFM Member States as well as for Martinique and Guadeloupe is given in Table 2.

[2] http://www.clmeproject.org/

Table 2. Country profiles for the CRFM Member States as well as French overseas territories of Martinique and Guadeloupe.

Primary data source: CIA (2009 &2014) The World Factbook. Other data sources include: [1] Mahon (1993); [2] International Labour Organisation Caribbean Office (2009) @ www.ilocarib.org.tt/portal/index.php; [3] FAO (1993) Status of Caribbean Aquaculture; [4] FAO (2008)Yearbook; [5] Barbados 2010 Population and Housing Census; [6] Barbados 2012 Social and Economic Report; [7] Sea Around Us Project; [8] NOAA – Fisheries of the United States

Country	Geography									
	Location	Land area (km^2)	Coastline (km)	Shelf area (km^2)	Inshore Fishing Area – IFA (km^2)	Approx. EEZ area (km^2)	Maritime claims (nmi)	Climate (rainy season)	Terrain	Elevation (m)
Anguilla	18°15'N 63°10'W	91	61	2,109	1,600	92,178	EEZ 200 Territorial sea 3	Tropical; moderated by northeast trade winds	Flat, low-lying island of coral & limestone	65
Antigua & Barbuda	17°03'N 61°48'W	443	153	3,710	3,144	107,914	EEZ 200 Territorial sea 12	Tropical maritime	Mostly low-lying limestone & coral islands, some higher volcanic areas	402
Bahamas	24°15'N 76°00'W	13,880	3,542	108,265	62,227	629,293	EEX 200 Territorial sea 12	Tropical marine; moderated by warm waters of Gulf Stream	Long, flat coral formations with low rounded hills	63
Barbados	13°10'N 59°35'W	432	92	407	320	186,107	EEZ 200 Territorial sea 12	Tropical (Jun-Oct)	Coralline & relatively flat	337
Belize	17°15'N 88°45'W	22,806	386	9,431	11,808	35,995	Territorial sea 12(north), 3(south)	Tropical (May-Nov)	Flat, swampy coastal plain, low mountains in south	1,160
Dominica	15°25'N 61°20'W	754	148	286	606	28,626	EEZ 200 Contig. zone 24 Territorial sea 12	Tropical (Jun-Oct)	Volcanic & mountainous	1,447
Grenada	12°07'N 61°40'W	344	121	2,292	943	26,158	EEZ 200 Territorial sea 12	Tropical (Jun-Oct)	Volcanic & mountainous	840
Guadeloupe	16°15'N	1,706	306	3,735	4,653	95,978	EEZ 200	Tropical	Basse-terre is	1,484

	61°35’W						Territorial sea 12	tempered by trade winds	volcanic with interior mountains; Grande-Terre is low limestone; other islands are volcanic	
Guyana	5°00’N 59°00’W	196,849	459	51,978	22,695	135,900	EEZ 200 Territorial sea 12	Tropical (May-Aug & Nov-Jan)	Rolling highlands, low coastal plain, savannah (south)	2,835
Haiti	19°00’N 72°25’W	27,560	1,771	5,082	7,081	112,025	EEZ 200 Territorial sea 12	Tropical; semiarid where mountains in east cut off trade winds	Rough and mountainous	2,680
Jamaica	18°15’N 77°30’W	10,831	1,022	13,401	4,512	263,283	EEZ 200 Territorial sea 12	Tropical, temperate interior	Mountains, narrow discontinuous coastal plain	2,256
Martinique	14°30’N 61°00’W	1,100	350	1,310	1,576	47,640	EEZ 200 Territorial sea 12	Tropical (Jun-Oct)	Volcanic & mountainous	1,397
Montserrat	16°45’N 62°12’W	102	40	145	127	7,582	EEZ 200 Territorial sea 3	Tropical	Volcanic island, mountainous, small coastal lowland	1,050
Saint Kitts & Nevis	17°20’N 62°45’W	261	135	788	551	10,201	EEZ 200 Territorial sea 12	Tropical (May-Nov)	Volcanic, mountainous interiors	1,156
Saint Lucia	13°53’N 60°58’W	616	158	811	416	15,484	EEZ 200 Contig. zone 24 Territorial sea 12	Tropical (May-Aug)	Volcanic & mountainous	950
Saint Vincent & Grenadines	13°15’N 61°12’W	389	84	2,082	2,080	36,314	EEZ 200 Contig. zone 24 Territorial sea 12	Tropical (May-Dec)	Volcanic & mountainous	1,234
Suriname	4°00’N 56°00’W	156,000	386	55,700	18,182	128,318	EEZ 200 Territorial sea 12	Tropical	Rolling hills, narrow coastal	1,230

									plain with swamps	
Trinidad & Tobago	10°39'N 61°31'W	5,128	362	21,136	18,804	77,502	EEZ 200 Contig. zone 24 Territorial sea 12	Tropical (Jun-Dec)	Plains and low mountains	940
Turks & Caicos	21°45'N 71°35'W	948	389	7,395	9,060	154,068	EEZ 200 Territorial sea 12	Tropical, marine, moderated by trade winds	low, flat limestone, extensive marshes and mangrove swamps	48

Table 2 Continued. Country profiles for the CRFM Member States as well as French overseas territories of Martinique and Guadeloupe.

Country	Demography							
	Population (year)	Population growth (annual %)	Language	Literacy (% over 15 yr)	Ethnicity (%)	Labour force	Unemployment rate (%)	Annual per capita fish consumption (kg) – 2009-2011
Anguilla	16,086 (2014)	2.06 (2014)	English		black 90.1; mixed 4.6; white 3.7; other 1.5	6,049 (2001)	8 (2002)	49.6
Antigua & Barbuda	91.295 (2014 est.)	1.25 (2014)	English, Antiguan creole	99	black 87.3; mixed 4.7; hispanic 2.7; white 1.6; other 2.7; unspecified 0.9	30,000 (1991)	11 (2001)	55.3
Bahamas	321,834	0.87 (2014	English, Creole		black 90.6; white 4.7; black & white 2.1; other 1.9; unspecified 0.7	196,900 (2013 est.)	16.2 (2013)	28.7
Barbados	277,821 (2010)	+0.33 (2010)	English	99.7	black 92.4; mixed 3.1; white 2.7; Asian & Middle Eastern 1.7	141,700 (2012) 72,800 (male) 68,900 (female) 2,200 (fishers) 3,800 (other fishery related)	11.6 (2012) 10.9 (male) 12.3 (female)	39.4
Belize	340,844 (2014 est.)	1.92 (2014 est.)	English, Spanish, Creole, Maya, German, Garifuna, other,		Mestizo 52.9; Creole 25.9; Maya 11.3; Garifuna 6.1; East Indian 3.9; Mennonite 3.6; white 1.2; Asian 1; other 1.2; unknown 0.3	120,500	15.5 (2013)	12.2
Dominica	73,449 (2014)	0.22 (2014)	English, French patois	94	black 86.8; mixed 8.9; Amerindian 2.9; white 0.8	33,420 (1997) 18,120 (male) 15,300 (female) 1,500 (fishers, 1983)	11 (2001) 11.9 (male) 9.5 (female)	26.9
Grenada	110,152 (2014)	0.5 (2014)	English	96	black 82; mixed 18; Amerindian (trace)	41,015 (1998) 23,171 (male) 17,844 (female) 1,500 (fishers),		33.9

						1991 120 (other fishery related)		
Guadeloupe	444,515 (2004)	0.96 (2004)	French, creole patois	90	black or mulatto 90; white 5; east indian, Lebanese, Chinese less than 5	125,900 (1997)	27.8 (1998)	21.8
Guyana	735,554	-0.11 (2014)	English, Guyanese Creole, Amerindian & Indian languages, Chinese	85	East Indian 43.5; black 30.2; mixed 16.7; Amerindian 9.1; other 0.5	313,100 (2009)	11 (2007)	29.2
Haiti	9,996,731	1.08 (2014)	French, Creole	48.7	black 95; mulatto & white 5	4.81 million (2010)	40.6 (2010)	4.6
Jamaica	2,930,050 (2014)	0.69 (2014)	English, English patois	87.5	black 92.1; mixed 6.1; East Indian 0.8; other 0.4	1.311 million (2014)	13.6 (2014)	24.7
Martinique	425,966 (2003)	0.85 (2003)	French, Creole patois	93	black/mixed 90; white 5; Others <5	126,900 (2008) 62,500 (male) 64,400(female)	21.5 (2008) 19 (male) 23.8 (female)	13.7
Montserrat	5,215	0.48 (2014)	English		black 88.4; mixed 3.7; Hispanic 3; white 2.7; east indian 1.5; other 0.7	4,521 (2012)	6 (1998)	28.3
Saint Kitts & Nevis	51,538 2014)	0.78 (2014)	English		predominantly black, some British, Portuguese, Lebanese	18,170 (1995)	4.5 (1997)	38.1
Saint Lucia	163,362 (2014)	0.35 (2014)	English, French patois	90.1	black 85.3; mixed 10.9; East indian 2.2; other 1.7	62,265 (2004) 34,838 (male) 27,428 (female) 2,500 (fishers, 1983)	21 (2004) 17.5 (male) 25 (female)	25.5
Saint Vincent & Grenadines	102,918 (2014)	-0.29 (2014)	English	96	black 66; mixed 19; East Indian 6; Amerindian 2; European 4; other 3	58,000 (2008 est.) 35,000 (male) 24,000 (female) 2,000 (fishers, 1983)	22 (1997)	18.3

						2,500 (other fishery related)		
Suriname	573,311 (2014)	1.12 (2014)	Dutch, English, Sranang Tongo, Caribbean Hindustan, Javanese	94.7	Hindustani 37; creole 31; Javanese 15,; Maroons 10; Amerindian 2; Chinese 2; white 1; other 2	165,600 (2007	9 (2008)	16.9
Trinidad & Tobago	1,223,916 (2014)	-0.11 (2014)	English, Hindi, French, Spanish, Chinese	98.8	black 34; Indian 35.4; mixed-other 15.3; other 1.3; mixed African/East Indian 7.7; unspecified 6.2	621,000 (2013)	5.9 (2013)	21.2
Turks & Caicos	49,070 (2014)	2.58 (2014)	English		black 87.6; white 7.9; mixed 2.5; east Indian 1.3; other 0.7	4,848 (1990)	10 (1997)	47.3

Table 2 Continued. Country profiles for the CRFM Member States as well as French overseas territories of Martinique and Guadeloupe

Country	Economy				
	Currency (exchange US$)	GDP (purchasing power parity in billions US$)	Per capita GDP (purchasing power parity in US$)	External debt (millions US$)	Main sectors (%GDP)
Anguilla	Eastern Caribbean dollar (2.7)	175.4 million	12,200 (2008)	8.8 (1998)	Agriculture: 2.6 Industry: 24.4 Services: 73 (2014 est.)
Antigua & Barbuda	Eastern Caribbean dollar (2.7)	1.989 (2014)	22,600 (2014)	441.2 (2012)	Agriculture: 1.9 Industry: 18.5% Services: 79.6 (2014)
Bahamas	Bahamian dollars (1)	9.034 (2014)	25,100 (2014)	17.56 billion (2013)	Agriculture: 2.1% Industry: 7.3% Services: 90.6% (2014)
Barbados	Barbados dollars (2 fixed)	7.056 (2012 est.)	19,100 (2008 est.)	4,490 (2013 est.)	Agriculture (incl. fish): 3.1 Industry: 13.9 Services: 83 (2013 est.)
Belize	Belizean dollars (2)	2.907 (2014)	8,100 (2014)	1.24 billion (2014)	Agriculture: 13.1 Industry: 16 Services 70.9 (2014 est.)
Dominica	Eastern Caribbean dollar (2.7 fixed)	1.015 (2013 est.)	14,300 (2013 est.)	274.9 (2010 est.)	Agriculture/fish: 15.7 Ind./Commerce: 15.6 Services: 68.7 (2013 est.)
Grenada	Eastern Caribbean dollar (2.7 fixed)	1.458 (2013 est.)	13,800 (2013 est.)	538 (2010 est.)	Agriculture/fish: 5.6 Services/tourism: 78.5 Light industry: 15.8 (2013 est.)
Guadeloupe	Euro	3.513 (2003)	8,000 (2001)		Agriculture: 15 Industry: 17 Services: 68
Guyana	Guyanese dollars (206.9 floating)	5.498 (2014)	6,900 (2014)	1.846 billion (2011)	Agriculture: 20.3 Industry: 39.2 Services: 40.5 (2014)
Haiti	Gourdes (45.25 floating)	18.54 (2014)	1,800 (2014)	1.687 billion (2014)	Agriculture: 24.7 Industry: 20 Services 55.3 (2014)
Jamaica	Jamaican dollars (111 floating)	24.28 (2014)	8,700 (2014)	15.99 billion (2014)	Agriculture: 17 Industry: 19 Services: 64

Martinique	Euro (0.68 floating)	11.250 (2006)	28,014 (2006)		Services/tourism: 83 Industry: 11 Agriculture/fish: 5 (1997)
Montserrat	Eastern Caribbean (2.7 fixed)	43.78 million (2006)	8,500 (2006)	8.9 (1997)	Agriculture: 1.6 Industry: 21.9 Services: 76.6
Saint Kitts & Nevis	Eastern Caribbean (2.7 fixed)	1.22 (2014)	20,300 (2014)	162.9 (2014)	Agriculture: 1.5 Industry: 23 Services: 75.4
Saint Lucia	Eastern Caribbean dollar (2.7 fixed)	2.216 (2013 est.)	13,100 (2013 est.)	446.4 (2013 est.)	Services: 79.5 Industry: 17.4 Agriculture/fish: 3.1 (2013 est.)
Saint Vincent & Grenadines	Eastern Caribbean dollar (2.7 fixed)	1.325 (2013 est.)	12,100 (2013 est.)	255.3 (2013)	Services: 74.4 Agriculture/fish: 5.4 Industry: 20.3 (2013 est.)
Suriname	Surinamese dollars (3.3 in 2014)	9.24 (2014)	16,700 (2014)	1.037 billion (2014)	Agriculture: 8 Industry: 14 Services: 78
Trinidad & Tobago	T & T dollar (6.29 floating)	27.14 (2013 est.)	20,300 (2013 est.)	4,823 (2013 est.)	Services: 42 Industry: 57.7 Agriculture/fish: 0.3 (2013 est.)
Turks & Caicos	US dollars	632 million (2007)	29,100 (2007)		Agriculture: 1.1 Industry: 23.3 Services: 75.7

5. BIOLOGY AND ECOLOGY OF MAIN LARGE OCEANIC AND COASTAL PELAGIC SPECIES CAUGHT ON MOORED FADS

Following FAO (2004), for management purposes, the large pelagic fish stocks of the region that represent the bulk of catches on moored FADs can be allocated to two separate groups:

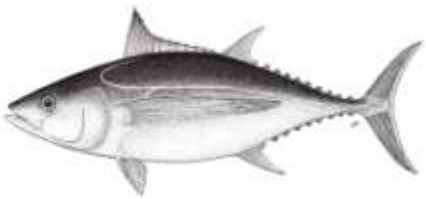
(1) the widely distributed *large oceanic pelagics*, here represented by eight species, i.e. albacore, yellowfin tuna, big eye tuna, skipjack tuna, Atlantic sailfish, Atlantic blue marlin, Atlantic white marlin, and swordfish; and

(2) the less widely distributed *large coastal pelagics*, mainly represented by seven species, i.e. wahoo, king mackerel, Serra Spanish mackerel, Atlantic Spanish mackerel, wahoo, dolphinfish, and little tunny.

A brief overview of the biology, ecology and distribution of the main species of interest, based mainly on Battaglia (1993), and supplemented by Carpenter (2002) and the ICCAT SCRS 2013-2014 reports, is given below.

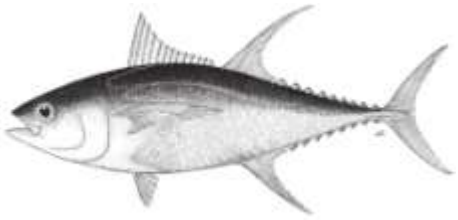
5.1 LARGE OCEANIC PELAGICS

Albacore (*Thunnus alalunga*)



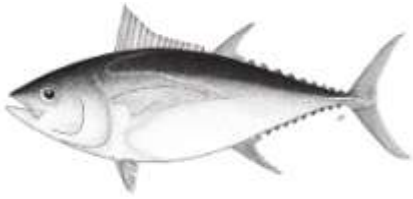
Maximum size: 130 cm for 40 kg.
Habitat: Bathymetric distribution: generally found between 200 to 300 meters, but rises to the surface to feed and can dive to depths greater than 900 m. Hydrological conditions: prefers temperatures from 16 to 21 °C.
Distribution: Widely distributed – temperate and tropical waters; from 45-50°N to 30-40°S (less abundant in surface waters between 10°N and 10°S).
Feeding: Small fish (sardines, anchovy, flyingfish, etc.), squid, small crustaceans.
Reproduction: Spawning takes place all year. There is a spawning area off Florida. Spawning grounds: subtropical western areas of both hemispheres and throughout the Mediterranean Sea (spring and summer). Size at maturity is 90 cm (5 years).
Migrations: a) West-Central Atlantic: This tuna species can cover large distances daily (more than 120 km). Stocks from the coasts of Brazil and the Caribbean spawn along the coasts of Florida. Large individuals (5 years and more) return to the Central-West Atlantic areas after spawning. b) Martinique: Fish catches reach their maximum from July to October.
Lifespan: Atlantic: 15 years.
Fishing method: a) West-Central Atlantic: Live bait fishing, purse seine fishing, Japanese long line, surface trolling occasionally. b) Martinique: Surface trolling, drift line fishing with live bait.

Yellowfin Tuna (*Thunnus albacares*)



Maximum size: 230 cm for 180 kg.
Habitat: Bathymetric distribution: prefers layer between 150 to 200 meters. Hydrological conditions: prefers warm waters (temperatures from 20 to 25 °C) in the water layer rich in dissolved oxygen.
Distribution: Tropical, subtropical – mainly in the epipelagic oceanic waters. In the western Atlantic it is known from about 42°N southward through the Sargasso Sea, Gulf of Mexico, and Caribbean Sea. Also present off the coast of South America from 10°N to 32°N.
Feeding: Mainly fish (cupleids, carangids, small tunas, etc.) and squid. It feeds early in the morning (from dawn until 10 am) or in the evening (from 4 pm to dusk), but not at all at night.
Reproduction: Spawning takes place all year. There are no significant spawning areas. Main spawning ground: equatorial zone of the Gulf of Guinea (January to April), and also in the Gulf of Mexico, southern Caribbean Sea, and off Cape Verde. Size at maturity is about 100 cm (3 years).
Migrations: Yellowfin adults can do transoceanic migrations: many marked large individuals in the Eastern USA have been re-caught off South Africa's coast. In the West-Central Atlantic, the migrations are from East to West, circularly, following the main direction of the currents (western part of Gulf Stream). In Martinique, peak fishing catches take place between July and February, i.e. outside the 'miquelon' period.
Lifespan: Around 10 years.
Fishing method: Purse seine (55% of catches), daytime Japanese long-lines (35 to 40% of catches), and surface trolling and live bait lines occasionally.

Bigeye Tuna (*Thunnus obesus*)

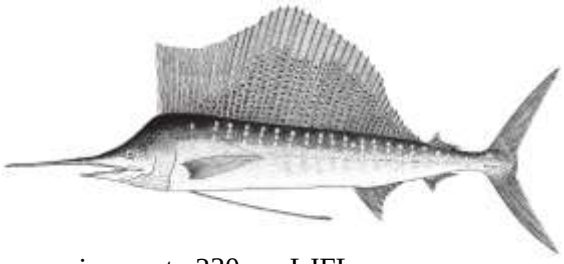


Maximum size: 236 cm for up to 197.3 kg.
Habitat: Bathymetric distribution: prefers layers between 200 to 300 meters. Rarely found close to surface. Hydrological conditions: prefers temperatures between 17 and 22 °C.
Distribution: Widely distributed-tropical and subtropical waters of Atlantic. Geographical limit: 55°-60°N and 45°-50°S.
Feeding: Fish (small pelagic, small tunas, mackerel, etc.), squid, cuttlefish. Prefers to feed between 1 and 3pm and between 5 and 6pm.
Reproduction: Spawning happens throughout the year. Size at maturity is around 96 cm (about 3 years old).
Migrations: This species makes only small migrations, mostly in pursuit of schools of small pelagics.
Lifespan: Around 15 years.
Fishing method: Modified Japanese longline (deep longline), deep longlines with live bait.

Skipjack Tuna (*Katsuwonus pelamis*)

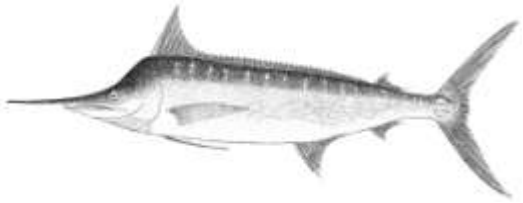
Maximum size: Around 100 cm for 18 kg
Habitat: Bathymetric distribution: found between 80 and 200 meters, but can dive up to 400 meters deep during the day. Hydrological conditions: prefers temperatures between 20 and 23 °C.
Distribution: Cosmopolitan in tropical and subtropical seas.
Feeding: Feeds mostly on fish, but also on crustaceans and molluscs, which are mostly pelagic. It can eat his congeners (cannibalism). It feeds early in the morning (from dawn until 8 am) and in the evening (from 4 to 6 pm). It does not feed at night.
Reproduction: Spawning period extends all year. Size at maturity is 74 cm (about 4 years old). Mature individuals are rarely caught. Spawning events have been recorded along the coasts of Texas and west Florida. This species breeds opportunistically throughout the year over wide areas of the Atlantic.
Migrations: a) West-Central Atlantic: Migrations in the Western Atlantic are poorly known. Mature individuals longer than 85 cm migrate towards the North Atlantic at the end of the reproduction period and do not return to the West Central Atlantic. b) Martinique: They migrate along Martinique from March to October, where peak catches take place in August.
Lifespan: Around 5 years.
Fishing method: Drift gillnets (60% of world catches by Japan), surface trolling, Japanese drifting long lines, live bait lines, seine fishing occasionally. Surface trolling in Martinique.

Atlantic Sailfish (*Istiophorus albicans*)



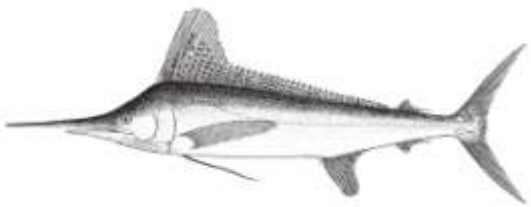
Maximum size: up to 230 cm LJFL.
Habitat: Bathymetric distribution: generally found in the warm water layer over the thermocline, between 0 to 100 meters. Hydrological conditions: prefers water temperature from 21 to 28 °C.
Distribution: Widely distributed – subtropical and tropical waters, occasionally in temperate waters and in the Mediterranean Sea – least oceanic of Atlantic billfishes; shows a strong tendency to approach continental coasts, islands and reefs. Densely distributed in the Caribbean Sea and the Gulf of Mexico.
Feeding: It feeds on large fish such as little tunny, yellowfin tuna, dolphinfish, and sharks, as well as on deep crustaceans, shells, and squid. It feeds in the morning only, between 7 and 9 am.
Reproduction: Spawning takes place from March to September, within depths of 200 meters, from the south of Cuba to North Carolina. Size at maturity: 147-160 cm / 180 cm LJFL (females), 135.7 cm LJFL (males)
Migrations: It is a highly migratory species that can travel large distances (more than 3000 km) to spawn. Its migration routes are poorly understood.
Lifespan: 13-15 years.
Fishing method: Surface trolling with fresh bait, Japanese longlines with live bait.

Atlantic Blue Marlin (*Makaira nigricans*)



Maximum size (total length): 450 cm for 910 kg. Common sizes in the northwestern Atlantic are 180-300 cm LJFL.
Habitat: Bathymetric distribution: generally found within 150 meters of depth. Hydrological conditions: it prefers warm (22 to 31°C) and clear waters.
Distribution: Widely distributed – subtropical and tropical waters, occasionally in temperate waters – from 50°N to 45°S, less abundant in eastern central and south central Atlantic. Densely distributed in the Gulf of Mexico, the Caribbean Sea, and in the Brazil Current.
Feeding: It feeds mainly on large pelagic fishes such as dolphinfish and tunas (skipjack, yellowfin, bluefin). It feeds near the bottom at night (where it searches for large squid), and on surface waters during the day, between 10 and 11 am.
Reproduction: Two periods of spawning: from February to May and from early September to November. Spawning grounds: mainly in tropical western areas of both hemispheres. Size at maturity: 256 cm LJFL (females).
Migrations: West-Central Atlantic: Geographical and seasonal migrations of Atlantic blue marlin are still very poorly understood. However, it is a transoceanic fish; an individual that was marked in the US Virgin Islands was re-caught along the coasts of Africa (Ivory Coast).
Lifespan: 11 years (tagging, longest time-at large in Atlantic).
Fishing method: Modified Japanese long line (few hooks), sports trolling with fresh bait or plastic lure (fish or squid type).

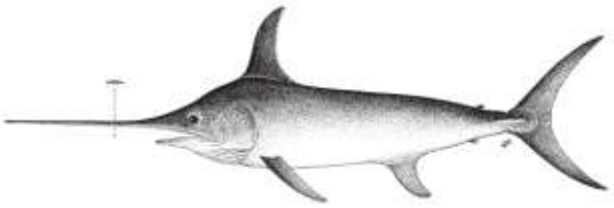
Atlantic White Marlin (*Tetrapturus albidus*)



Maximum size (total length): 280 cm for 82 kg. Common sizes are 150-180 cm LJFL.
Habitat: Bathymetric distribution: generally found within 150 meters of depth, over the thermocline. Hydrological conditions: this species prefers very clear warm (22 to 29 °C) waters with currents of 0.5 to 2 knots, with salinity between 35 and 37 ppt.
Distribution: Widely distributed – subtropical and tropical waters – occasionally in temperate waters and in the Mediterranean Sea – from 55°N to 45°S, less abundant in waters of eastern central south, central Atlantic. Densely distributed off Florida, in the Caribbean Sea, and along the Brazilian coast to Argentina.
Feeding: It feeds on large pelagic fish (dolphinfish, little tunny, small tunas), small pelagic (flyingfish, sardines, anchovy), and large squid.
Reproduction: First spawning takes place at 55 cm (1 year). Spawning takes place at the beginning of the summer in the subtropical region, in waters from 20 to 29 °C, and with salinity over 35 ppt. Spawning grounds: mainly in the tropical western areas of both hemispheres. Size at maturity is of 149-160 cm LJFL (females), 139 cm LJFL (males).

Migrations: a) West-Central Atlantic: This species does a few transoceanic migrations, but in general, most migrations take place during the spawning period towards subtropical regions. b) Martinique: Its presence has been noted from January to March.
Lifespan: 15 years (tagging, longest time-at large in the Atlantic).
Fishing method: Modified Japanese long line, sports trolling with lure.

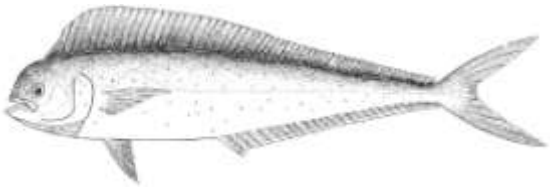
Swordfish (*Xiphias gladius*)

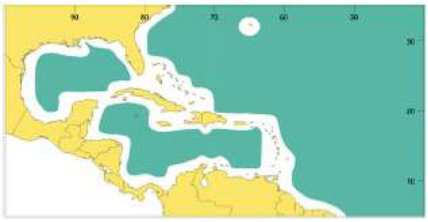


Maximum size (total length): Atlantic: 455 cm for 537 kg.
Habitat: Bathymetric distribution: this species is found generally between 6 to 700 meters deep. Hydrological conditions: It tolerates a wide range of temperature (from 5 to 27 °C).
Distribution: Cosmopolitan species – in the tropical and temperate waters of all the oceans, between 45°N and 45°S, including the Mediterranean.
Feeding: It feeds on pelagic fish (dolphinfish, barracudas, small tunas, flyingfish), benthic fish (triglids, boxfish), and cephalopods (squid, octopus, cuttlefish, etc.). This species feeds at night, very exceptionally at dawn.
Reproduction: Spawning takes place in average temperature waters (23 °C), shallow depths (between 75 and 150 meters) and salinity varying between 33.8 and 37.4 ppt. Spawning grounds: in subtropical western areas of both hemispheres. Spawning takes place from November to February. The first spawning takes place at 5 years (140 cm LJFL). Size at maturity is about 180 cm LJFL (females age 5).
Migrations: This species is found across all the world's oceans, from temperate zones to tropical regions. In the Caribbean Sea basin, it migrates towards North at the beginning of summer following currents. It returns at the beginning of the fall, along the edges of the continental shelf. During its return, it is rarely caught because it travels too deep (sometimes at more than 1000 meters). It is found around Martinique from March to early June.
Lifespan: 15 years.
Fishing method: Modified Japanese long line (few widely spaced hooks), live bait lines, sports trolling, gillnets occasionally.

5.2 LARGE COASTAL PELAGICS

Common Dolphinfish (*Coryphaena hippurus*)

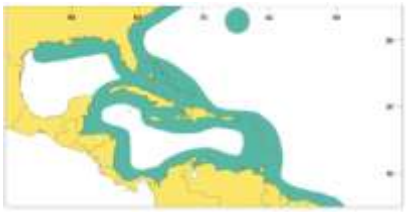




Maximum size: 210 cm TL for 39.5 kg.
Habitat: Bathymetric distribution: generally found in depths between 0 to 40 meters. Hydrological conditions: it prefers temperatures above 20 °C.

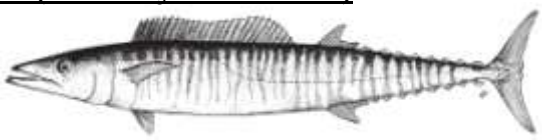
Distribution: Highly migratory pelagic species, in tropical and sub-tropical oceanic waters worldwide, bounded in N and S by 20 °C isotherm. In Western Atlantic ranges from Nova Scotia to Rio de Janeiro, but most common from North Carolina, throughout Gulf of Mexico, Caribbean to NE coast of Brazil.
Feeding: It feeds on small fish (flyingfish, sardines, etc.) and cephalopods (squid, cuttlefish).
Reproduction: Spawning takes place from March to January on the Eastern coasts of Florida and Texas. Size at maturity is of 40-73.5 cm (3.5-7 months). Adult males are recognizable by the presence of a projection at the top of the skull.
Migrations: a) West-Central Atlantic: Spawning migrations take place almost all year. After spawning, they return to their starting point in the southern Caribbean, feeding mainly at night. b) Martinique: Migrations close to Martinique take place from January to June. Peak catches take place between February and end of April. This fish lives generally in schools of 15 to 20 individuals near drifting objects.
Lifespan: 12-18 months (Southern Caribbean).
Fishing method: Surface trolling, with a plastic squid or cuttlefish type of lure. The first individual caught is often kept hooked on the line along the boat to attract and secure its congeners that are then caught more easily.

Little Tunny (*Euthynnus alletteratus*)



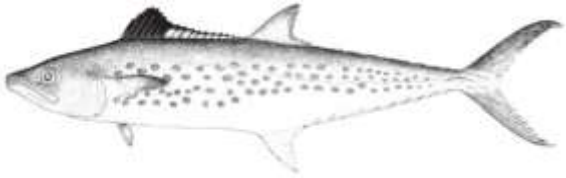
Maximum size: 125 cm for 12.2 kg
Habitat: Bathymetric distribution: it prefers water depths between 100 to 150 meters, but goes to the surface to feed. Hydrological conditions: it prefers temperatures from 18 to 29 °C, although it is very tolerant to temperature changes.
Distribution: Widespread in the Caribbean area, from New England south Victoria Island, Brazil, including Bermuda. Also found in the eastern Atlantic and Mediterranean.
Feeding: It feeds on fish (small pelagic: sardines, swordfish, etc.), benthic molluscs (small bivalves, etc.), and pelagic crustaceans (euphausiids, etc.).
Reproduction: Spawning takes place from March to November, in warm waters (more than 25 °C), close to deep bottoms (probably in the order of 400 meters). Size at first sexual maturity is 35 cm (end of first year).
Migrations: a) West-Central Atlantic: This species does not engage in long migrations. At the beginning of the spawning period, fish from Venezuela's coasts go up towards Cuba, along the Antilles to come back at the end of October. It forms small schools that are particularly abundant in the south of the Lesser Antilles. It is a rather coastal species. b) Martinique: It comes along Martinique from March to November. Peak catches take place between August and October.
Fishing method: Mainly fished by surface trolling.

Wahoo (*Acanthocybium solandri*)



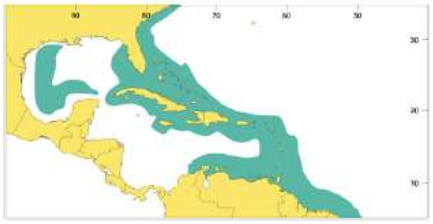
Maximum size: 250 cm TL.
Habitat: Bathymetric distribution: generally found in depths varying between 50 and 100 meters. Hydrological conditions: it prefers temperatures between 17 to 28 °C.
Distribution: circum tropical; tropical and subtropical waters of Atlantic; including Mediterranean and Caribbean Seas, Pacific and Indian Oceans; seasonally may extend to temperate waters. In Western Central Atlantic, it extends from NE Brazil to Rhode Islands, USA.
Feeding: It feeds on fish (small pelagic: sardines, swordfish, flyingfish, etc.), crustaceans (pelagic shrimps), and molluscs (squid, cuttlefish).
Reproduction: Spawning takes place from April to the end of September. Spawning grounds: North Gulf of Mexico (May to August, peak in June), North Carolina (June to August, peak in June/July), Bermuda (May to August). Size at maturity is of 86 to 101 cm TL (1 year), males and females considered.
Migrations: a) West-Central Atlantic: From April to the beginning of September, it migrates towards the Gulf of Mexico and to the North of Cuba and Puerto Rico, along the coasts of the arc of the Lesser Antilles. At the end of the reproduction period, it migrates towards the Central Atlantic following the Gulf Stream. b) Martinique: It forms large schools from April to May. It remains off Martinique until September. Peak catches take place between July and September.
Lifespan: 5-6 years, possibly extending to 10 years.
Fishing method: Mainly fished by surface trolling, with a plastic squid type of lure. Some are also caught in by-catch with Japanese drifting longlines.

Serra Spanish Mackerel (*Scomberomorus brasiliensis*)



Maximum size: 125 cm for 11.4 kg
Habitat: Bathymetric distribution: generally found between 50 and 100 meters deep. Hydrological conditions: it prefers temperatures between 15 and 25 °C.
Distribution: Western Atlantic: along the Caribbean and Atlantic coasts of Central and South America from Belize to Rio Grande do Sul, Brazil – does not migrate extensively, although some seasonal movement appears to occur off Trinidad.
Feeding: It feeds on small fishes, molluscs (squid, octopus) and crustaceans (pelagic shrimps).
Reproduction: Spawning takes place from April to the end of December off the east coast of Florida. Spawning grounds year round in Gulf of Paria, Trinidad. Size at maturity is of 41.9 FL (females), 42.3 cm FL (males NE Brazil).
Migrations: a) West-Central Atlantic: Little is known about migrations.
Fishing method: The majority of catches are by surface trolling, with a plastic squid type of lure. Some are also caught in by-catch with gillnets in the western Caribbean basin.

King Mackerel (*Scomberomorus cavalla*)



Maximum size: 184 cm TL for 45 kg
Habitat: Bathymetric distribution: generally found between 50 and 100 meters deep, but also found on the surface where it feeds. Hydrological conditions: it prefers temperatures between 16 and 26 °C.
Distribution: The western Atlantic from Massachusetts, USA to Rio de Janeiro, Brazil; also reported in the mid Atlantic at Saint Paul's rocks.
Feeding: Fish (sardinellas, small mackerel, etc.), pelagic shrimps, and squid.
Reproduction: Spawning takes place at depths of 35 to 180 meters, in the western Gulf of Mexico (May to September), NE Caribbean (April to September), Trinidad and NE Brazil (year round, peaks from October to March). Size at maturity is 81 cm. Maturity at 1-2 years.
Migrations: a) West-Central Atlantic: Migrations take place from February. The stocks from Venezuela and the Grenadines come up to the West Indies (to the Atlantic and Caribbean sides). After spawning, they return through the centre of the Caribbean Sea. b) Martinique: Migrations near Martinique are from March to October. Peak catches take place between March and May.
Lifespan: 7-10 years (males and females, Trinidad); 14 years (Brazil).
Fishing method: In Florida, it is caught in gillnets and seine fishing. In sport fishing, it is caught by trolling. Bycatch with live bait. In Martinique, the main fishing method is by surface trolling.

Atlantic Spanish Mackerel (*Scomberomorus maculatus*)

Maximum size: 77 cm for 4.8 kg
Habitat: Bathymetric distribution: generally found between 50 and 100 meters deep. Hydrological conditions: it prefers temperatures from 15 to 27 °C.
Distribution: Restricted to the western North Atlantic (although reported from the eastern Pacific and eastern Atlantic, based on 2 other species, *Scomberomorus sierra* and *Scomberomorus tritor*, respectively). Ranges from Maine to Yucatán, primarily in waters over the continental shelf. Absent from Bermuda and most of the West Indies. Replaced from Belize to Brazil by a similar species, *S. brasiliensis*.
Feeding: It feeds on fish (anchovy, small herring, etc.), pelagic shrimps, and cephalopods (squid, cuttlefish, etc.).
Reproduction: Spawning takes place from April to November on the coasts of Texas and from May to October on the Eastern coasts of the US, at depths less than 50 meters. Size at first sexual maturity is about 36 cm (2 years).
Migrations: a) West-Central Atlantic: One spawning migration takes place from the Venezuelan coast to the US East coast from March. A reverse migration takes place towards the end of November. In Puerto Rico, these fish live near murky waters. b) Martinique: Migrations pass close to Martinique from April to October. Peak catches are between May and June. In general, it is found fairly far from the coasts.
Fishing method: a) West-Central Atlantic: It is generally caught by gillnets, purse seine or by trolling. b) Martinique: It is mainly caught by surface trolling during the 'miquelon' season.

Blackfin Tuna (*Thunnus atlanticus*)

Maximum size: 107 cm for 19.5 kg.
Habitat: Bathymetric distribution: during daytime, it stays in a fairly wide range of water, between 100 to 300 meters deep. During night time, it comes back to the surface. Hydrological conditions: it prefers warm waters (between 20 and 30 °C).
Distribution: Highly migratory, epipelagic – found over reefs, bays and offshore, confined to coastal waters warmer than 20°C; believed to occur only in western Atlantic from Massachusetts to Rio de Janeiro, Caribbean and Gulf of Mexico.
Feeding: Small fish (small pelagic, filefish, etc.), crustaceans (shrimps, crabs, larvae, etc.). It feeds mainly at night.
Reproduction: Spawning takes place from April to September in the Caribbean Sea and from March to November in the Gulf of Mexico and along coasts of Florida. Possible breeding grounds in Lesser Antilles around May-June. Size at maturity is of 40-50 cm (2 years).
Migrations: a) West-Central Atlantic: From February, mature individuals from the Central Atlantic go towards spawning areas following the Gulf Stream, to leave in June (always following currents). Individuals from Venezuela and Brazil mostly spawn in the Caribbean Sea. However, some follow the Lesser Antilles arc to spawn along the coasts of Florida and in the Gulf of Mexico. b) Martinique: They pass along the coasts of Martinique from July to October. Peak catches take place between July and October.
Lifespan: Around 5 years.
Fishing method: Purse seine, surface trolling, gillnets occasionally.

6. LEGAL ASPECTS

6.1 INTERNATIONAL LAW AND AGREEMENTS

Internationally agreed fisheries instruments directly relevant to moored FAD fisheries in the Caribbean include the following legally binding treaties and agreements:

- The 1966 International Convention for the Conservation of Atlantic Tuna (ICCAT Convention);
- The 1995 United Nations Agreement for the Implementation of the Provisions of the UN Convention the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN Fish Stocks Agreement), which came into force in 2001;
- The 1973 Western Central Atlantic Fishery Commission (WECAFC) established through Resolution 4/61 of the FAO Council under Article IV (1) the FAO Constitution;
- The 2002 Agreement Establishing the Caribbean Regional Fisheries Mechanism (CRFM Agreement). It will (once ratified) govern the fisheries through establishment of measures for conservation, management, sustainable utilization and development of fisheries resources and related ecosystems; the building of capacity amongst fishers and the optimisation of the social and economic returns from their fisheries and the promotion of competitive trade and stable market condition;

- The 1982 United Nations Convention on the Law of the Sea (UNCLOS), which came into force in 1994;
- The 1993 FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (FAO Compliance Agreement), which came into force in 2003;
- The 1946 International Convention for the Regulation of Whaling (ICRW Convention);

Other relevant international instruments include the following non-binding declarations/codes:

- The 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES);
- The 1973/78 International Convention on the Prevention of Marine Pollution from Ships (MARPOL);
- The 1983 Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (i.e. the Cartagena Convention), which entered into force in 1986, along with the ensuing 1990 Protocol for Specially Protected Areas and Wildlife (SPAW), which entered into force in 2000;
- The 1992 UN Agenda 21: Programme of Action for Sustainable Development, Chapter 17: Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas and coastal areas, and the protection, rational use and development of their living resources;
- The 1992 Convention on Biological Diversity (CBD);
- The 1994 Declaration of Barbados on Sustainable Development of Small Island Developing States (SIDS) and its related Programme of Action for the Sustainable Development of Small Island Developing States;
- The 1995 FAO Code of Conduct for Responsible Fisheries. The code gives particular attention to Small Island Developing States and small-scale fisheries and covers all aspects of fisheries;
- The 2001 Reykjavik Declaration, representing a voluntary commitment to adopt an ecosystem-based approach to fisheries management;
- The 2005 Rome Declaration on IUU Fishing, recognizing the impacts of IUU fishing on small-scale fisheries, and calling for improved national and regional monitoring, control and surveillance of unauthorized, illegal fishing and implementation of severe punitive measures;
- The April 2015 Advisory Opinion of the International Tribunal on the Law of the Sea on the duties of coastal and flag states to ensure sustainable fisheries management (ITLOS Case 21);
- The 2010 United Nations General Assembly Resolution "Towards the Sustainable Development of the Caribbean Sea for Present and Future Generations" (UNGA 65/155, adopted on 20 December 2010);
- The 2002 World Summit on Sustainable Development (WSSD) Johannesburg Plan of Implementation and the International Labour Organization Work in Fishing Convention of 2007 (ILO Convention No. 188);
- The 2009 FAO Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (Port State Measures Agreement);
- 2010 Castries (Saint Lucia) Declaration on Illegal, Unreported and Unregulated Fishing of the Caribbean Regional Fisheries Mechanism;
- 2012 Resolution of the members of the Western Central Atlantic Fishery Commission on Strengthening the Implementation of International Fisheries Instruments;
- The Agreement on the Establishment of the Caribbean Community Common Fisheries Policy (CCCFP) which was endorsed by the CRFM Ministerial Council in 2011 and approved as a regional policy document by the Council for Trade and Economic Development at its 51st Special Meeting in Suriname on 10 October 2014.

CRFM Member States (and Martinique and Guadeloupe) ratification of global and regional marine-related Multinational Environmental Agreements (MEAs) is given in Table 3.

6.2 NATIONAL LAWS AND REGULATIONS

In terms of fisheries legislation, most CARICOM states exhibit fisheries regulations that are generic in nature, in the sense that they do not tend to have provisions specific to particular fisheries such as the moored FAD fishery. Exceptions are Antigua & Barbuda (whose 2013 Fisheries Regulations make provisions for marking, official designation, deployment and disposal of FADs), Dominica (1987 Fisheries Act n^{o} 11 includes a provision for licensing and control of FADs), Saint Lucia (1984 Fisheries Act n^{o} 10 includes a provision for licensing and control of FADs), and Saint Kitts & Nevis.

6.3 RELEVANT REGIONAL FISHERY BODIES (RFB)

Membership of CRFM Member States (and Martinique and Guadeloupe) to Regional Fishery Bodies (RFB) and international organizations with responsibility for fisheries management and development is given in Table 4. Three RFBs play particularly important roles in all activities pertaining to the management and sustainable exploitation of highly migratory fishery species in the Caribbean region. These are the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Caribbean Regional Fisheries Mechanism (CRFM), and the Western Central Atlantic Fishery Commission (WECAFC).

6.3.1 THE INTERNATIONAL COMMISSION FOR THE CONSERVATION OF ATLANTIC TUNAS (ICCAT)

The International Commission for the Conservation of Atlantic Tunas is an inter-governmental fishery organization responsible for the conservation of tunas and tuna-like species in the Atlantic Ocean and adjacent seas. This organization came to life after the 1969 ratification of the International Convention for the Conservation of Atlantic Tunas, which stemmed from the desire of governments to co-operate in maintaining the populations of tuna and tuna-like fishes in the Atlantic Ocean at levels that would permit maximum sustainable catch for food and other purposes. To achieve its objectives, ICCAT is responsible for research on the populations of tuna and tuna-like fishes and other species of fishes with similar biological and fishery characteristics such as the billfishes and dolphinfish. This research includes studies on (1) abundance, biometry and ecology of tuna and tuna-like species; (2) oceanographic environments of tuna and tuna-like species; (3) the effects of natural and anthropogenic factors on populations of tuna and tuna-like species. Activities involved in these objectives include, among others, the collection and analysis of statistics on current state and trends in tuna and tuna-like fish fisheries as well as the publishing and dissemination of findings of the state of tuna fishery resources. The Convention establishes that ICCAT is the only fisheries organization that can undertake the range of work required for the study and management of tunas and tuna-like fishes in the Atlantic. Research conducted by ICCAT is used in the species assessments leading to the IUCN Red List of Threatened Species.

Most tuna and tuna-like species are migratory trans-boundary species and thus jointly fished by different countries. This implies that accurate stock assessments require obtaining fishery statistics from all countries involved in the fishery. Thus, the Commission requests that all countries or fishing entities operating tuna and tuna-like fisheries in the Atlantic Ocean and adjacent seas submit their fisheries data. These data need to be submitted in standardized form and cover at least basic information such as catch

statistics (e.g., annual catch of each species) and fleet characteristics (number of fishing boats by size classes) (https://www.iccat.int/en/submitSTAT.htm).

6.3.2 THE CARIBBEAN REGIONAL FISHERIES MECHANISM (CRFM)

The Caribbean Regional Fisheries Mechanism (CRFM) is a Caribbean inter-governmental organization whose mission is to promote and facilitate sustainable use of fishery resources across the region for the socio-economic benefits of the current and future population of the Caribbean. The CRFM was inaugurated in 2003 and is currently headquartered in Belize City, Belize. The Ministerial Council of the CRFM is responsible for, among other things:

(1) "promoting the efficient management, conservation and development of shared, straddling and highly migratory marine and other aquatic resources of the Caribbean Region through attainment of competence over the resources and through co-operation with the relevant competent organizations;
(2) promoting and facilitating human resource training and development in the fisheries sub-sector at the professional, technical and vocational levels in Member States;
(3) promoting and supporting programmes designed to establish, facilitate and strengthen fisheries research, including the acquisition and sharing of relevant data in Member States";

And the Technical Unit of the CRFM Secretariat is responsible for, among other things:

(1) "providing technical, consultative and advisory services to Member States in the development, assessment, management and conservation of marine and other aquatic resources and, on request, in the discharge of any obligations arising from bilateral and other international instruments;
(2) collecting and providing relevant data on fisheries resources, including sharing, pooling and information exchange;
(3) supporting and enhancing the institutional capacity of Member States in fisheries' areas such as: policy formulation; economics and planning; registration and licensing systems; information management; resource monitoring, assessment and management; education and awareness building; harvest and post-harvest technologies;
(4) encouraging, supporting and, as appropriate, providing effective regional representation at relevant international fora";

Table 3 - Country ratification of global and regional marine-related Multinational Environmental AgreementsMEAs)

Basel – Convention on the Transboundary Movements of Hazardous Wastes and their Disposal; **Cartagena** – Convention on the Protection and Development of the Marine Environment in the Wider Caribbean; **CDB** - United Nations Convention on Biological Diversity; **CITES** - Convention on International Trade in Endangered Species of Wild Fauna and Flora; **FAO Compliance Agreement** – Food and Agriculture Organization of the United Nations (FAO) Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas; **MARPOL** - International Convention for the Prevention of Pollution from Ships. **Annex I**: Regulations for the Prevention of Pollution by Oil. **Annex II**: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk. **Annex III**: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form. **Annex IV**: Prevention of Pollution by Sewage from Ships. **Annex V**: Prevention of Pollution by Garbage from Ships. **Annex VI**: Prevention of Air Pollution from Ships; **RAMSAR** - Convention on Wetlands of International Importance especially as Waterfowl Habitat; **UNCLOS** - United Nations Convention on the Law of the Sea; **UNFCC** - United Nations Framework Convention on Climate Change; **UN Fish Stocks Agreement** - Agreement for the implementation of the provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the conservation and management of straddling fish stocks and highly migratory fish stocks, 1995; **LBS** - Land-Based Sources and Activities Protocol; **SPAW** - Protocol for Specially Protected Areas and Wildlife

Countries	Global MEAs													Regional MEAs			
	Basel	CBD	CITES	FAO Compliance Agreement	MARPOL - Annexes I & II	MARPOL - Annex III	MARPOL - Annex IV	MARPOL - Annex V	MARPOL - Annex VI	RAMSAR	UNCLOS	UNFCC	UN Fish Stocks Agreement	Cartagena	LBS	Oil Spill	SPAW
Anguilla	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X
Antigua & Barbuda	X	X	X		X	X	X	X	X	X	X	X		X	X	X	X
Bahamas	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X
Barbados	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Belize	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Dominica	X	X	X		X	X		X			X	X		X		X	
Grenada		X	X							X	X	X		X	X	X	X
Guadeloupe	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Guyana	X	X	X		X	X	X	X	X		X	X		X	X	X	X
Haiti	X	X									X	X					
Jamaica	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X
Martinique	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Montserrat	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X
Saint Kitts & Nevis	X	X	X	X	X	X	X	X	X		X	X		X		X	
Saint Lucia	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
Saint Vincent & the Grenadines	X	X	X		X	X	X	X	X		X	X	X	X		X	X
Suriname	X	X	X		X	X	X	X	X	X	X	X					
Trinidad & Tobago	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Turks & Caicos Islands	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X

6.3.3 THE WESTERN CENTRAL ATLANTIC FISHERY COMMISSION (WECAFC)

The WECAFC was established in 1973 by Resolution 4/61 of the FAO Council under Article VI (1) of the FAO Constitution. The goal of the WECAFC is "to promote the effective conservation, management and development of the living marine resources of the area of competence of the Commission, in accordance with the FAO Code of Conduct for Responsible Fisheries, and address common problems of fisheries management and development faced by members of the Commission". This goal applies to all living marine resources in both, the high seas as well as in national waters.

The work of the Commission is guided by the three following principles:

- To promote the application of the FAO Code of Conduct on Responsible Fisheries and its related instruments,
- To ensure that appropriate attention is paid to small-scale, artisanal and subsistence fisheries,
- To coordinate and cooperate closely with other relevant international organizations on matters of common interest.
- The functions and responsibilities of the Commission include:
    - "to assist its members in implementing relevant international fisheries instruments, in particular the FAO Code of Conduct for Responsible Fisheries and its related International Plans of Action;
    - to promote, coordinate and, as appropriate, undertake the collection, exchange and dissemination of statistical, biological, environmental and socio-economic data and other marine fishery information as well as its analysis or study;
    - to promote, coordinate and, as appropriate, strengthen the development of institutional capacity and human resources, particularly through education, training and extension activities in the areas of competence of the Commission;
    - to promote and facilitate harmonizing of relevant national laws and regulations, and compatibility of conservation and management measures;
    - to assist its members in and facilitate, as appropriate and upon their request, the conservation, management and development of transboundary and straddling stocks under their respective national jurisdictions;
    - to serve as a conduit of independent funding to its members for initiatives related to conservation, management and development of the living resources in the area of competence of the Commission."

Of particular relevance is the fact that the Commission established a Working Group (WG) in 2012 focusing on the use of Fish Aggregating Devices in the Lesser Antilles, the IFREMER/WECAFC WG on the Development of Sustainable Moored Fish Aggregating Device (FAD) Fishing in the Lesser Antilles (FAO 2012) (see also http://en.magdelesa.eu/). The role of this WG is to provide fishery management advice and recommendations to the Commission. The goal of this WG is to contribute to the sustainable development and management of large pelagic fisheries associated with moored FADs. An extract of the terms of reference of this WG is given below (FAO 2012):

- Use the best available scientific information, review periodically and report on the magnitude and state of moored FAD fishing in the Lesser Antilles.
- Promote and facilitate national and regional monitoring and research programmes on FAD fishing, including the harmonization of methodologies.
- Collect data and information on moored FAD fishing which can be used for the large pelagic fisheries assessment and management in the WECAFC Region (e.g. biological, environmental, socio-economic);

- Review periodically the economic and social situation of the moored FAD fishing at national and regional levels;
- Evaluate when necessary the impact of national and regional management measures on the economic and social aspects of these fisheries;
- Integrate moored FAD fishing in national fisheries management plans; Formulate projects and programmes as necessary;
- Promote the sharing of information and expertise;
- Promote and co-ordinate acquisition of international aid in support of its activities;
- Promote an extensive exchange of ideas and experiences regarding moored FAD fishing, including appropriate technologies;
- Submit reports on its inter-sessional activities for consideration by the WECAFC;
- Organize any other relevant studies requested by the Commission; and
- Inform other relevant regional fishery bodies, such as ICCAT of their activities and work.

This IFREMER/WECAFC WG on the Development of Sustainable Moored Fish Aggregating Device (FAD) Fishing in the Lesser Antilles last met in December 2013 (CRFM 2013c).

More recently, the WECAFC 15th Commission meeting endorsed a new regional WG – the CRFM/WECAFC/IFREMER/JICA Working Group on Fisheries that use Fish Aggregating Devices (FAO 2014a). The scope of this new joint WG is the development and management of moored FAD fishing in the WECAFC Area 31, in a manner that is consistent with the long-term sustainability of associated pelagic fish resources and through the application of international best practices consistent with the precautionary and ecosystem approaches to fisheries management (FAO 2014b). This new WG will undertake a multidisciplinary and participatory approach to the sustainable development of moored FAD fishing for pelagics and will contribute to the fulfilment of national and regional management responsibilities for shared pelagic fish stock management under the Code of Conduct for Responsible Fisheries, and in particular Article 8.11: "Artificial reef and fish aggregation devices" as well as related management recommendations of the International Commission for the Conservation of Atlantic Tunas (ICCAT). The Working Group is to function in a technical and advisory capacity over the period April 2014 to March 2016. The specific terms of reference of CRFM/WECAFC/IFREMER/JICA Working Group on Fisheries that use Fish Aggregating Devices (FAO 2014b) are:

1. To consider data on FAD fisheries in analyses of pelagic fish resources;
2. To collaborate with JICA on the CARIFICO Project, and to share the outputs with Member States;
3. To collaborate with IFREMER on research of key pelagic species associated with FAD fisheries;
4. To develop manuals on best practices in the fisheries using FADs. The manuals are to address issues of safety in the construction and deployment of FADs, user conflicts associated with activities around FADs and improvements in FAD technology.

Table 4 - Membership of CRFM Member States and Martinique and Guadeloupe to regional fishery bodies and international organisations with responsibility for fisheries management and development.

Countries	ACS	CARICOM	CARIFORUM	CRFM	ICCAT	IOCARIBE	IWC	OECS	WECAFC
Anguilla[1]		*		X	X	X	X	*	X
Antigua & Barbuda	X	X	X	X		X	X	X	X
Bahamas	X	X	X	X		X			X
Barbados	X	X	X	X	X	X		C	X
Belize	X	X	X	X	X	X	X		X
Dominica	X	X	X	X		X	X	X	X
Grenada	X	X	X	X		X	X	X	X
Guadeloupe[1]	*				X	X	X		X
Guyana	X	X	X	X	C	X		C	X
Haiti	X	X	X	X		X			X
Jamaica	X	X	X	X		X			X
Martinique[1]	*				X	X	X	*	X
Montserrat[1]		X		X	X	X	X	X	X
Saint Kitts & Nevis	X	X	X	X		X	X	X	X
Saint Lucia	X	X	X	X		X	X	X	X
Saint Vincent & the Grenadines	X	X	X	X	X	X	X	X	X
Suriname;	X	X	X	X	C	X	X	C	X
Trinidad & Tobago	X	X	X	X	X	X			X
Turks & Caicos Islands[1]		*		X	X	X	X		X

* Associate member; C – co-operators; ACS – Association of Caribbean States; CARICOM – Caribbean Community and Common Market; CRFM – Caribbean Regional Fisheries Mechanism; ICCAT – International Commission for the Conservation of Atlantic Tunas; IOCARIBE – Regional subsidiary body of UNESCO Intergovernmental Oceanographic Commission (IOC); IWC – International Whaling Commission; OECS – Organisation of Eastern Caribbean States; WECAFC – Western Central Atlantic Fishery Commission.

[1]- Membership of Anguilla, Montserrat, Turks and Caicos Islands is by virtue of their being UK Overseas Territories and of Martinique and Guadeloupe is by virtue of their being French Overseas Departments.

7. MANAGEMENT UNIT

Management units for several oceanic pelagic species actively managed by ICCAT are given in Section 9. For the remaining species, and for the purpose of the present plan, the management units should be the combined EEZs of the CRFM Member States.

8. CHARACTERISTICS OF THE MOORED FAD FISHERY

8.1 ECOSYSTEM SERVICES OF THE PELAGIC ECOSYSTEM

The species targeted by the use of moored FADs are part of the pelagic ecosystem (FAO 2004). The pelagic ecosystem provides a range of ecosystem services, which can be divided into provisioning, regulating, cultural and supporting services. The provisioning services include the provision of fish for food and for commercial, recreational and subsistence fishing; the generation of wave energy and the provision of a medium for transportation, i.e. shipping and pharmaceutical products. The prominent regulatory service of the pelagic ecosystem is climate regulation. Cultural ecosystem services include recreational and tourism services and values, knowledge systems and educational values as well as spiritual and inspirational values. Supporting ecosystem services of the pelagic ecosystem include habitat for fish, including critical habitat for eggs and larval stages of fish and shellfish, transport of eggs and larvae to feeding and recruitment grounds as well as biodiversity functions related to sea turtles, sea birds and marine mammals.

8.2 INITIAL OBJECTIVES AND EXPECTATIONS OF THE MOORED FAD FISHERY

Reynal et al. (1999) and Reynal et al. (2002) highlight that the first introduction of moored FADs in the insular Caribbean region in the 1980's took place under a general context of fully exploited or overexploited near-shore fish resources, with some islands exhibiting trade deficits in fish products. In contrast, the continental nations of the region were rapidly increasing the exploitation of offshore pelagic resources from the western central Atlantic (Fig 2 in Reynal et al. (1999)). Under a pervasive lack of management effectiveness of the near-shore (and mainly artisanal) fisheries, the exploitation of relatively underutilized pelagic offshore resources to diversify the fishery seemed at the time a reasonable solution to the near-shore overexploitation problem. Exploratory surveys between the 1960's and 1980's in the area suggested a low overall abundance of pelagic resources, with resources generally aggregated around natural drifting objects, thus limiting the value of using traditional fishing techniques, but highlighting the potential value of FADs.

A review of the reasons put forward by CRFM Member States in the last decade to justify the development of a moored FAD fishery is highly consistent with Reynal et al. (1999)'s account. Indeed, the most recurrent broad objectives and/or expectations explicitly given by representatives of CRFM Member States revolve around: (1) a reduction of fishing pressure on overexploited near-shore resources, (2) an increase in fish landings, and (3) an increase in fishers' revenues. Other recurrent reasons put forward include an increase in food security and an increase in fishing efficiency (Table 5).

Table 5 - Objectives/expectations put forward by representatives of CRFM Member States and the French Antilles for the development of a moored FAD fishery. They arranged in decreasing order of recurrence across states from top to bottom.
Sources: (Le Gall et al. 1999, FAO 2002a, b, 2007, CRFM/JICA 2011, CRFM 2013d, c)

Objective / Expectation	Antigua and Barbuda	Grenada	Belize	Dominica	Haiti	Saint Kitts and Nevis	Saint Lucia	Saint Vincent and the Grenadines	Trinidad and Tobago	Martinique	Guadeloupe
Increase fish landings	X	X	X	X	X		X	X		X	X
Increase fisher socio-economic development (through increased revenue)	X	X		X	X	X	X	X		X	X
Reduce fishing pressure on coastal/demersal/reef resources	X		X	X	X	X	X		X	X	X
Increase fishing efficiency (less time fishing and/or less fuel consumed)	X	X		X			X	X	X	X	X
Facilitate access to underutilized pelagic resources	X		X	X	X		X			X	X
Increase food security		X		X	X	X					
Increase employment					X					X	X
Decrease dependence on fish imports										X	X
Increase security at sea				X							X
To reduce fisher competition	X										
Create new income opportunities through sports tourism						X					
Promote co-management	X			X							
Increase quality of landed fresh fish product								X			
Extend fishing grounds											X
Reduce dependency on reef resources							X				
Reduce conflicts with coastal users (tourism, boat traffic))							X				
Encourage fishers to remain within EEZ											X
Decrease the high physical demands of the fishing activity											X
Promote social (fisher) cohesion/collaboration				X							

8.3 HISTORICAL OVERVIEW OF MOORED FAD DEVELOPMENT IN THE REGION

Reynal et al. (1999) and Reynal et al. (2002) provide an account of the development of the moored FAD fishery in the region. The first experiences recorded date from the late 1960's and early 1970's in Curacao, Bonaire, Barbados and Anguilla, through the deployment and mooring of bamboo rafts. Other locations experimenting with moored FAD of various designs in the 1970's and 1980's included Panama City (Florida) (Klima and Wickham 1971, Wickham et al. 1973), US Virgin Islands (Clavijo et al. 1987) and Puerto Rico (McIntosh 1984). At that time, moored FADs made out of locally available and simple materials were increasingly being perceived as an economical and effective way to increasing fish yields of artisanal and recreational fishers (de Sylva 1982). In that regard, and of particular significance, during the 1983 annual meeting of the Gulf and Caribbean Fisheries Institute, a group of eastern Caribbean fishery officers identified "FAD use and training" as one of four top regional priorities and requested assistance in developing the FAD fishery in the region (McIntosh 1984). Further moored FAD experiments subsequently took place throughout the region (mid 1980s to late 1990s) including Martinique, Saint Kitts, Guadeloupe, Dominica, Grenada, Haiti, Puerto Rico, Cuba, Curacao and Saint Lucia (see Reynal et al. 1999 and references therein). However, most of the FAD experimental trials at that time were carried out in relatively shallow depths, possibly conditioned by the concern over FAD loss, and so generally aggregated coastal pelagics rather than the oceanic ones (Reynal et al. 1999). Furthermore, most fishing took place using surface trolling, limiting the range of fish exploited and the subsequent fishing yields (Reynal et al. 1999). Despite their recognized potential, the regular use of moored FADs for the exploitation of the large oceanic pelagics, as it takes place nowadays, only took firm place in a few islands such as Guadeloupe, Martinique and Curacao during the late 1980's (Reynal et al. 1999).

How the FAD fishery developed overtime appears to be specific to each location, as a result of different socio-economic and bio-physical conditions. Mathieu et al. (2014) compared a proxy of FAD fishery development (i.e. the number of vessels engaged in FAD fishing) between Guadeloupe, Martinique and Dominica and noted that although the three islands have a similar type of fleet, the pattern of development differed between islands. In the French islands, they noted a three-stage pattern characterized by:

1. " *A light rise where Martinican FAD activity is above Guadelupian for the first seven years of FAD fishery (1985 - 1992),*
2. *A strong increase where Guadeloupian FAD activity goes over Martinican between 1992 to 2002, and*
3. *A ceiling around 300 vessels for both islands as if a maximum capacity of the FAD fleet has been reached in 2002 in Guadeloupe and 2006 in Martinique*".

In contrast, the Dominican FAD fleet has continued growing strongly during the 2008-2012 period, nearly doubling in size to exceed 200 vessels, even though the number of FADs is similar to that in Martinique (Mathieu et al. 2014). Mathieu et al. (2014) highlighted the importance of non-monetary factors in influencing the development of the FAD fishery in the French Antilles such as a narrow insular shelf (limiting coastal fisheries), owner's age (young fishers might be more inclined to FAD fishing), vessel size (and engine power necessary for alternative offshore pelagic fisheries), crew size, and seasonality of the FAD activity. They also highlighted the role of competition with fish product imports from developed countries, which had been on the rise since the 1970's, and which were cheaper than fish products from the local FAD fishery. In contrast, fish imports in Dominica had experienced a slight decrease between the early 1990's and the early 2010's, and local prices of FAD fish were considerably lower than those of the French Antilles, making these products much more competitive in the local markets.

Finally, although the use of moored FADs by artisanal fishers is at the core of a rapidly developing fishery across the CRFM Member States, it is important to note that a few Member States, and in particular Barbados, Saint Lucia, and Trinidad and Tobago, exhibit a well-developed small-scale flyingfish fishery that makes extensive use of drifting FADs (CRFM 2014c).

8.4 RELEVANT ASPECTS OF THE MOORED FAD FISHERY

Nine island states, two French overseas territories (Martinique and Guadeloupe), and five Dutch territories (Aruba, Curacao, Bonaire, Saint Bathelemy and Saba) at present exhibit a fishery that makes a significant use of moored FADs (Table 6) (Reynal et al. 2015a). The remaining (continental and insular) countries in the Wider Caribbean region either do not have a significant moored FAD fishing activity or their status in that regard is not known. At present, nine CRFM Member States exhibit a fishery that makes a significant use of moored FADs (Table 6).

The data available in the literature on the number of moored FADs deployed within each state's territorial waters, the number of vessels and fishers making use of those FADs, as well as on FAD associated landings and the relative contribution of the latter to total landings by the state are notoriously scarce (Table 7). In those states where data on some of these indicators exist, the evidence suggests that the moored FADs do indeed make a significant contribution to the fleets' occupational fishing activity and to total fish landings (e.g. south of Haiti, Grenada, Dominica, Saint Lucia, Tobago; Table 7).

8.4.1 FISHING VESSELS, FISHING TECHNIQUES AND POSTHARVEST SECTOR

The vast majority of vessels engaged in the commercial moored FAD fishery across the region are small (<9 m), open, multi-purpose, outboard-powered vessels, consistent with the dominant vessel type in the artisanal fisheries of CARICOM states (FAO 2004, CRFM 2014b). Within this broad vessel category, there can be considerable variability in vessel specific characteristics (size, building material, shape, presence or absence of sail) within and among locations (e.g. Vallès 2015). Similarly, the average outboard engine power can differ strongly across the region (e.g. from the 170 hp engine in Guadeloupe to the 15 hp in Haiti; (CRFM 2014b, Guyader et al. 2015, Vallès 2015)).These small vessels will generally engage in one-day fishing trips to FADs and will generally have a crew size varying between 2 and 4 members depending on location in the region (e.g. FAO 2007, Guyader et al. 2013, Vallès 2015). In addition to small-scale commercial fishing activities, recreational fishing is also likely to play an important role in the exploitation of oceanic and coastal pelagics on FADs, as it does on the non-FAD associated fishery (FAO 2004). This type of fishing is carried out by charter boats, by individuals owning their own boat, or by visiting sport fishing boats, but remains poorly documented (FAO 2004, Tietze and Singh-Renton 2012).

The fishing techniques used around the moored FADs across the region tend to be highly selective. Three techniques predominate: surface trolling, deep trolling, and drifting longline with live bait (generally with one single hook) (FAO 2007, Sidman et al. 2015, Vallès 2015).

FAD captures are landed within the larger set of available landing sites and shore facilities used for the landings of large pelagic species, although it is likely that distance of the FADs from the different landing sites might influence which specific landing sites are used more frequently. In any case, these landing sites can generally be allocated to three categories: (1) a developed complex with a building, office, cold storage, ice making equipment, jetty and breakwater if required; (2) a small landing site with some

government provided facilities such as water supply, gear sheds, lighting, covered working areas; and (3) beaches with minimal facilities and makeshift structures (FAO 2004).

Table 6 - States and overseas territories within the Wider Caribbean region with a significant moored FAD fishery and Caribbean states and overseas territories with a moored FAD fishery that is not significant or is currently unknown as indicated by Section 6 of Reynal et al. (2015a) and updated on June 2015 after inputs from the CRFM Secretariat. * - indicates CRFM Member States.

Significant moored FAD fishery	No significant moored FAD fishery / Unknown
*Antigua & Barbuda	*Anguilla
*Dominica	*The Bahamas
Dominican Republic	*Barbados
*Grenada	*Belize
French Antilles (2)	Brazil
*Haiti	Colombia
Netherland Antilles (5)	Costa Rica
*Saint Kitts & Nevis	Guatemala
*Saint Lucia	*Guyana
*Saint Vincent & the Grenadines	Honduras
*Trinidad & Tobago	*Jamaica
	Mexico
	*Montserrat
	Nicaragua
	Panama
	Venezuela
	Cuba
	USA
	*Suriname
	British BVI

Across the region, the post-harvest sector for large pelagics is less developed and specialized than the harvest one, with the exception for yellowfin tuna and swordfish in the main fishing nations (FAO 2004), and this is particularly well exemplified in the least developed nations such as Haiti (Vallès 2015).

Table 7 - Current or recent estimated number of moored FADs, FAD fishers, and FAD vessels, as well as proxies of the importance of the FAD fishery and recent FAD funding source for CRFM Member States where the FAD fishery is significant and the French Antilles. Year to which estimates apply is given in brackets.

Country	# of FADs	# FAD fishers	# boats	Importance to the fishery	Recent funding source	References
Antigua and Barbuda	≥3 (2012)	26 (2013)	-	-	JICA (CARIFICO)	(CRFM 2013d, c)
Grenada	1 (2012)	-	50 (2013)	7% of fleet; 1.2% of national catch (2013)	FAO; OECS, JICA (CARIFICO); Govt of Grenada; IFREMER (MAGDELESA); Private	(CRFM 2013c)
Dominica	40 (2013)	338 (2011)	200 (2011)	74% of total fish production (2012); 45% of vessels	Private; JICA (CARIFICO); IFREMER (MAGDELESA); University of Florida; Texas A & M University; Govt of Dominica	(CRFM 2012d, 2013d, c, Mathieu et al. 2014)
Guadeloupe	>400 (2013)	-	300 (2010)	37%, 28% and 25% of fleet, landings, and value, respectively (2013)	Mainly private;	(Guyader et al. 2011, CRFM 2013c, Mathieu et al. 2014)
Martinique	16 (2008), but many more private	-	300 (2010)	35% of fleet (25% when considering exclusive FAD fishing) (2011)	Mainly public;	(CRFM 2013c, Mathieu et al. 2014)
Saint Kitts and Nevis	19 private (2008-2013) + 4 (2012) + 5 (2014)	41(Nevis, 2013)	16 (Nevis, 2013)	-	IFREMER (MAGDELESA); JICA (CARIFICO); CAMPAM; Private	(CRFM 2013d, c)
Saint Lucia	10 - 15 (2010-2015)	1000 (2015)	ca 500 (2004)	80% of 670 vessels engage in trolling on FADs (2004)	FAO; JICA (CARIFICO); Govt of Saint Lucia; EU; Fisher cooperatives and private	(FAO 2007, CRFM 2013d, c); S. Ferrari (Dept. of Fisheries of Saint Lucia) pers. com. (2015)
Saint Vincent and the Grenadines	2 (2006) + 2 (2002) + 1 (2014)	-	-		European Interregional Cooperation; IFREMER (MAGDELESA); JICA (CARIFICO)	(CRFM 2013d, c)
Haiti (south)	21 (2015)	450 (2015)	136 (2015)	About 10% of fishers and vessels (2015)	UNEP; Spanish Cooperation; private;	(CRFM 2013c, Vallès 2015)
Trinidad & Tobago	Off Tobago: 11 (2003-2004); but currently many more private	100 (Tobago, 2013)	-	25 % of fishers (Tobago, 2013)	JICA + Gov of T&T; Private	(FAO 2007, CRFM 2013c)

8.4.2 SOCIO-ECONOMIC STATUS OF FISHERS

Little information is available on the socio-economic status of FAD fishers, and of fishers in general, in the CRFM Member States. In Haiti, fishers are generally considered one of the poorest sectors of society and many fishing communities live without any access to basic services (Breuil 1999, Damais et al. 2007, Favrelière 2008). There is evidence that the recent introduction of moored FADs has contributed to improve fishers' livelihoods in south-eastern Haiti (Macías 2014).

In a study assessing levels of poverty and vulnerability to natural hazards in fisher communities (but not specific to moored FAD fishers) across several Member States of CRFM that make significant use of moored FADs, household poverty levels varied between 0 % (Saint Kitts and Nevis) and 6.61% (Grenada) (CRFM 2012a). For the same Member States, household vulnerability levels were consistently higher, varying between 9.86% (Saint Kitts and Nevis) and Grenada (25.45%) (CRFM 2012a).

Overall, these results highlight the need to better characterize the socio-economic conditions of fishers across the region, while pointing to considerable differences among locations in poverty levels. Overlaid over these poverty differences, there appears to be a general background of high vulnerability of fisher communities to natural hazards across the region (Nurse 2011).

8.4.3 MOORED FAD DESIGN AND LOCATION

Lebeau and Reynal in FAO (2007) provide an account and synthesis of the evolution of design and location deployment of moored FADs in the region from the 1980's to the 2000's. The first models were based on designs from other regions (e.g. the Pacific), and the emphasis at that time was on building economical FADs using inexpensive and locally available materials (de Sylva 1982). A mixture of three factors generally prevailed in determining the location of FADs. The first was associated to the fact that the initial inexpensive designs were not hardy, and so the FADs were often deployed relatively near-shore and at relatively shallow depths to prevent FAD loss. The second important factor determining FAD location stemmed from fisher's traditional knowledge of the migratory routes of oceanic pelagics, which favoured the East side of the Lesser Antilles. The last factor was the desire to minimize fuel expenses by minimizing travel time to fishing grounds, and so in several locations FADs were deployed within six nautical miles from shore. During that time, the life span of the FADs was typically short, i.e. just a few months and the need to account for the effect of other fishing and maritime activities (e.g. shipping lanes) to minimize FAD losses and increase FAD life span was being increasingly acknowledged. Islands like Curacao, through public funds, were among the first to invest in larger, more visible, more resilient and more expensive models.

As the importance of FAD fishing increased, the different designs have evolved to adapt to the local context (FAO 2007) and other factors have now come into play in determining where FADs are being deployed. First, the depth at which FADs are being laid has increased to a typical range of 1,000 to 2,000 m to prioritize targeting oceanic species. Similarly, the distance from shore has also increased to a typical range of 10 to 55 nautical miles. The latter has been driven by both, the desire to target oceanic species as well as to minimize interference with other fishers in those instances where FADs are privately owned. In contrast, in those instances where FADs have been funded by public or aid-agencies, they have generally being deployed closer to shore (within 10 nautical miles) in a balance between the desire to allow most small boats to reach the FADs in safety and with minimum fuel consumption and the desire to target the oceanic species. Moreover, FADs are now being increasingly deployed all around the islands, particularly in Martinique and Guadeloupe, and at locations that are not necessarily known to be within the migratory routes of traditional target species, thus effectively extending the local fishing grounds for these species as

well as increasing the exploitation of species that were not very much exploited by traditional fisheries in the past, such as the yellowfin tuna and blue marlin.

A moored FAD is generally made up of six main components: (1) the surface float component (one or multiple buoys of various dimensions and sizes), (2) a fish aggregating structure (e.g. coconut leaves; tarps; nets; fishpots), (3) a mooring structure or device (e.g., metal pieces; old engines; a concrete structure; sand bags), (4) the mooring line [e.g., a diverse range of synthetic floating (e.g. polypropylene) and/or sinking (e.g. nylon) lines; telephone wire; banana string; wire cable; mixed (e.g. polypropylene + stainless steel) lines], (5) the joining elements (e.g., knots; swivels; shackles; thimbles), and (6) occasionally, the elements attached to the floating component to enhance the detection of the FAD (e.g., mast; flag; radar reflector; solar light).

Within that general description, Dempster and Taquet (2004) split moored FAD design into three broad categories: heavy, semi-heavy and light FADs. Heavy FADs typically have as surface float component a single large surface buoy made of steel, PVC (e.g. Curacao, (Le Gall et al. 1999) or composite material (e.g. Martinique, PLK600 model). The mooring line in these FADs is made up of different portions, with chain or wire cable near the surface (e.g. the first 200 m) to protect the FAD from ship and fishing line damage, sinking line in the mid-section and floating line in the lower section connecting to the mooring structure. The latter is generally made up of one to three concrete blocks.

In semi-heavy FADs, the surface float is made up of many pressure resistant buoys that sink progressively with strong currents and return to the surface after immersion (e.g. Martinique - IFREMER model). The mooring line system is similar to that of the heavy FADs, except that the lines tend to be smaller in diameter (Dempster and Taquet 2004). In contrast, the light FAD are simpler in design (e.g. a mooring line entirely made of the same material) and their individual components are varied and mainly determined by local availability of inexpensive materials.

The three FAD types, heavy, semi-heavy and light are found in the Caribbean region. Since the heavier and more expensive models will tend to have a longer life span, whether one FAD type prevails over another at a particular location will depend on the trade-off between specific FAD cost and life span, without any clear link to the capacity of the different models to attract and concentrate fish (Dempster and Taquet 2004). Differences in cost between the different FAD designs can reach one order of magnitude (e.g. from 400 euros to 2350 euros), and the average typical life span of a given FAD design at a specific location can range from several weeks, to several months, and to several years (FAO 2007). The trade-off between specific FAD cost and life span is likely to vary across locations and remains poorly known in the region, particularly because accurate data on FAD life span are lacking. The predominance of a FAD type also depends on the actors involved in the funding, with aid and public agencies generally investing in the heavy to semi-heavy models, whereas individual fishers predominantly investing in light ones (FAO 2007, CRFM 2013d, c). In Guadeloupe, fishers consider their privately deployed FADs as consumables and so minimize investment in the units. Moreover, the costs of FAD deployment are not negligible and will increase dramatically with the size and weight of the mooring structure (FAO 2002a).

The FAD designs from the French Antilles (Figures 5 and 6) have been particularly influential in guiding FAD design across the rest of the region either through direct knowledge transfer among fishers (who have then modified them to suit their local needs) or through formal research and aid collaborations with government/donor agencies (FAO 2007). More recently, lessons learned on FAD design (such as the use of sand bags and sand bottles as mooring component and mid-water buoys, respectively) from the FAD Pilot Project in Dominica (CRFM/JICA 2012) have been transferred to other CRFM Member States through technical cooperation (Figure 7).

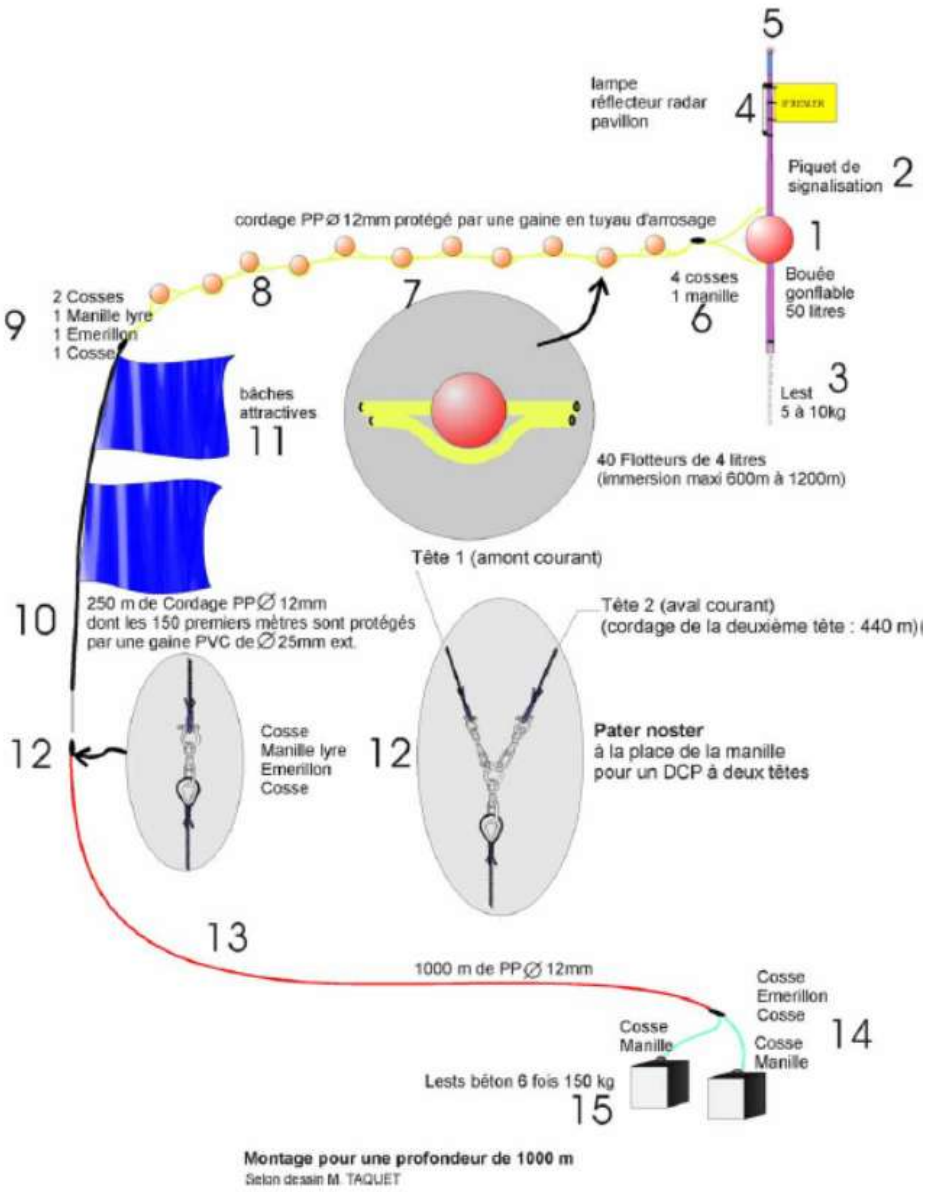


Figure 5. Schematic representation of the moored FAD model used by IFREMER in Martinique (for a deployment depth of 1000 m). Number labels are 1) 50 litre inflatable buoy; 2) signalling pole; 3) 5 to 10 kg sinker; 4) radar reflector and flag; 5) light; 6) 4 thimbles and 1 shackle; 7-8) 12 mm diameter PP rope protected with water hose along with 40 x 4 litre floaters; 9) 2 thimbles, 1 lyre shackle, 1 swivel and 1 thimble; 10) 250 m of 12 mm diameter PP rope of which the first 150 m are protected by a 25 mm diameter PVC sheath; 11) aggregating tarps; 12) thimble, lyre shackle, swivel and thimble; 13) 1000 m of 12 mm diameter PP rope; 14) thimble, swivel, thimble (mooring line) + thimbles and shackles (mooring blocks); 15) 6 concrete blocks x 150 kg each. PP – polypropylene. Taken from FAO (2007).

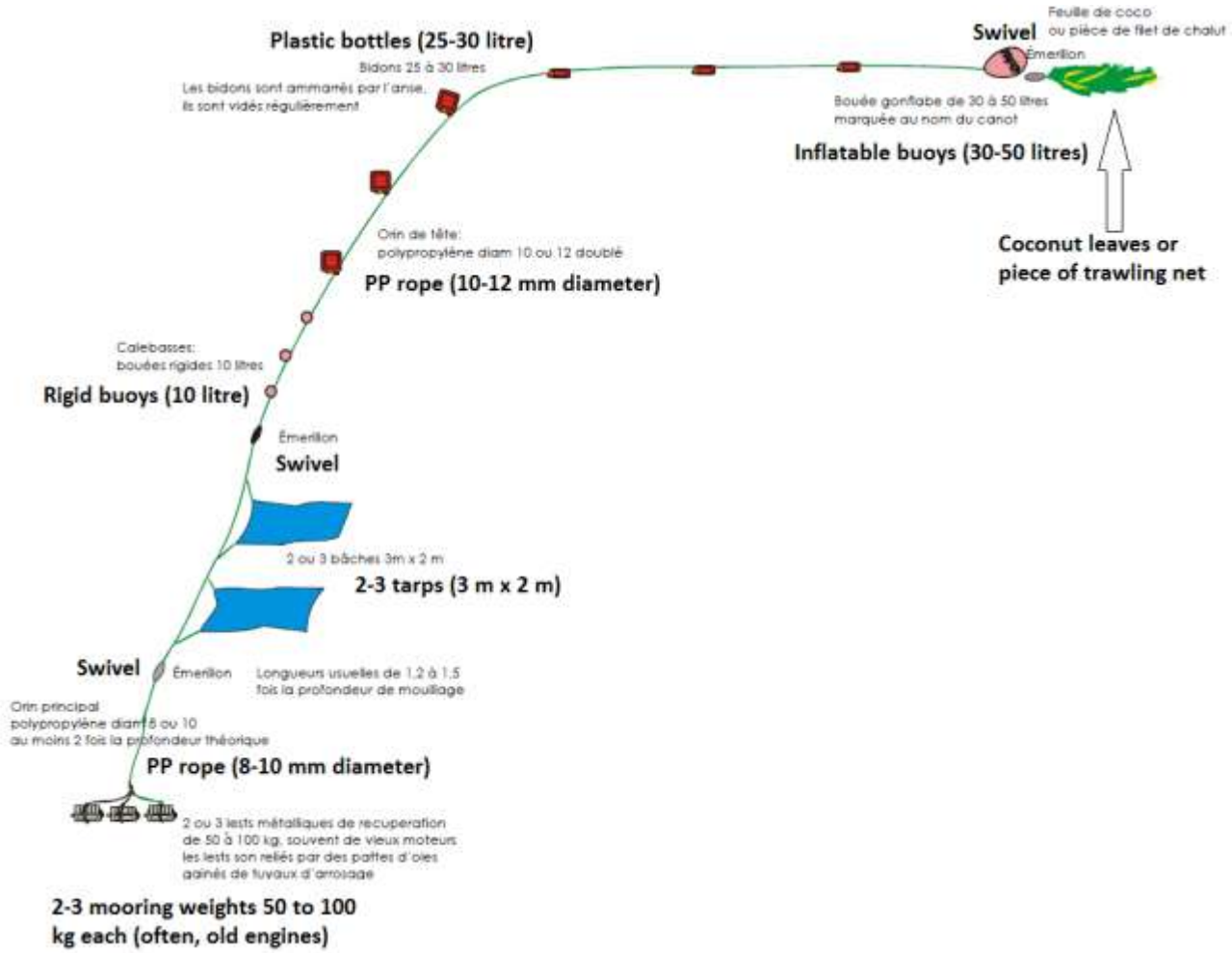


Figure 6 - Schematic representation of the artisanal moored FAD model used in Guadeloupe (adapted from FAO 2007). PP – polypropylene

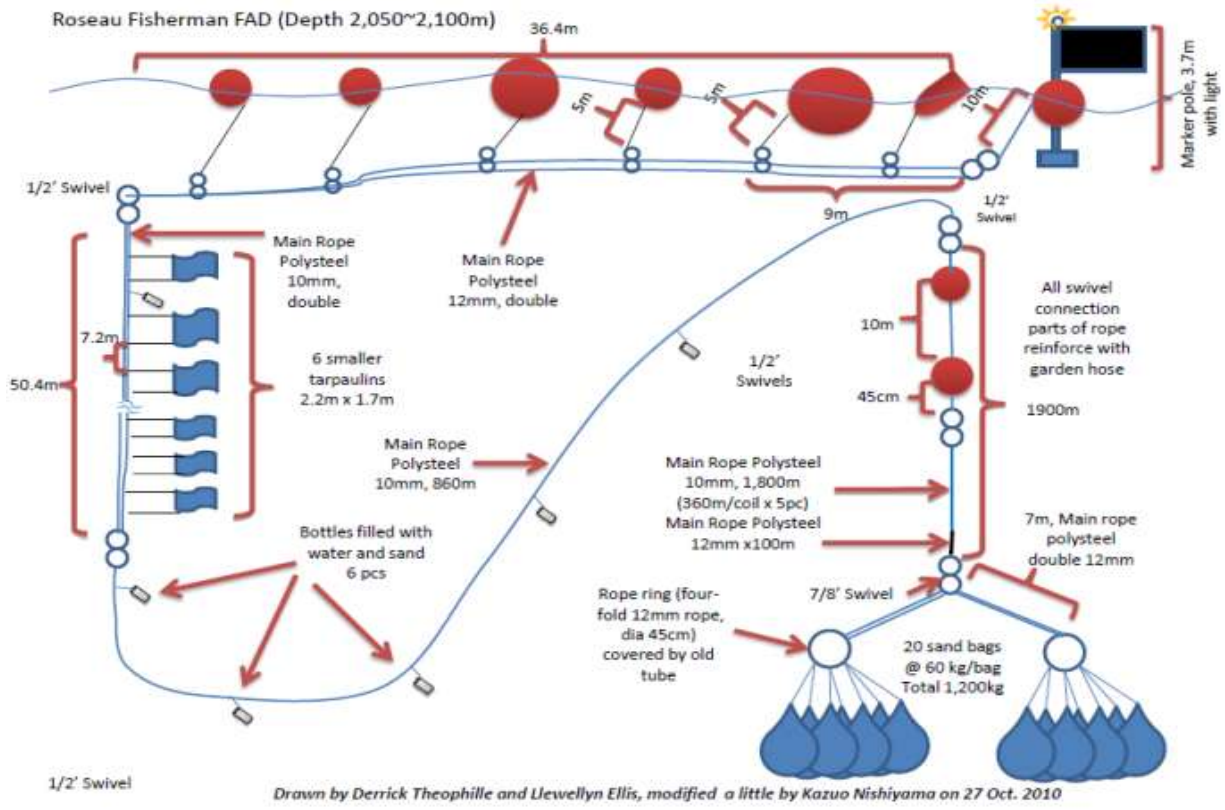


Figure 7 - Schematic representation of the artisanal moored FAD model used in Dominica. Note the use of sand bags and sand bottles as mooring component and mid-water buoys, respectively.

Ideally, a design that maximizes FAD life span and FAD use would incorporate, among others, the following characteristics. First, the surface float component should be sufficiently buoyant so as to withstand the strongest currents without submersion all year long. This float component should be sufficiently large to be detected from distance by ships and should be equipped with solar-powered lights strong enough to be seen from far at night. Finally, the first section of the mooring line (e.g. the first 200m) should be effectively protected to prevent the cutting of the line by fishing lines or fish bites. These basic characteristics would allow fishers to fish on FADs all year long as well as during the day and night periods, optimizing FAD use. These characteristics would also minimize FAD losses due to ship traffic, which is a major driver of FAD losses across the region (FAO 2007, CRFM 2013a, b).

Of particular relevance to this sub-regional plan is the recommendations on moored FAD design recently issued by the CRFM-JICA CARIFICO / WECAFC-IFREMER MAGDELESA Workshop on FAD Fishery Management held in Kingstown, Saint Vincent, (CRFM 2013c) determining minimum standards for FAD construction, particularly:

- A sufficient mooring weight in relation to lines (diameter and length) and the buoy, to avoid FAD dragging, so as to prevent possible damages to critical submarine habitats and infrastructure, such as cables, pipes and to marine traffic at the surface;
- Correct night and day markings to prevent navigational hazard;
- An adapted buoy volume to resist to local currents to reduce the FAD losses and the generation of debris in the marine environment

Finally, it is noteworthy to point out that the CARAFAD website, funded by the MAGDELESA project and which will be operational in 2015, is intended to fill a gap in technical assistance in FAD design and construction, as well as to facilitate the monitoring of FADs across the region.

8.4.4 MOORED FAD LANDINGS

Several fisheries departments across the region have long-term monitoring systems of fishery landings (e.g., Saint Lucia, Trinidad and Tobago). However, the need to specifically separate the landings from the moored FAD fishery from other activities has only been recognized more recently and often a result of the collaboration with fisheries aid and research projects such as CARIFICO (JICA) and MAGDELESA (IFREMER). Thus, there is a pervasive lack of landing data (total fish biomass, catch composition, seasonality, spatial differences) from the moored FAD fishery across the insular Caribbean region, with the notable exception of the French Antilles, particularly during specific periods (e.g. Guadeloupe in 2008; (Guyader et al. 2015)). A summary of some of the data available is given below.

8.1.1.1 TOTAL LANDINGS

Grenada has recently reported a total landings annual yield of approximately 22 metric tons from fishing one single moored FAD (from August 2012 to July 2013), which represents a monthly average of 1.9 metric tons (CRFM 2013c). Saint Vincent has recently reported 6.9 metric tons of landings from two FADs between August 2012 and November 2013, for a monthly average of 0.6 metric tons (CRFM 2013c). In Haiti, total FAD associated yields across four landings sites (and 6 -7 FAD units) in the Southeast between June 2013 and August 2014 indicated an annual yield of approximately 43 metric tons, for a monthly average of 3.6 metric tons (Vallès 2015). FAD landings in the French Antilles are considerably larger. Guyader et al. (2011) estimated that yearly catches on FADs in Guadeloupe (about 400 FAD units) approximated 1,090 metric tons in 2008, for a monthly average of 91 metric tons. In Martinique, Reynal et al. (2011) estimated yearly catches (on 12 FAD units) at 334 and 287 metric tons for 2009 and 2010, respectively, corresponding to monthly averages of 27.8 and 23.9 metric tons, respectively (see also Reynal et al. 2015b).

8.1.1.2 FISHING EFFORT AND FISHING EFFICIENCY ON FADS

Most of the detailed data on variability in fishing effort and efficiency on moored FADs comes from the French Antilles (FAO 2007, Guyader et al. 2013, Mathieu et al. 2013, Guyader et al. 2015, Reynal et al. 2015b). In 2008, Guyader et al. (2013) estimated that about 300 vessels engaged in the FAD activity in Guadeloupe jointly accounted for 12,000 fishing trips (day at sea), which represented 19% of the total number of fishing trips of the entire Guadeloupian fleet. In Martinique, Reynal et al. (2015b) found that the number of fishing trips in a year remained relatively constant between 2009 and 2012, with approximately 6,500 trips for a fleet of approximately 300 vessels.

Fishing effort will tend to vary seasonally within a given location, but the strength and nature of the seasonal component are likely to differ across locations. For example, Mathieu et al. (2014) showed that the number of FAD fishing trips per month remained relatively constant throughout the entire year in Dominica, whereas Martinique and Guadeloupe exhibited much stronger seasonal patterns. Furthermore, fishing effort on FADs in Guadeloupe peaked between June and August, whereas that of Martinique peaked in the October-December period (Mathieu et al. 2014).

Fishing effort on FADs will also vary spatially at local scales as fishers respond to differences in FAD distance and productivity (Guyader et al. 2015, Reynal et al. 2015b). For example, in Martinique, the proportion of the total number of fishing trips to FADs decreases strongly with FAD distance from shore, with about half the fishing trips taking place within 12 nautical miles (Reynal et al. 2015b).

In Guadeloupe, FAD-associated landings per trip were around 100 kg in 2008 (Guyader et al. 2013). In Martinique, fish landings per fishing trip typically varying between 55 kg and 65 kg per trip for most years between 2009 and 2013 (Reynal et al. 2015b). The duration of most fishing trips was 8-12 hours (25% of all trips), with yields per hour varying between 2.7 kg and 5 kg (Reynal et al. 2015b). In Dominica, average catches per trip vary between 118. 2 kg and 56.8 kg per trip (Sidman et al. 2014). In Haiti, a short term study during the low season estimated average catches to be of 18.7 kg per fishing trip and fishing trip duration differed dramatically from one location to another varying between 6 to 12 hours (Vallès 2015). Nevertheless, the short term nature and limited coverage of the aforementioned study warrant caution in the interpretation of these data.

There is also evidence that fishing efficiency increases with increasing distance from shore. In Martinique, between 2004 and 2005, fishing within 12 nautical miles yielded on average 44.9 kg per fishing trip (8.2 kg per fishing hour) whereas exceeding 24 nautical miles yielded on average 135.7 kg per fishing trip (19.4 kg per fishing hour) (Reynal et al. 2015b). This distance effect might partly reflect the fact that the number of vessels concurrently exploiting a FAD on a given day decreases with distance, going from an average of 3 to 8 vessels per FAD (maximum observed: 30 vessels) within 12 nautical miles to an average of 2 to 6 vessels (maximum observed: 22) beyond 24 nautical miles (Reynal et al. 2015b). In Dominica, there is evidence that reducing the average number of vessels concurrently exploiting a FAD from about 4 (on public FADs) to about 2 (on private individual FADs) results in approximately twice the amount of fish landed per fishing trip (Sidman et al. 2014). In Haiti, it is usual to have between 3-4 vessels fishing on any given FAD, with the maximum numbers of vessels reaching 16 in some locations (Vallès 2015). The effect on fishery yields of the number of boats concurrently fishing on a single FAD remains poorly studied.

Guyader et al. (2013) conducted a detailed study on the economic performance of fishing on FADs compared to other fisheries in Guadeloupe in 2008. They found that the apparent benefits of fishing on FADs compared to other fishing activities (e.g. near-shore fishing) were considerably reduced if time spent at sea (about 10 hours) was included in the cost-benefit analysis, since part of that time could be used to generate revenue through other economic activities (i.e. opportunity cost). Thus, whether or not there exist other economic opportunities available to fishers might dictate whether they decide or not to dedicate themselves exclusively to FAD fishing. More similar studies are needed across the region.

8.1.1.3 CATCH COMPOSITION IN SPACE

The proportion of species exploited around moored FADs will differ from those fished by the traditional surface trolling line around flotsam, which are typically dominated by dolphinfish and wahoo (Diaz et al. 2006). This will be due partially to the use of deep trolling and drifting longlines around FADs targeting notably yellowfin tuna and blue marlin (FAO 2007), as well as to the specific nature of the multi-species groups aggregated around FADs compared to the open sea (Doray et al. 2006, 2008).

Nevertheless, there can still be considerable differences among locations in the relative contributions of the different species to total FAD landings. This is illustrated by the available data on catch composition (for ≥1 year of sampling) across the Lesser Antilles (Fig 8, Table 8). Notably, only yellowfin tuna and dolphinfish are part of the top five species landed across the five locations for which data were available (i.e. Guadeloupe, Martinique, Dominica, Grenada, Saint Vincent and the Grenadines). These two

ubiquitous species are followed by blackfin tuna, which is part of the top five species across four of the five locations, and by blue marlin, which was a dominant species in three of the five locations (Fig 8, Table 8). These data did not suggest any latitudinal pattern in species composition across the Lesser Antilles (Fig 8, Table 8). Consistent with this spatial variability in catch composition over long distances, Vallès (2015) found evidence that, along a 300 km stretch along the southern coastline of Haiti, dolphinfish and tunas dominated the catches in the east whereas billfishes did so towards the west.

Over smaller spatial scales, at the small island scale, the level of exposure and the distance from shore at which FADs are deployed will have an effect on the composition of the catch. For example, in Martinique (period 2000 to 2002), the joint relative contribution of blue marlin and yellowfin on FADs on the Caribbean side and within 10 nm from shore was 36% of the catch, which was dominated by blackfin tuna (33% of the catch) (FAO 2007). In contrast, blue marlin and yellowfin accounted for 70% of the catch on FADs on the Atlantic side deployed at distances of 10 to 20 nautical miles during the same period, with blackfin tuna exhibiting only 6% of the catch (FAO 2007). Thus, the cross-regional differences in FAD catch composition will be confounded with differences across the region in exposure, depth, and distance from shore of deployed FADs.

8.1.1.4 CATCH COMPOSITION IN TIME

At any given location, the catch composition on moored FADs will vary over a range of temporal scales, including inter-annually [Fig 13 in Reynal et al. (2015b)] as well as seasonally, due to the local availability of highly migratory target species. For example, data from the French Antilles illustrates seasonal differences in catch composition between and within islands, with fishers from Guadeloupe landings proportionally more dolphinfish during the dolphinfish season (December to May), and doing so in a considerably larger proportion than those of Martinique (Fig 9) (Mathieu et al. 2014).

Furthermore, the main target species are likely to differ in seasonal patterns of abundance. For example, in Martinique, yellowfin tuna and blue marlin appear to have contrasting seasonal patterns, with blue marlin catches peaking in April and those of yellowfin tuna doing so around the end of the year (Fig 10) (FAO 2007, Reynal et al. 2015b). In contrast, blackfin tuna catches increase steadily from January onward to reach a peak in October, whereas skipjack tuna exhibits a bimodal pattern with peaks in May and September (Reynal et al. 2015b). It is likely these species-specific patterns differ among locations across the region as these species move along their migration range. In that regard, it is also important to point out that seasonal variability in environmental and biological factors influencing fish catchability on FADs such as sea conditions, strong currents, cetacean abundance, and baitfish availability can also influence the seasonal patterns of fish abundance when the latter are inferred from fishery-dependent data.

Finally, over much finer temporal scales, the night-day cycle that leads to a re-distribution of fish biomass along the FAD depth gradient and radius (Doray 2006, Doray et al. 2006, 2008) will also likely affect the composition of the catch on FADs (i.e. day vs night fishing).

8.1.1.5 SIZE-STRUCTURE AND MATURITY STAGE OF MAIN TARGET SPECIES

It is informative to examine the size-structure of the catch when using moored FADs for each of the main target species in Martinique, for which these data are available (FAO 2007, Reynal et al. 2015b). For the dominant tunas, catches under FADs tend to be numerically dominated by small sized individuals and juveniles. For yellowfin tuna, Reynal et al. (2015b) highlight the presence of tri-modal distribution, with the first and dominant peak observed at approximately 30 cm in fork length (FL), the second one at approximately 50 cm FL, and the last and smallest peak occurring at approximately 135 cm FL (Fig 11).

The first two peaks are clearly below the size at maturity (Lm) for yellowfin tuna (Fig 11). The first one represents the small individuals that are caught using surface trolling to be used as bait. The second peak represents the larger individuals that are forming mixed schools with blackfin tuna. The third peak, well above the yellowfin's size at maturity, represents those individuals which are caught using drifting longline with baitfish (Fig 11). These large individuals will account for the bulk of the catch in fish weight. Similarly, visual inspection of the size-frequency distribution of blackfin tuna reveals a bi-modal distribution with a dominant peak around 30 cm FL, below size at maturity, and another around 49 cm FL, well above size at maturity (Fig 11) (Reynal et al. 2015b). For dolphinfish, the size-frequency distribution of fishes caught under FADs differs strongly from that of fish caught in the open offshore, with a considerably larger proportion of juveniles caught under FADs (Fig 11) (Reynal et al. 2015b).

Overall, the data by Reynal et al. (2015b) indicate that catches under FADs are dominated by juvenile fish for several of key target species, with juveniles accounting for 87%, 56% and 76% of the number of fish caught under FADs for yellowfin tuna, blackfin tuna and dolphinfish, respectively (see also FAO 2007). In contrast, for blue marlin, the pattern is reversed with only 9% of individuals being in the juvenile stage (FAO 2007, Reynal et al. 2015b).

Furthermore, time of day at which fishing takes place (e.g. night vs day), level of exposure and FAD location (e.g. Atlantic versus Caribbean side), and fishing depth (e.g. deep vs surface trolling) will have strong effects on the size-structure of the individuals captured as well as on the proportion of juveniles for a given species (FAO 2007). For example, skipjack tunas caught by surface trolling will be, on average, larger than those caught using deep trolling (Fig 12); blackfin tunas that are fished before 5 am will be, on average, considerably larger and more mature than those fished after 5 am (Fig 12); and blue marlins caught on the Caribbean side will be, on average, larger than those caught on the Atlantic side of Martinique (Fig 12).

In summary, fishing gear, lure and/or bait type, depth, time of day, distance from shore, exposure, and season will strongly influence the selectivity of the species and size-classes caught on FADs (FAO 2007, Reynal et al. 2015b, Sidman et al. 2015) and deserve research efforts to minimize the undesirable disproportionate capture of juveniles. In that regard, current research by the MAGDELESA project has recently highlighted the potential of the "jigging" fishing technique to selectively capture large adult blackfin tuna (Reynal et al. 2015b), which is one of the most abundant species aggregating under FADs (Doray 2006, Doray et al. 2006, 2008), but appears to be less exploited by current FAD fishing techniques (trolling, drift longlines) compared to the other species and/or fish size groups. This "jigging" technique, however, appears to be quite labor intensive (L. Reynal, pers. com), so its value as a viable alternative still remains to be seen.

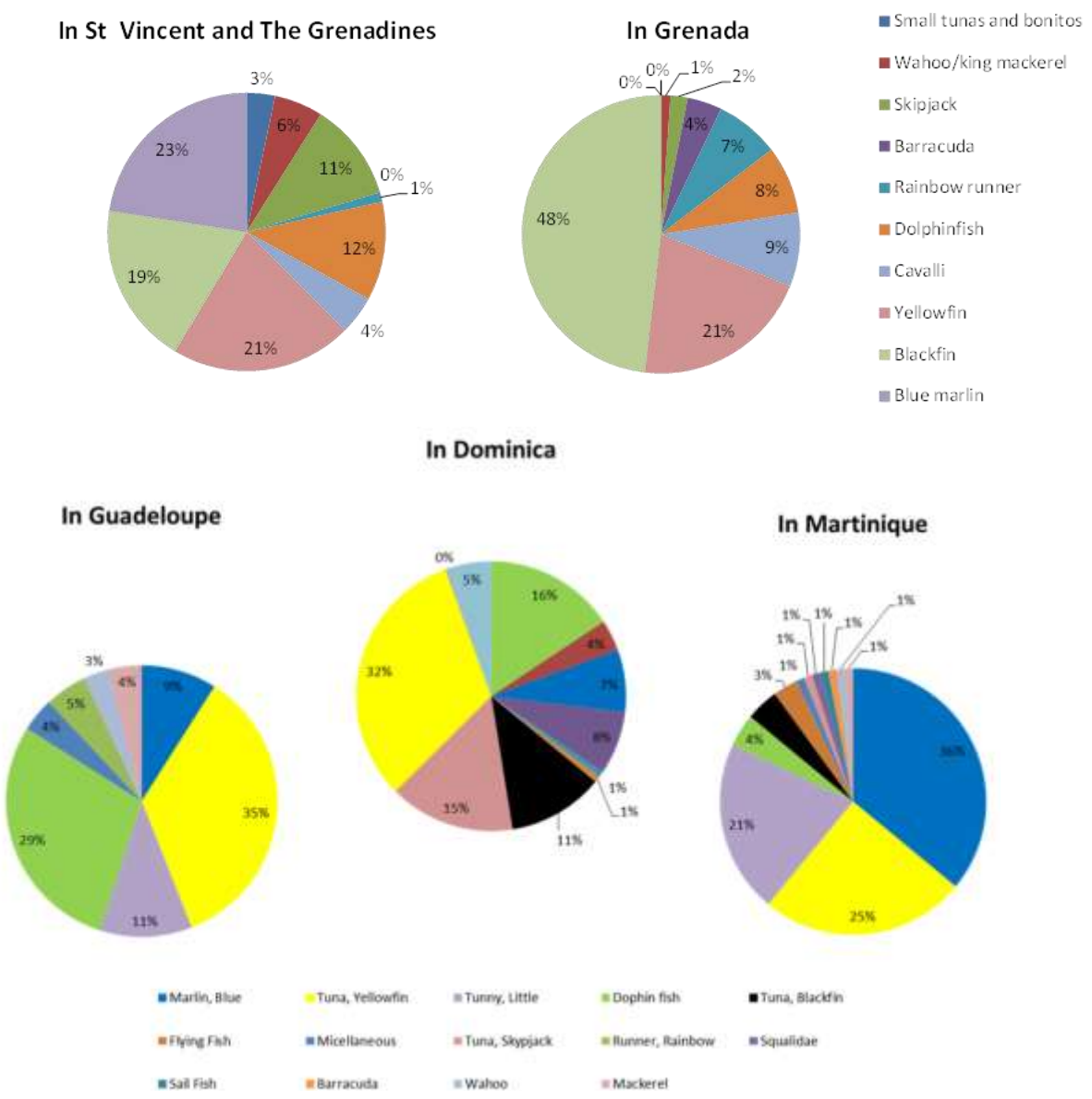


Figure 8 - Catch composition of the main target species caught on moored FADs across five different islands of the Lesser Antilles over ≥ 1 year. Source: (CRFM 2013c, Mathieu et al. 2014)

Table 8 - Top five species (or fish groups) caught on FADs at five different locations across the Lesser Antilles over ≥ 1 year. * - indicates species that were present in the top five at all locations. Source: (CRFM 2013d, c, Mathieu et al. 2014)

Top species	Grenada	Saint Vincent and the Grenadines	Martinique	Dominica	Guadeloupe
1	Blackfin	Blue marlin	Blue marlin	Yellowfin*	Yellowfin*
2	Yellowfin*	Yellowfin*	Yellowfin*	Dolphinfish*	Dolphinfish*
3	Cavalli	Blackfin	Little tunny	Skipjack	Little tunny
4	Dolphinfish*	Dolphinfish*	Blackfin	Blackfin	Blue marlin
5	Rainbow runner	Skipjack	Dolphinfish*	Sharks	Rainbow runner

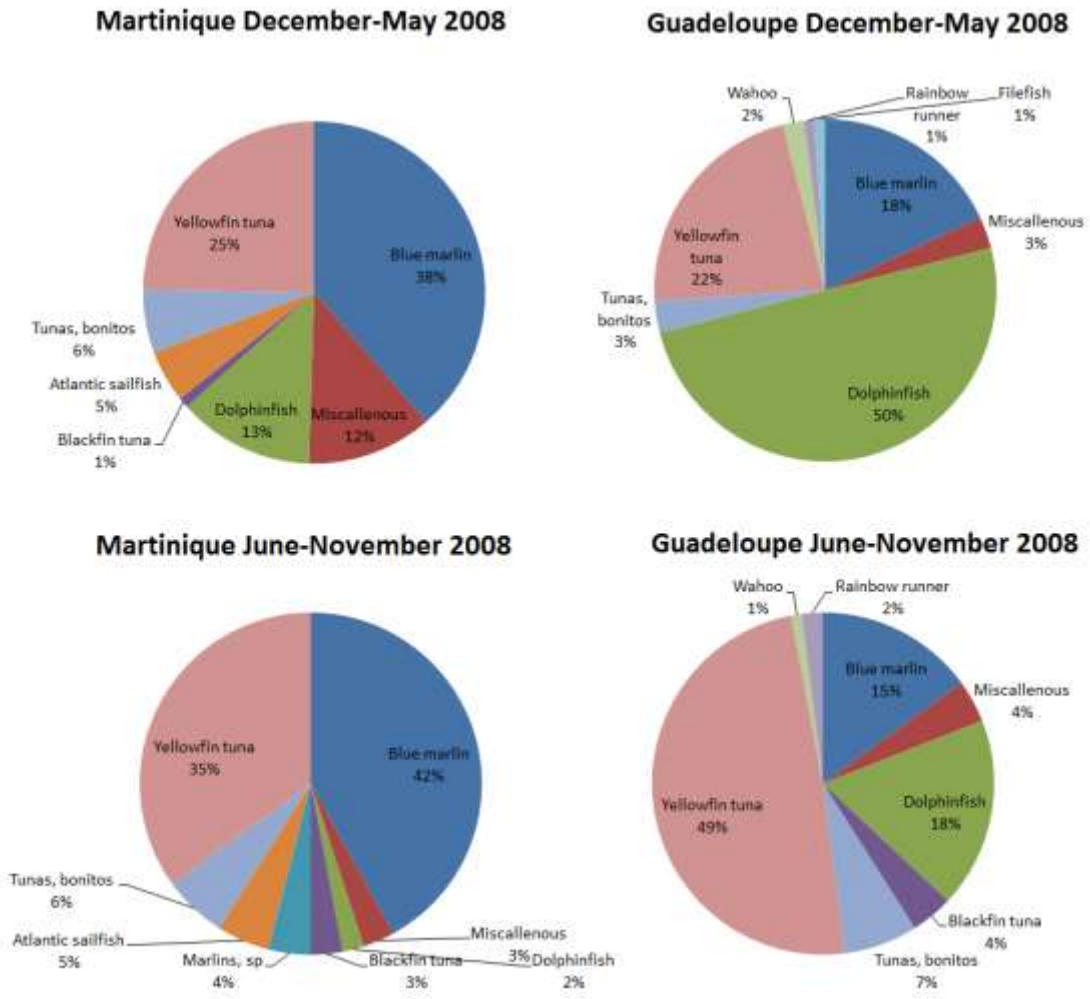


Figure 9 - Proportion of main target species caught on moored FADs in Guadeloupe and Martinique during (December-May) and off (June-November) the dolphinfish season. Modified from Mathieu et al. (2014)

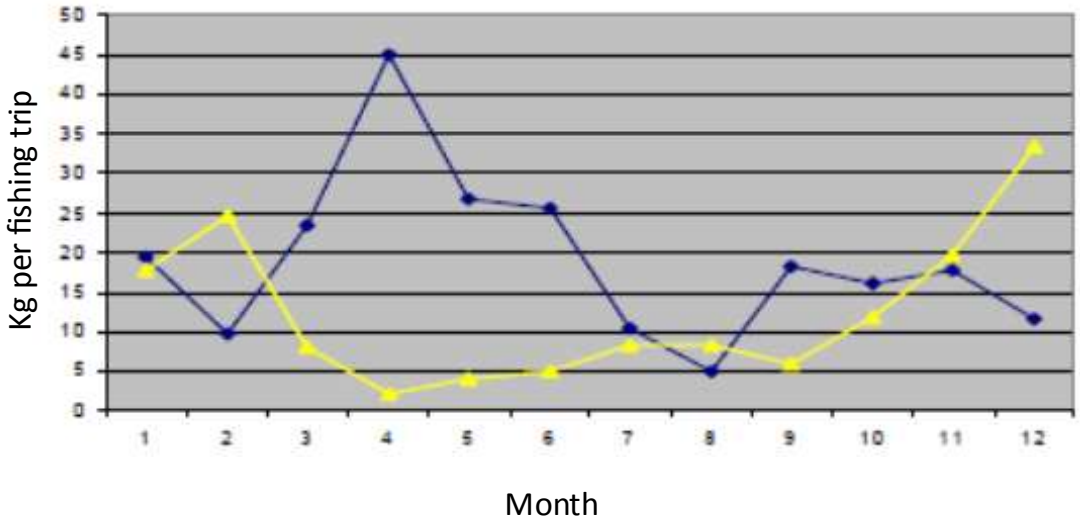


Figure 10 - Seasonal variation in catches of blue marlin (blue line) and yellowfin tuna (yellow line) in Martinique. Month 1 is January. Taken and modified from FAO (2007)

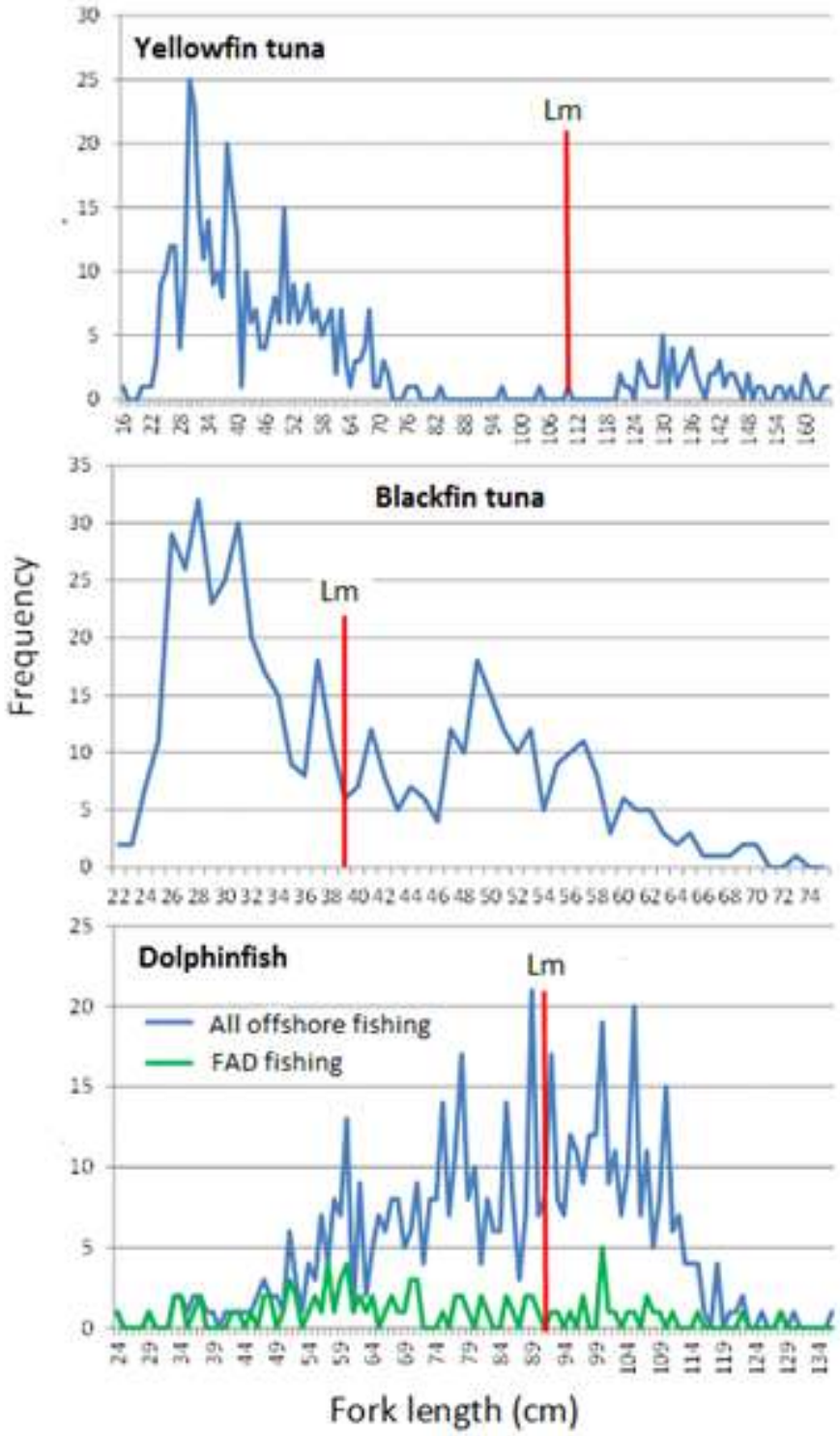


Figure 11 - Size-frequency distribution of key target species caught on moored FADs in Martinique. Lm represents size at maturity. Taken and adapted from Section 1 in Reynal et al. (2015b)

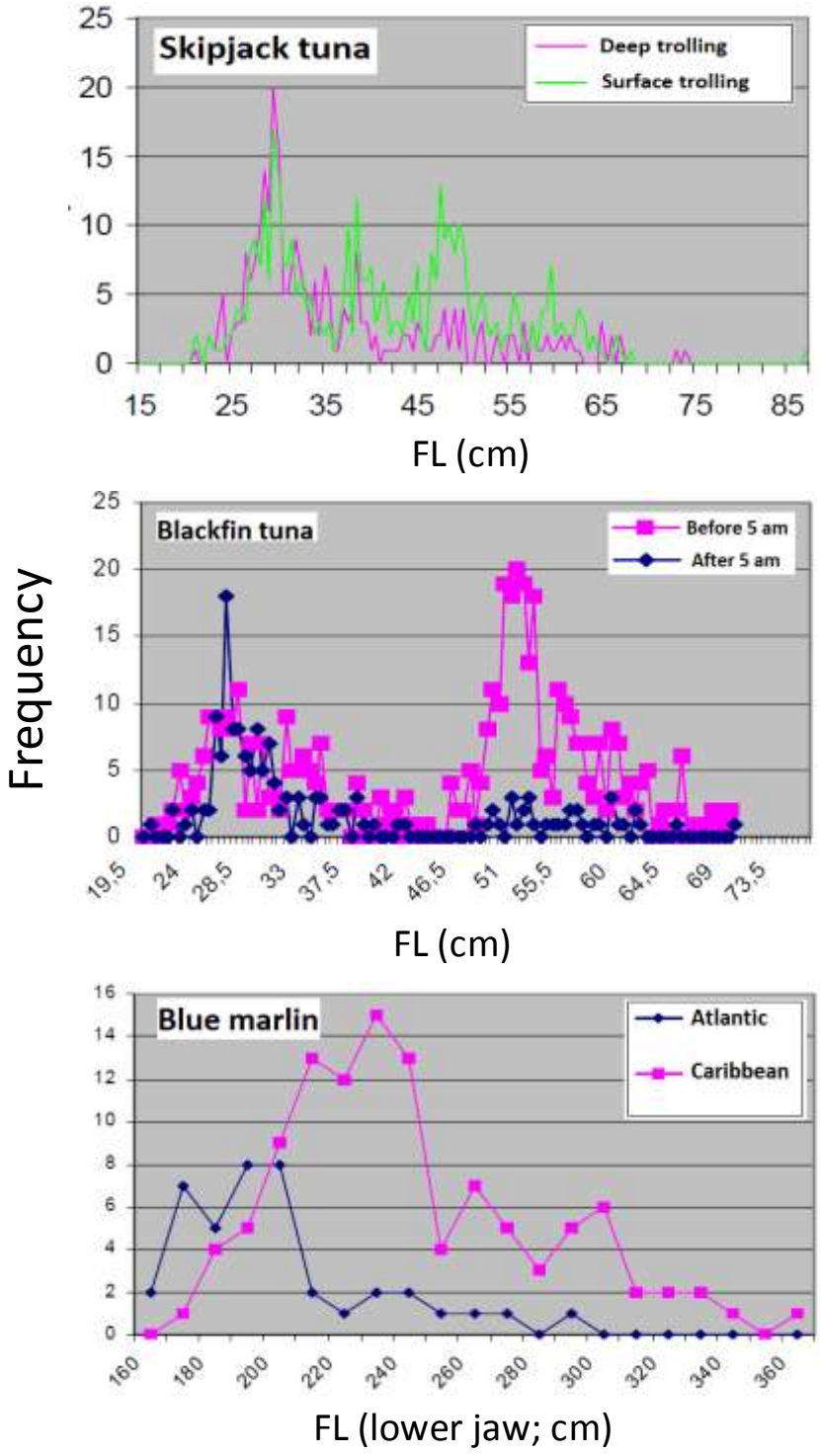


Figure 12 - Size-frequency distribution of key target species on moored FADs in Martinique comparing the effect of deep versus surface trolling, night versus day fishing (before vs after 5 am), and Atlantic versus Caribbean side. Lm represents size at maturity. Taken and adapted from FAO (2007)

8.4.5 FAD MANAGEMENT SYSTEMS

Ramdine in FAO (2007) provides an overview of moored FAD funding, the local legal context surrounding moored FAD use and regulation, and the types of conflicts that can arise during FAD use, across several islands in the region, i.e. Saint Kitts and Nevis, Saint Lucia, Guadeloupe, Martinique, Netherland Antilles. Although Ramdine's account dates from a decade ago, it still resonates strongly with the way the FAD fishing currently takes place across the insular Caribbean and so a summary is given below.

8.4.5.1 FAD FUNDING

Overlaying a background of great diversity of biophysical, social, economic and governance contexts characterizing the Caribbean region, there typically exists three broad types of funding modes for moored FADs in the region, i.e. government funded FADs (public FADs), FADs funded by a collective of fishers (private collective FADs), and FADs funded by individual fishers (private individual FADs). However, it is not unusual to find the three systems co-existing in the same nation. The first introduction of FADs in a nation is typically carried out through funding suppport from specific short-term projects from aid-agencies and/or governement agencies, which typically bear most of the costs of initial FAD construction and deployment; these FADs can be, for most puposes, considered as public FADs. These FADs tend also to be heavy or semi-heavy designs, often built with high quality imported materials, and thus rather expensive, so as to maximize the units' life spans (see also Table 9). However, the weak economies of many states generally prevent them from continuing to bear the costs of such FAD programs beyond the duration of the projects. It is therefore generally expected that, as the local FAD fishery develops, the fishers will contribute significantly towards FAD funding (multiplication of units, unit replacement and/or unit maintenance).

Despite the general recognition that FAD fishing significantly contributes to improve fishers' revenues, to date it has not been possible to create the organisational structure necessary to channel a portion of those increased revenues towards a national—level collective system that would ensure continued funding for FADs (construction, deployment, maintenance and replacement) anywhere in the region. Thus, as the fishery develops, what is generally observed in the region is a multiplication of private collective and/or private individual FADs, irrespective of the presence or absence of public ones. In that regard, these private FADs will generally undergo transformations in design, maximizing the use of locally available and cheap materials and becoming lighter, so as to be more affordable for the individual fishers or fisher groups. In some states, the relevant government agencies will still provide some level of support to organized groups of fishers (e.g., detaxation of material, logistial support for FAD deployment, maintenance), thus promoting the creation of private collective FADs over private individual ones (Table 9). It is also important to note that the use of private FADs seems to allow for a better spatio-temporal tracking and subsequent use of the FAD fishery resources, as its avoids the typical administrative delays associated with the obtention of public funds.

Table 9 - Diversity of funding modes for moored FADs in the islands of the Lesser Antilles (Year 2004) – Excerpted from Ramidine in FAO (2007)

Country	Purchase of equipment				Construction	Deployment	Maintenance
	International Cooperation	Public national	Fishermen	Others			
Saint Kitts & Nevis			Individually or in group		Fishermen	Fishermen	Fishermen
Guadeloupe		Experimental phase	Individually or in group		Fishermen	Fishermen	Fishermen
Dominica	EU (project to establish reserve)	Tax refund on material	Fishermen mostly in group	Rarely individuals	Fishermen	Fisheries service	Fishermen
Martinique		EU, State, Region	Individually or in group	IFREMER	Fishermen, contracting (CRPM, IFREMER)	Fishermen, contracting (CRPM, IFREMER)	Fishermen, IFREMER
Saint Lucia*	JICA; CARIFICO; MFC; EU; FAO	State	Cooperatives	Fishers	Fisherswith Fisheries Department	Fishers; Fisheries Department	Fishers; Cooperatives; wFisheries Department
Saint Vincent & the Grenadines[1]	JICA, IFREMER	JICA, State			Donor (IFREMER) fishermen with Fisheries Division	Donor (IFREMER) fishermen with Fisheries Division	Fishermen with Fisheries Division
Curaçao, Bonaire, Aruba		State		Mariculture foundation	State and contracting	State and contracting	State and contracting

JICA: Japan International Cooperation Agency; MFC: Mission Française de Cooperation; EU: European Union; CRPM: Comité Régional des Pêches Maritimes;

*- information updated in June 2015 through personal communications with S. Ferrari (Dept. of Fisheries of Saint Lucia)

[1] - information obtained in June 2015 through personal communications with C. Andrews (Fisheries Division of Saint Vincent and the Grenadines)

8.4.5.2 FAD REGULATIONS

The relatively recent adoption of FAD fishing by the different states has not been swiftly followed by the drafting of the detailed national legal instruments that are necessary to regulate FAD deployment and to prevent interference of FADs with maritime traffic. In those instances where a detailed body of regulations does exist for moored FADs (e.g. French Antilles), a lack of enforcement remains the major hurdle (L. Reynal, pers. com). For example, in several states, FAD deployment requires a formal authorization from the relevant governmental agency and minimum set of guarantees to ensure that the FAD deployed does not interfere with maritime traffic (Table 10). However, it is often the case that FADs continue to be deployed by fishers without formal authorization and without the minimum marking requirements to prevent collisions with boats. Overall, this has contributed to a an *ad hoc* proliferation of private FADs in several islands, with little regard to shipping lanes. In this context, boat traffic remains one of the major cited sources of FAD loss by fishers across the region.

8.4.5.3 FAD OWNERSHIP VERSUS FAD USE

Generally, an agent who has been granted a formal authorization to deploy a FAD will be recognized as the FAD owner and will be required to mark the FAD in a way that identifies ownership. However, owning a FAD does not typically imply exclusive rights to the exploitation of the fish resources around it, although it does often imply a priority of exploitation over the others (Table 10). Regulations of access to the resources surrounding a FAD, when they exist, typically apply over a radius of half or one nautical mile of the demarcating floating component of the FAD (Table 10). In some locations, fishing on a FAD requires a specific type of license (Table 10).

8.4.5.4 FISHING ON FADS

When they exist, the regulations or codes of conduct determining how fishing should be practiced around a FAD seek to minimize the risk of accidents among fishing boats due to the limited space available (e.g., direction of travel around a FAD; presence of night lights), to minimize direct contact with the FAD (e.g. a minimum 50 m distance from the floating component; prohibition of mooring on the FAD; authorizing the use of compatible gears) and to limit the exploitation of juveniles (Table 10).

8.4.5.5 CONFLICT RESOLUTION OVER FAD USE

Most conflicts will get resolved among fishers. In some extreme cases, however, they can lead to theft or deliberate destruction of FADs. Since most individual private FADs are not declared, there is little incentive for fishers to seek assitance from the local authorities in conflict resolution, justice or compensation. This seems an important factor pushing fishers to deploy private FADs further offshore and to use inconspicous models, so as to minimize the likelihood of their FADs being detected by other fishers, and therefore, any ensuing potential conflict.

A synthesis of attributes and related aspects associated with the use of private individual FAD versus public FADs is given in Table 11.

8.4.5.6 WEAK EFFECTIVENESS IN CURRENT MANAGEMENT SYSTEMS

In line with Ramdine's account on issues surrounding currently existing moored FAD management systems (FAO 2007), the CRFM Pelagic Fisheries Working Group recently highlighted the weak effectiveness of currently existing FAD management systems and the urgent need to more effectively regulate the development of the moored FAD fishery. Furthermore, it suggested specific areas that needed further rule clarification so as to minimize user conflict and the *ad hoc* proliferation of private FADs as well as improve the collection of biological data (CRFM 2014a). These areas included:

- Rules regarding the construction and placement of FAD
- Clarification of the responsibilities of management organizations
- Designated FAD
- Clarification of identification and marking of FAD
- Clarification of fishing operations near FAD
- Clarification of FAD user license and fee
- Clarification of FAD users‟ responsibility pertaining to provision of the required data (catch and effort data)".
- Clarification of FAD users‟ responsibilities in resource management measures".

The Pelagic Fisheries Working Group also highlighted that it is critical that fishers clearly understand the benefits of a license system, and that in order to ensure this, it is necessary to engage in sensitization activities and consultations with fishers on these issues (CRFM 2014a). This highlights the need for a better integration and participation of fishers in the decision-making process surrounding the regulation of the FAD fishery.

Table 10 - Example of regulations of moored FAD use in the Lesser Antilles (Year 2004) - Excerpted (and adapted) from Ramdine in FAO (2007).

	Saint Kitts & Nevis	Guadeloupe	Dominica	Martinique	Saint Lucia*	St. Vincent & the Grenadines[1]
Conditions to deploy a FAD	Administrative authorization	- Administrative authorization with prior declaration - Only commercial fishermen	Authorized persons	- Administrative authorization - CRPM exclusiveness	Consultation with Department of Fisheries	Written administrative authorization
Formalities before/during/ after deployment	- 1 month delay after application for deployment	- Delay after application for deployment not specified; - FAD location to be registered during deployment	----------	- Delay after application for deployment not specified; - FAD location to be registered during deployment	- 1 – 2 weeks delay (if deployment is via Dept. of fisheries; otherwise no delay); - After deployment FAD coordinates given to Saint Lucia Air and Sea Ports Authority (SLASPA)	- Delay after application for deployment not specified; - FAD location to be registered with 24hrs of deployment
Marking of floating component	- Names of fisher and vessel; - Radar reflector; - Others markings required by authority	- Vessel number - Navigation marker; - Buoys in red, yellow and orange colours	Recommended presence of radar reflector and flag	- Flag; - Saint Andrew's flag; - Radar reflector; - Night lights;	- Radar reflector + light + flag	Name of owner and the vessel from which the device was placed; Radar reflector; Other equipment or marking required by CFO
Means to communicate the existence of the FAD	Statement in the press	----------	----------	AVURNAV (urgent communications to sailors)	Information given to SLASPA; Fisheries extension officers can distribute information upon request	Notice published in the gazette
Area to which FAD use regulations apply	Radius of 1 NM	Radius of 0.5 NM	----------	Radius of 1 NM	----------	Radius of 0.5 NM
Access to fish concentrations	- No exclusive right to owner; - Only authorised persons; - Who is authorised is stated in the press.	- Only commercial fishermen; - Owner has exclusive right to access when he is present	----------	Only commercial fishermen with licence delivered by CRPMEM	No exclusive right to owner (any licensed fisher can fish)	No exclusive right to owner
FAD protection	----------	Prohibition to moor, make physical contact with FAD	----------	Prohibition to moor, make physical contact with FAD	- No mooring on FAD (save emergency); - Fishing within 50 m of FAD is recommended against	No person shall fish within a radius of 0.5 NM of FAD
Regulation of fishing	----------	----------	Encourages juvenile fishing only for bait	Only trolling 'into the wind' and drifting vertical longline allowed	- Rules being currently developed	----------
Existing sanctions	For removal of FAD	For destruction of FAD	----------	----------	A fine (≤ EC $ 5000) for persons not abiding by fisheries regulation	A fine (≤ EC $ 5000) for persons not abiding by fisheries regulation

*- information updated in June 2015 through personal communications with S. Ferrari (Dept. of Fisheries of Saint Lucia)

[1] - information obtained in June 2015 through personal communications with C. Andrews (Fisheries Division of Saint Vincent and the Grenadines)

Table 11 - A synthesis of attributes highly relevant for effective management of the FAD fishery associated with the use of public versus private individual moored FADs, i.e. the two extremes in FAD funding systems. Attributes for private collective FADs will typically lie somewhere in the middle.

Attributes	Public FAD (donor or government funded)	Private individual FAD
Benefits and costs	**Benefits shared by all fishers ; minimal costs to fishers**	**Costs and benefits borne by a single fisher**
FAD design	**Expensive, but highly visible and longer-lived FAD units:** o More regular fishing activity	**Inexpensive, inconspicuous, shorter-lived FAD units:** o More irregular fishing activity due to frequent FAD loss and/or immersion
FAD maintenance and replacement	**Highly dependent on public fund availability:** o Low fisher's engagement in FAD maintenance o Lower long-term financial sustainability	**FAD maintenance and replacement mainly dependent on fisher's funds:** o High fisher's engagement in FAD maintenance o Higher long-term financial sustainability: self-financing
Ratio of number of FADs to number of fishers	**High number of fishers per FAD unit:** o Low overall FAD density in EEZ o Lower overall yields per fishing trip o Fishing gear used must be compatible with presence of other users	**Multiple FAD units per fisher:** o High overall FAD density within EEZ o Possible dilution of fish aggregating effects o Visits to multiple FADs in a fishing trip o Higher overall yields per fishing trip o Fishing gear used can be incompatible with presence of other users
Distance to shore	**Nearshore deployment (<10 nm):** o Higher unauthorized recreational fishing on FADs o Higher security at sea o Lower vessel and engine size required o Lower fuel costs o Higher amounts of coastal pelagics (e.g. blackfin tuna)	**Offshore deployment (>20 nm) and secrecy in deployment:** o Lower unauthorized recreational fishing on FADs o Lower security at sea o Higher engine and vessel size required o Higher fuel costs o Higher amounts of oceanic pelagics (e.g. yellowfin tuna)
Levels of enforcement of regulations	**High levels of regulation enforcement:** o Low interference with shipping o Low levels of conflicts over FAD use: ▪ Cut-off and entanglement of fishing lines o No illegal FAD fishing in foreign waters	**Low levels of regulation enforcement:** o High interference with shipping o High levels of conflicts over FAD use: ▪ Between FAD owner vs non-owners ▪ Between FAD fishers and other fisheries (e.g. long-lines, recreational) o High potential for illegal FAD fishing in foreign waters

8.4.6 A COMMUNITY-BASED PARTICIPATORY APPROACH TO FAD FISHERY MANAGEMENT: DOMINICA

In Dominica, Sidman et al. (2014) emphasized the importance of a co-management participatory approach to ensure identification of, and compliance with, best management practices in the moored FAD fishery. They highlighted that management of the FAD fishery must take into account the three spatial scales that are relevant to the fishery, i.e. regional, national and local, and successfully address the different major issues that arise at each scale. As such, they make the point that Caribbean-based co-management governance efforts have been generally conducted at national and regional levels through the establishment of fisherfolk organization networks, but that at the local/community level, there is also a need for strengthening synergies between government and fisher stakeholders through an emphasis on participatory decision-making processes (Sidman et al. 2014). At the local/community scale, Sidman et al. (2014) underscore the importance of three overarching approaches for the development of best management practices:

- Non-regulatory options have the beneficial effect of fostering positive synergies between government and fisher stakeholders.
- Consensus-based options derived from direct consultation with fishers have a better chance for successful implementation.
- Data-driven options have a better chance for acceptance and adherence among stakeholders.

Sidman et al. (2014) conducted a series of workshops/discussions with fishers which revolved around three areas of inquiry: (1) factors eroding the profitability and sustainability of the FAD fishery, (2) best management practices, and (3) the roles of fishers, fisher cooperatives and the Fisheries Division in FAD fishery management. These discussions yielded a series of outputs (Table 12) that would necessarily have to be considered during the development of a FAD management plan under a participatory approach in Dominica. Overall, the two most pressing issues voiced by Dominican FAD fishers were (1) the need to improve the quality of the FAD materials so as to increase their life span and (2) the need to recognize that those who invest in private FADs should have some level of exclusivity over the fish resources aggregated around them (Sidman et al. 2014). However, with regard to the latter, it was noted that it might be possible to design a "compromise solution" that allows fishers who invest in FADs to benefit from their investment without completely excluding other fishers from access to the resources, i.e. recognised and enforceable, but limited exclusive rights to FAD owners (Sidman et al. 2014). Alternatively, exclusive rights could be granted to FAD owners provided that they organize themselves into groups, so as to provide an incentive for fishers to share FAD use and ownership in a formal setting and discourage the use of individual private FADs (Sidman et al. 2014). The latter would ensure a more equitable access to the resources.

8.4.7 THE JICA/CARIFICO PROJECT

The CARIFICO project funded by JICA aims to establish a co-management of moored FAD fishing activities in six locations across the Eastern Caribbean, i.e. Antigua and Barbuda, Dominica, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, and Grenada. The timeframe for this project is May 2013 to April 2018.

As part of the CARIFICO project, FADs are deployed in close collaboration with fishers and in return, fishers are expected to form groups for the management of the fishery. The latter involves addressing regulation of fishing on FADs to ensure an effective transition from an open access fishery to an effort control system based on registration, licensing, and participation in co-management. It also involves establishing a set of FAD rules as to who is authorized to set FADs and exploit FADs and as to how FADs are maintained to ensure the long term viability and self-sufficiency of the fishery.

The fishers are also involved in collecting fishing statistics data such as catch and effort and in the development of management rules. The project also seeks to clarify the institutional arrangements and responsibilities of the different stakeholders within the management system through the full integration of fishers in the decision-making process.

As such, a participatory community-based management approach has been at the centre of recent efforts to draft fishery management plans for the FAD fishery in Saint Lucia and Dominica (CRFM/JICA 2011), opening the way to a formal co-management arrangement between the respective Fisheries Divisions and local networks of fisherfolk organizations such as the National Fisherman Organization (NFO) and affiliated Fisherman Cooperatives in Saint Lucia, and the National Association of Fisherman Cooperatives (NAFCOOP) in Dominica. Out of those bottom-up efforts, a working FAD fishery management plan draft document exists, which outlines specific objectives and general guiding principles to achieve the objectives in all areas that need to be addressed by management (policy and legislation; statistics, research and development; FAD monitoring and evaluation; control, surveillance and enforcement; funding arrangements; advocacy and sensitization) (CRFM/JICA 2011). In that regard, Dominica and Saint Lucia appear further ahead than other states in setting up more effective national-level FAD fishery management plans.

In Haiti, efforts by aid and government agencies to organize fishers along with, or in return for, the introduction of moored FADs have generally failed. The inherent weak or non-existent organizational structure of fisher communities represents a major hurdle in Haiti, and management activities undertaken by fishers (e.g. reporting of catches), typically cease when the different projects come to an end. It is now increasingly recognized that chances of achieving a viable moored FAD fishery in Haiti require a medium to long-term commitment by the aid and government agencies to support and help strengthen the fisherfolk organizations through participatory approaches to tackle issues within fisher communities that go beyond those surrounding the use of FADs (Macías 2014). Thus, any attempt to improve management of FADs via the active participation of fishers will have to adjust its strategies to accommodate the great variability in community-level socio-economic context that exists across the region.

Table 12 - Areas of inquiry revolving around moored FAD use and addressed through discussions with fishers in Dominica and associated outputs. Adapted from Sidman et al. (2014)

Factors eroding the profitability and sustainability of the FAD fishery
• Lack of cooperation among fishers in deployment, use and maintenance of FADs • Lack of information sharing and communication (e.g. on FAD productivity) • Strong belief that fishers should be allowed to deploy private FADs and that they should have exclusively rights over them • Overexploitation of public FADs • Too few public FADs • Open access to private FADs discourages entrepreneurship initiatives
Best management practices
• Greater government inputs to deploy, monitor and repair public FADs, including more public FADs • A code of conduct guiding the use of private and public FADs (e.g. letting FAD rests, leaving small fish, addressing poaching) • Time share for fishing on FADs (e.g. full vs part time fishers; allocating specific fishing days based on licence; daily activity planner) • Flexible regulatory framework supporting private and public FADs • Spatial separation of FADs to balance use, reduce conflicts and increase fish yields (e.g. private FAD located offshore; public FADs located onshore)
Roles of fishers, fisher cooperatives and fisheries division in FAD fishery management
• Fisheries Division can help support and provide assistance to individuals or small groups of fishers in building, deploying and maintaining FADs • Fisher cooperatives can help identify markets for fish products and add value to fish products • Fishers and Fisheries Division can collaborate to develop a code of conduct and encourage self-compliance with principles through outreach and education • Fisheries Division can put in place a regulatory framework such as licensing to reach ratio of boats per FAD and to reinforce self-compliance with code of conduct • Fishers can promote individual accounting and primary data collection so that FAD use, catch and effort data and profitability can be monitored. • The Fisheries Division can collaborate with fishers too increase communication and cooperation among fishers.

8.4.8 MONITORING OF MOORED FAD LANDINGS

Several CRFM Member States conduct some level of formal monitoring of fishery landings (CRFM 2014a, Mohammed and Masters 2014, Masters and Mohammed 2015, Mohammed and Masters 2015). However, these efforts are deemed to be generally insufficient to ensure appropriate fisheries management of the main pelagic species exploited by the different fisheries in the region (e.g. lack of periodic biological data collection; lack of adequate information on fishing efforts; lack of harmonization and purpose-driven in data collection across the region)(CRFM 2014a).

In light of the increasing importance of FADs in the region, and of the potential high negative impact that FAD fishing can have on the life history of the species of interest, there is a consensus that catches originating on FADs should be carefully monitored and that this monitoring should be done in a way that

complies with the minimum data requirements requested by ICCAT, while being consistent with existing data acquisition protocols (CRFM 2014a). There is also a general consensus that, given the limited resources of fisheries departments across the region, the participation of fishers in statistical data collection is essential to ensure the long-term acquisition of usable data (CRFM 2014a). In that regard, under the CARIFICO project of JICA, the CRFM Secretariat is currently developing a model FAD fishery logbook, which is to be customized, tested and implemented in six Member States (Antigua and Barbuda, Saint Kitts and Nevis, Dominica, Saint Lucia and Saint Vincent and the Grenadines) aimed at overcoming the current existing deficiencies in the collection, standardization and quality of catch and effort data for the moored FAD fishery (Mohammed and Masters 2014, Masters and Mohammed 2015, Mohammed and Masters 2015).

8.4.9 MOORED FADS: LINKS BETWEEN COASTAL AND PELAGIC ECOSYSTEMS

A key and recurrent premise for the justification of the use of moored FADs is that their use will result in a reduction of fishing pressure on the heavily exploited reef and demersal coastal resources, since artisanal fishers (who can effectively transition from one fishery to the other in most places), will be able to redirect some of that fishing pressure on the locally underutilized pelagic resources that aggregate around moored FADs. Implicit in this is the belief that moored FADs can significantly contribute to the recovery of the heavily exploited coastal/reef ecosystem that characterizes most locations across the region (Halpern et al. 2008, Burke et al. 2011). Thus, moored FADs have the potential to re-distribute the negative effects of fishing between the coastal (indirectly) and pelagic (directly) ecosystems in a more balanced manner, leading to a more sustainable fisheries exploitation at the larger scale. However, this simple premise, which is likely to have been influential in helping secure funding for moored FAD programmes in the past, has not been rigorously tested in the region.

The evidence available to date indicates that the reality is much more complex and strongly dependent on the local socio-economic and regulatory context in which the moored FAD and coastal fisheries operate as well as on the stage of development of the FAD fishery. In the only regional study examining fishers' use of moored FAD and coastal resources, Mathieu et al. (2014) found that, in Martinique and Guadeloupe, most fishers using moored FADs (59% and 61%, respectively) continued to fish the nearshore area using passive gears such as fish pots. In contrast, in Dominica, only a minority of FAD fishers (15%) continued to fish the nearhsore, suggesting a greater reduction in fishing pressure on the nearshore in this island (Mathieu et al. 2014). Mathieu et al. (2014) noted that the number of vessels engaged in the FAD fishery in the French Antilles had stabilized over the past years, whereas that of Dominica was still increasing. This suggested that while fishers in Dominica still found it more profitable to completely abandon coastal fishing to enter the FAD fishery, those of the French Antilles did not. In the French Antilles, market saturation in pelagic products, the irregularity of catches associated with FAD fishing, and increases in fuel prices would have contributed to lower the profitability of the FAD fishery relative to that of coastal fishing over time (Guyader et al. 2013, Mathieu et al. 2014). As such, for many fishers, a more secure strategy to ensure stable revenue was to simultaenously engage in both, and so, counterintuitively, it is likely that some of the revenue from FAD fishing was being used for funding coastal fishing (Mathieu et al. 2014). Similarly, in Haiti, discussion with fishers indicate considerable differences among fisher communities in the extent to which fishers using moored FADs continue to engage in coastal fishing, likely as a result of differences across communities in socio-economic conditions and overall productivity of coastal resources (Vallès 2015).

In conclusion, a key point stemming from Mathieu et al. (2014)'s study is that, if FADs are meant to effectively reduce fishing pressure on coastal resources in the long run, regulations aimed at governing FAD fishing must be accompanied by concurrent regulations seeking to reduce fishing effort on coastal

resources. Furthemore, the latter should be implemented during the early stages of the development of the FAD fishery.

9. STATUS OF THE FISHERY

9.1 STOCK STATUS

A summary of the most recent stock assessments undertaken by ICCAT for eight large oceanic pelagics is given in Table 13. Five stocks of relevance to the sub-regional plan are currently considered to be overfished, i.e. yellowfin tuna, bigeye tuna, albacore, blue marlin, and white marlin. Another species, sailfish, is considered to be possibly overfished (Table 13). A summary of the management measures recommended by ICCAT for those eight species is given in Table 14. The effort control and space/time closure measures recommended by ICCAT apply exclusively to semi-industrial and industrial fishing operations making use of large (20 m length overall) vessels in the long-line fishery as well as in the purse seine and bait-boat fisheries associated with FADs, with particular emphasis on fishing activities off the African coast (ICCAT SCRS 2013 Report) (ICCAT 2011, 2013, 2014). **Thus, these specific management measures do not apply to the small-scale moored FAD fishery of the CRFM Member States**. However, of direct relevance to the sub-regional plan is ICCAT's emphasis on the need to considerably improve the monitoring of fish catches associated with moored FADs and the need to implement national-level FAD fishery management plans.

The CRFM has led stock assessments of several large coastal pelagic species of regional importance. Although these species also fall under the jurisdiction of ICCAT, they are not currently assessed by ICCAT. These species are blackfin tuna, serra Spanish mackerel, king mackerel, wahoo and dolphinfish. A summary of the results of these assessments is given in Table 15. These assessments were either inconclusive or indicated no evidence of overfishing. The management measures currently existing apply to recreational fishing in Saint Lucia as well as to gillnet restrictions in the gillnet fishery of Trinidad and Tobago. In all cases, the precautionary approach is recommended whereby catches and fishing mortality should not be increased (Table 15).

Table 13 - Summary of ICCAT's most recent stock assessments for the fish stocks exploited in the Caribbean of eight oceanic large pelagics for which such assessments are available. Source: ICCAT SCRS 2013-2014 reports

Species	Stock	Year Last Assessed	MSY (t)	Min	Max	2013 Yield (t)	Status (overfished)	Bx/Bmsy	Fx/Fmsy
Skipjack Tuna	West Atlantic	2014	-	30,000	32,000	27,086	No	possibly > 1	most likely <1
Albacore	North Atlantic	2013	31,680	-	-	20,948	Yes (rec)	0.94 (0.74-1.14)	0.72 (0.55-0.09)
Yellowfin Tuna	Atlantic	2011	144,600	114,200	155,100	92,615	Yes	0.85 (0.61-1.12)	0.87 (0.68-1.4)
Bigeye Tuna	Atlantic	2010	92,000	78,700	101,600	63,066	Yes	1.01 (0.72-1.34)	0.95 (0.65-1.55)
Atlantic Sailfish	Western Atlantic	2009	-	600	1,100	412	Possibly	possibly > 1	possibly > 1
Atlantic Blue Marlin	Atlantic	2011	2,837	2,343	3,331	1834[1]	Yes	0.67 (0.58-0.81)	1.63 (1.11-2.16)
Atlantic White Marlin	Atlantic	2012	-	874	1,604	403[1]	Yes	0.32 (0.23-0.41)	0.99 (0.75-1.27)
Swordfish	North Atlantic	2013	13,660	13,250	14,080	11,980	No	1.14 (1.05-1.24)	0.82 0.73-0.91)

[1]Estimate from 2012

Table 14 - Management measures prescribed by ICCAT for the fish stocks exploited in the Caribbean of eight oceanic large pelagics for which stock assessments are available. Source: ICCAT SCRS 2013-2014 reports and ICCAT (2011, 2013, 2014)

Species	Stock	Year Last Assessed	Effort controls	Total allowable catch	Time/Area closure	Minimum size limit and catch and trade restrictions
Skipjack Tuna	West Atlantic	2008	none	none	none	none
Albacore	North Atlantic	2013	Fishing capacity limited to average of 1993 and 1995 vessels	28,000 metric tons (2014 to 2016)	none	none
Yellowfin Tuna	Atlantic	2011	Limit number of long-liners and purse-seine boats for several countries; CPCs have to authorize vessels >20 m long to fish in Convention Area	110,000 metric tons (2013 onwards)	Surface fishing on FADs from African coast to 10° S, 5° W to 5° E, during January-February in the Gulf of Guinea; No purse seines and bait boat fishing during November in area 0°-5° N; 10°-20° W	none
Bigeye Tuna	Atlantic	2010	Limit number of long-liners and purse-seine boats for several countries; CPCs parties have to authorize vessels >20 m long to fish in Convention Area	85,000 metric tons (2013-2015)	No fishing with natural or artificial floating objects during January or February in the area encompassed by the African coast, 10° S, 5° E and 5° W.	none
Atlantic Sailfish	Western Atlantic	2009	none	none	none	none
Atlantic Blue Marlin	Atlantic	2011	2,837	2,000 metric tons (2013 to 2015); annual amount harvested by pelagic long-lines and purse seine vessels and retained for landing not more than 50% of 1996 or 1999 landing levels, whichever is greater	none	Recreational fishery: 251 cm LJFL; Catch and trade restriction in recreational fishery
Atlantic White Marlin	Atlantic	2012	none	400 metric tons (2013 to 2015); annual amount harvested by pelagic long-lines and purse seine vessels and retained for landing not more than 33% of 1996 or 1999 landing levels, whichever is greater	none	Recreational fishery: 168 cm LJFL; Catch and trade restriction in recreational fishery
Swordfish	North Atlantic	2013	13,660	13,700 metric tons (2014 to 2016)	none	125 cm LJFL with a 15% tolerance, or 119 cm LJFL with zero tolerance and evaluation discards

* Provisional; ** Highly Uncertain; Bx/Bmsy: biomass in year x relative to biomass at maximum sustainable yield (MSY); Fx/Fmsy: fishing mortality at which the biomass necessary to generate maximum sustainable yield is achieved. CPCs – Contracting parties and Cooperating non-Contracting Parties, Entities or Fishing Entities; LJFL – lower jaw fork length

Table 15 - Summary of stock assessment of four coastal pelagic species for which such assessments exist in the Caribbean. Source: CRFM scientific meeting reports (2005-2010).

Output	Serra Spanish mackerel	King mackerel	Wahoo	Dolphinfish	Blackfin tuna
Methodological approach	2005 – Surplus production model (Trinidad – catch data from 1972 to 1991; 1995 to 2002; gillnet effort data; ICCAT landings data for 1977 to 2002)	2006 & 2007: Length frequency analysis (Trinidad – 2006-2007) and Analytical Yield Per Recruit Model – Southern stock assumed – shared among Trinidad and Tobago, Venezuela and Guyana – recognized catches in Brazil and Grenada may be from same stock and so stock range may be incompletely defined.	2005 & 2007 – Non-equilibrium, surplus production model and length frequency analyses, catch and catch rate analyses – (2005 – Barbados, Dominica, Grenada, Saint Lucia, Saint Vincent; 2007 with data from 1994 to 2003 – Barbados and Saint Lucia with data for 1996-2006). MSY (t): Assumed as peak catches taken in 1997 – 1999 (1400-1600 t)	2010 – Catch and Catch Rate Analyses (Barbados, Saint Lucia, Saint Vincent – 1994 to 2010). Yield: 1,200 t (2009 for EC countries)	2012: CRFM –draft sub-regional management plan developed; Detailed review of biology and country summaries of data collection systems, available data, estimation of total landings and recommendations for improved data coverage (Saint Vincent, Grenada, Dominica, Saint Lucia); Standardization of catch rates – Saint Lucia;
Status	Overall, results inconclusive – conflicting results from runs with B1977 estimated and fixed; status sensitive to estimates of catches, and starting biomass level for which there is great uncertainty	Overall, results inconclusive – status of the stock as measured by the target reference point (F0.1) and limit reference point (F20%SPR) varies greatly depending on growth/natural mortality parameter combination used in the analysis.	No declines in CPUE between 1995 and 2003; Local abundance of stock sustainable at 1996 – 2006 harvest levels, at least in the short term.	No evidence of decline in stock abundance over the period; current levels of harvest probably sustainable.	No evidence that overfishing is occurring
Management	Current measures in Trinidad and Tobago include mesh size restrictions on gillnets and limitations in net dimensions as well as a size limit of 30.5 cm (12 inches) which may not be taken, sold or exposed for sale.	Current measures same as for Serra Spanish Mackerel. STL: recreational fishery – gear restrictions – limit number of fish caught – 18 king mackerel, dolphin and wahoo.	Currently there are no management measures in effect except for recreational fishery in Saint Lucia	Currently there are no management measures in effect except for recreational fishery in Saint Lucia.	Currently no measures in effect
Recommendations	Maintaining the status quo will be ok in the short-medium term but will be problematic in the long-term. Maintaining fishing mortality at 0.75 Fmsy would result in short term sacrifices and under-performance within next 10 years, but more sustainable in the long term.	Precautionary approach – current levels of fishing effort should not be increased.	Precautionary Approach – no large increases in fishing pressure recommended until stock dynamics are better understood.	Due to uncertainties in assessment, cannot make predictions on long-term stock sustainability – suggest precautionary approach to management – no further development until the stock structure and dynamics are better understood	Catch levels should not be allowed to increase beyond current levels given concerns as regards impacts of recent catch increases likely due to FAD fishing and improvements in data collection.

In a recent review of the CRFM on the areas that need to be addressed to improve the regional management of large pelagics, the following lines of intervention were highlighted (Appendix 9 in CRFM 2013c):

1. Need for policy/decision-makers to guide scientists – management objectives must be clear and measurable;
2. Need to delineate stocks so as to identify those countries which must be included in assessment and management;
3. Need to collect data to facilitate improved quality of assessments and management advice provided:
    a. better data collection protocols and analysis – validation/verification
    b. estimate of all removals from fishing – total catch
    c. better estimate of fishing effort
    d. historical time series data of catch and effort
    e. improve biological parameter estimates- age; growth; natural mortality
    f. identify minimum data collection standards that can be sustained with given resources
4. Research on ecological impacts of fishing, in particular FAD fishing (e.g. changes in species composition, diet, abundance);
5. Research – technological, behavioural change or other measures to reduce catches of juvenile fish
6. Licensing systems to ensure limited entry so as to help address issues pertaining to:
    a. Resource sustainability
    b. Conflict avoidance
    c. Maintained profitability
    d. Acquisition of fishing effort data
7. Social and Economic importance of FAD fisheries

9.2 ISSUES

Below are presented the main issues identified in the moored FAD fishery, and which are the main focus of the sub-regional management plan. These represent a summary of recurrent issues that have been highlighted in numerous regional documents and workshops (Le Gall et al. 1999, FAO 2002a, b, 2007, CRFM 2013d, c, Guyader et al. 2015, Reynal et al. 2015a, Reynal et al. 2015b). In line with an ecosystem approach to fisheries management, they have been allocated to four main topics, socio-economic, biological, ecosystem and governance. A summary of these issues is given in Table 16.

9.2.1. SOCIO-ECONOMIC ISSUES

Conflicts among fishers: Conflicts among fishers over FAD use are common and generally take place among FAD fishers exploiting the units. A phenomenon typical of the early stages in the development of the FAD fishery is the destruction of FADs by fishers either because they believe the FAD is drifting lost material or because they feel that the FAD, if private, will exclude them from access to those fishing grounds. Another important and common source of conflict occurs when the FAD units are privately owned by one fisher or by a group of fishers, and fishers who did not contribute to FAD construction and deployment make use of them.

Another important source of conflict over FAD use can take place between FAD fishers and longliners, as well as between FAD fishers and recreational fishers who come to fish near FADs.

Generally, the intensity of the conflict increases with the degree of ownership of the FADs, with public FADs generating the least number of conflicts. However, public FADs tend to be located closer to shore than private ones and so these FADs are concurrently fished by a higher number of fishers and vessels (fisher crowding). In this situation, the entangling and accidental cut off of the fishing lines can also be a substantial source of conflict among the users.

Long-term financial viability of the fishery: There are a number of issues regarding the long term financial viability of the FAD fishery. These include the high cost of investment and maintenance of the FADs themselves, which will be strongly affected by FAD ownership (private vs public). The life span of the FAD will be affected by the quality of the materials used, by incidences of vandalism and theft, by loss due to boat traffic and/or strong currents, as well as by poor deployment. Operating costs (mainly fuel) of the vessels accessing FADs can be considerable, especially if FADs are placed far from the landing sites or/and if fishers are forced to visit multiple FADs on a single trip.

Seasonal variability of most target species will affect the profitability of the fishery and might require supplementing with other fishing practices and/or employment outside the fishery sector. Alternatively, high season might result in market gluts and low prices, especially where post-harvest facilities are deficient or lacking. Furthermore, the handling and conservation of very large fish such as tunas and billfishes (typically caught on moored FADs) on relatively small vessels can be particularly problematic, and will affect the quality of the landed product. Lack of training in sanitary and phytosanitary (SPS) measures for these fish species will exacerbate the problem. Finally, in some locations such as Guadeloupe, fish imports can compete with locally caught fishery products and lead to lower revenue for fishers (L. Reynal, pers comm).

Decreasing catches over time will threaten the financial viability of the FAD fishery. This might occur at a local level with fisher overcrowding on FADs and/or with overly high FAD density. On the one hand, yields per fishing trip will decrease with increasing number of vessels using the FADs. On the other hand, an overly high density of FAD is likely to reduce FAD effectiveness at aggregating the target species. Decreasing catches over time might also occur at a regional level due to overexploitation of the shared pelagic fish resource. For example, several of the target species are already considered to be overexploited by ICCAT.

Safety at sea: Important issues regarding fisher's safety at sea are intimately linked to the typical un-decked small vessel size (<9 m) associated with FAD use (Section 8 in Reynal et al. 2015a). These safety issues involve:

- Travelling offshore carrying heavy FAD moorings for deployment, which is considered to be an activity of high risk because of the increased risk of capsizing on small boats;
- Entanglement of the fishing line around the fisher's body when catching a large fish, which can lead to serious injuries;
- Injury during landing (boating/towing) large fish into small vessels by hand.

Other concerns revolve around the inadequate provision of safety equipment in these vessels such as life jackets as well as inadequate communication equipment (e.g. radio transmitters).

FAD design and construction: Irrespective of local context, FAD design, construction and deployment requires adequate training to minimize FAD loss (e.g. prevent buoy implosion; minimize collision with boats; prevent material wear out) maximize fish aggregating properties, minimize by-catch, and improve safety at sea.

Inadequate socio-economic information and statistics: Social and -economic information on FAD fishers and statistics on FADs (e.g. average life span) and FAD fishing (e.g. cost and revenues) are sparse

or not collected at all. This lack of data precludes a rigorous assessment of the contribution of the FAD fishery to fisher's income and livelihoods across the region. It also precludes an identification of the social and economic conditions that can contribute to the long-term profitability of the fishery and the specific constraints that need to be addressed to improve its efficiency.

9.2.2. BIOLOGICAL ISSUES

Exploitation of overfished species: FADs are known to aggregate several species which are already considered overexploited by ICCAT such as blue marlin and yellowfin tuna. Responsible fishing requires that this issue is addressed, while keeping in mind that the moored FAD fishery represents a portion of the large pelagic fishery for these species.

Exploitation of juveniles: FADs are known to aggregate juveniles of the main target species, some of which are already considered overexploited such as yellowfin tuna and dolphinfish. Juveniles can be targeted as bait for the large fishes and/or targeted specifically for commercial sale, which has different implications. Responsible fishing requires that this issue is addressed.

Potential effects of FADs on fish migrations: There is some concern that FADs may disrupt natural seasonal migration patterns for the species that aggregate around FADs because they are fixed rather than free floating.

Inadequate biological data: Biological data on FAD fishery species are sparse and consequently cannot be effectively used for an adequate evaluation of the state of the stocks.

9.2.3. ECOSYSTEM ISSUES

Lack of monitoring of presumed reduction of fishing on reefs: Reduction of fishing pressure on coastal and reef resources is often used to justify the development of the moored FAD fishery. There is no strong evidence that moored FADs programs, as currently implemented, help achieve this reduction in the long-term. This important issue requires more attention across the region.

Marine littering through FAD proliferation and loss: FADs are rarely retrieved and often lost, which implies an accumulation of marine litter with unknown effects on the ecosystem. This will be exacerbated by the uncontrolled proliferation of poorly made private FADs.

Conflicts with other sectors: Unregulated proliferation of FADs may interfere with the safe passage of marine transport (commercial shipping and recreational vessels), which can in turn lead to increase in FAD losses and production of marine debris. There might also be space-use conflicts with the oil and gas sector.

Potential effects on non-target species: Although fishing on moored FADs is typically carried out through highly selective techniques, with no discard of catches, there can still be a risk that non-target species such as marine mammals, sea birds, and turtles get entangled with the FAD, if nets are part of the aggregating and/or surface component. Some of these species might be currently considered endangered or threatened.

9.2.4. GOVERNANCE ISSUES

Unclear or absent national policies and regulation for FADs: There are few examples of national policies specifically on FAD fishing although several countries participating in the CARIFICO Project are currently drafting them. As such there is a lack of effective guidance for regulating the fishery.

Uncontrolled & secretive multiplication of individual private FADs: There are many examples of undesirable, uncontrolled or *ad hoc* multiplication of private FADs, exacerbated by a lack of effective regulation and absence of marine spatial planning in most countries.

Inadequate national-level stakeholder participation in FAD decision-making: Countries outside the CARIFICO project are lagging in effective inclusion of stakeholders in decision-making processes specific to FADs.

Weak monitoring, control and surveillance: Monitoring, control, and surveillance of FAD fisheries is generally weak across the region.

No regional data archiving on FADs and no formal regional information-sharing system for the FAD fishery: Sparse data collection and lack of harmonized system for data archiving constraints the ability for regional sharing of FAD data to inform regional management decision-making. Furthermore, although in the past decade there has been considerable information exchange among Caribbean countries on the moored FAD fishery through a number of *ad hoc* sub-regional workshops involving CRFM and WECFAC, there remains to be established a formal sub-regional system for the exchange of information.

Transboundary issues: There are two transboundary issues regarding the FAD fishery. Firstly, incidences of IUU fishing where fishers from neighbouring territories illegally access FADs have been reported. Secondly, FAD fisheries have the potential to exacerbate ICCAT catch quota overruns, which can impact the good standing of CRFM Member States in the international arena.

Inadequate sub-regional representation in ICCAT: There is urgent need to increase the representation of CRFM Member States with stake in the large pelagic fisheries (thus including the moored FAD fishery) in ICCAT so as to better voice and defend their collective interests.

Table 16 - Recurrent issues in the developing FAD fishery

Category	Main issue	Components	Sub-components
Socio-economic issues	Conflicts among fishers	Vandalism/theft	
		User rights conflicts between FAD fishers	Access rights
			Fisher crowding
		Conflict with recreational fishery	Access rights
		Conflicts with other large pelagic fisheries	Space use conflict
			Catch allocation quota
	Long-term financial viability of the FAD fishery	High capital investment and maintenance costs	Private vs Public FADs
		FAD short life span	Losses dues to boat traffic
			Losses due to inadequate models and materials
			Losses to theft
		Vessel operational costs	Increasing engine, gear, and fuel costs
		Seasonal variability in resource availability	
		Market glut	
		Quality of FAD fishery products	Preserving and handling large fish in small vessels
			Training in fish product handling
		Competition from imports	
		Decreasing catches	FAD crowding
			Fisher crowding on FADs
			Exploitation
	Safety at sea	High safety risks during FAD deployment	
		High safety risks when fishing from small vessels	
	FAD design and construction	Training	
	Inadequate socio-economic information and statistics		
Biological issues	Exploitation of overfished species		
	Exploitation of juveniles	Use of juveniles for as bait	
		Use of juveniles for commercial purposes	
	Potential effects of FADs on fish migration		
	Inadequate biological data		

Table 16 continued. Recurrent issues in the developing FAD fishery

Category	Main issue	Components	Sub-components
Ecosystem issues	Lack of monitoring of reduction of reef fishing		
	Marine littering through FAD proliferation and loss		
	Conflicts with other sectors	Marine shipping	
		Tourism / recreational users of sea space	
		Oil and gas	
	Effects on non-target species		
Governance issues	Unclear or absent national FAD policies and regulations	To FAD or not too FAD; that is the question	
		Use of private versus public FADs	
	Uncontrolled & secretive multiplication of individual private FADs		
	Inadequate national-level stakeholder participation in FAD decision-making	Poor organizational structure	
		Inadequate participation at all levels	
	Weak monitoring, control, and surveillance		
	No sub-regional data archiving system		
	No formal sub-regional arrangement for information sharing		
	Transboundary issues	ICCAT quota overruns	
		IUU fishing	
	Inadequate representation of CRFM Member States in ICCAT		

9.3 OPPORTUNITIES

A number of activities and/or achievements could provide expansion and development opportunities and/or contribute to fill in research needs for the moored FAD fishery of the sub-region. These include:

- Lessons learned through current (or recent) implementation of the CARIFICO-JICA project and MAGDELESA-IFREMER projects with specific focus on the moored FAD fishery in the sub-region;
- Introduction of new technologies such as the "smart" FADs and the use of GPS tracking for submerged FADs as well as floating FADs.
- Assistance to develop and strengthen fisherfolk cooperatives/associations/networks to facilitate improved collection and sharing of data and information and greater involvement in the fisheries management process
- Implementation of a Common Fisheries Policy in the Caribbean;
- Availability of new international instruments and regional initiatives to end IUU fishing such as the 2010 Castries (Saint Lucia) Declaration on Illegal, Unreported and Unregulated Fishing of the Caribbean Regional Fisheries Mechanism (CRFM) and the FAO Port State Measures agreement;
- Delimitation of maritime boundaries and conclusion of fishing agreements with neighbouring states;
- Availability of international support for ecosystem based fisheries management initiatives and food security through fisheries;
- Increasing interest of stakeholders in information and management measures.

10. HARVEST STRATEGY

10.1 MANAGEMENT OBJECTIVES AND INDICATORS

The overall management objective is to help small scale fishers to improve their revenues by more efficiently fishing offshore pelagic resources, whilst (1) reducing fishing pressure on coastal resources; (2) ensuring responsible, safe, and sustainable fishing practices; (3) minimizing interference with other users; and (4) rationalising the development of this fishing method across the region's shared stocks.

An ecosystem-based approach to the management of the moored FAD fishery is strongly justified by:

- the significant trophic links among the large oceanic and coastal species that are typically exploited on moored FADs;
- the trophic, technical, and economic linkages between the moored FAD fishery and the fisheries also targeting large oceanic and coastal pelagics that do not make use of moored FADs (e.g. long-liners);
- the widely accepted expectation of a reduction in fishing pressure on the adjacent coastal marine ecosystem (near-shore/reef resources) as a result of the development of the moored FAD fishery;
- the need to secure an equitable and fair access to the marine (pelagic and coastal) ecosystem to all its different users.

Many of the coastal and oceanic large pelagic species are shared among Caribbean islands and as such these islands are legally obligated to collaborate in their management. An institutional arrangement allowing for sub-regional collaborative management is therefore critical.

Management of the moored FAD fishery in the sub-region is to be guided by three general management objectives that have been identified for the flyingfish fishery in the Caribbean (CRFM 2014c). However,

the three general management objectives have been further sub-divided into operational objectives that are meant to address the main issues identified during the description of the state of the moored FAD fishery in the sub-region. These are shown in Table 17 together with their assessment criteria.

10.2 REFERENCE POINTS

(Details of this subsection will be included following consultation with stakeholders)

10.3 STAKEHOLDER PERCEPTIONS

(Details of this subsection will be included following consultation with stakeholders)

10.4 HARVEST CONTROL RULE

(Details of this subsection will be included following consultation with stakeholders)

11. DATA, MONITORING AND RESEARCH REQUIREMENTS

11.1 CATCH/EFFORT AND VESSEL DATA

Tietze and Singh-Renton (2012) provide an overview of the shortcomings in fishery data collection and analysis in the sub-region and highlight the need for additional technical and financial assistance to adequately cover all data requirements in Annex 1 of the United Nation Fish Stocks Agreement to which most CRFM Member States are signatory (Table 3). These shortcomings also extend to the moored FAD fishery, as part of the fisheries for large pelagics. Furthermore, Tietze and Singh-Renton (2012) list a number of recommendations to improve the data collection and networking on large pelagic fisheries in the sub-region:

- Establishment of a sub-regional data base including catch data to be maintained and managed by CRFM. A separate sub-regional database is needed because ICCAT's databases do not include space for social and economic data at present. Additionally, basic catch and effort data should continue to be stored by ICCAT and the sub-regional database should help to strengthen the ICCAT database for ICCAT purposes.

- Establishment of a regional network for improvement of collaboration of national scientists from fisheries authorities, other agencies and academic institutions in collection and sharing of data and information needed for integrated evaluations of large pelagic fish resources and small tunas and tuna-like fishes and related ecosystems including social, economic, environmental and climate data.

- Allocation of more staff and resources for the collection, recording and analysis of fisheries statistics and CLME information and provision of adequate training.

- Strengthening of national data collection systems for large pelagic migratory species to ensure supply of adequate data to data bases on large pelagic migratory fish resources. This should include the collection of catch and effort data from recreational fishing for both coastal and oceanic large pelagic species by making it mandatory to submit catch records on a routine basis. Renewal of fishing licenses should be made subject to submission of satisfactory catch records.

- Harmonization and standardization of catch and effort as well as social, economic and ecological data collection systems among all states so that it can be easily shared/pooled for inclusion in CRFM sub-regional/regional data bases.

As stated in Section 8.4.8, there is a consensus that catches of large pelagics on FADs should be carefully monitored and that this monitoring should be done in a way that complies with the minimum data requirements requested by ICCAT while being consistent with existing data acquisition protocols. In that regard, and in addition to catch and effort data reporting requirements on FAD catches, ICCAT recommends the collection and reporting of information regarding deployment (position, date, FAD type, FAD identifier, FAD design), visits (type of visit, position, date, FAD type, FAD identifier) and losses (last registered position, date, FAD identifier) of FADs, although such recommendations strictly apply only to large purse seine and baitboat fishing vessels (>20m long) (ICCAT 2014). ICCAT also recommends the establishment of FAD log-books for the aforementioned vessels (ICCAT 2014). It will be therefore important to reach a compromise between ICCAT's recommendations, which apply to semi-industrial and industrial fishing operations, and the small-scale artisanal context in which the moored FAD fishery operates in the sub-region, for any attempt to improve data collection and analysis across the sub-region to be succesful.

In that regard, the FAD logbook system currently under development through the CARIFICO project with the input from several national fisheries department across the insular Caribbean (Mohammed and Masters 2014, Masters and Mohammed 2015, Mohammed and Masters 2015) represents a signficant step forward towards the development of a harmonized system for FAD fishery data (catch and effort; vessel registry) collection, storage and management in the sub-region. These actions should pave the way for the establishment of a sub-regional database for moored FADs, which could be maintained and managed by CRFM to facilitate assessment of the status of the stocks and management decision-making.

11.2 ECONOMIC, SOCIAL AND ECOLOGICAL INFORMATION

The sub-regional fisheries management plan encourages research aimed at strengthening the moored FAD fishery including: the social and economic status of fishers and other stakeholders; the governance structures facilitating sustainable fisheries; the contribution of moored FAD fishery to food security/nutrition and to poverty alleviation; the factors influencing fishing strategies (private versus public FADs); the factors contributing to the variability in profitability in the moored FAD fishery; the indirect effects of the moored FAD fishery on the nearshore/reef resources; the selectivity of fishing techniques on moored FADs; the effect that handling large fishes on small vessels has on product quality and safety at sea; and the technological aspects influencing FAD lifespan.

The proposed studies in Section 11.3 ultimately aim to generate information about the moored FAD fishery needed to help ensure the sustainability of the fishery and to facilitate application of the ecosystem approach to management of the moored FAD fishery.

11.3 RESEARCH NEEDS

The following studies are proposed:

- Economic and social evaluation of national moored FAD fisheries:

- Conduct a sub-regional cost and earnings study and comparison of the economic and financial performance of moored FAD fisheries, including differences in FAD fishing strategies (public versus private FADs), in selected countries representing a diverse range of governance and socio-economic conditions.
- Conduct a socio-economic study of moored FAD fishers, including an examination of their conditions at work, in selected countries representing a diverse range of governance and socio-economic conditions.
- Conduct a study assessing the role of the moored FAD fishery in food security/nutrition and in poverty alleviation in selected countries representing a diverse range of governance and socio-economic conditions.
- Conduct research to determine the optimal FAD density and optimal number of fishers per FAD so as to help maximize the profitability of the fishery.
- Conduct research on markets and product development and SPS issues to improve the added value and overall quality of the FAD fishery products.

- Biological, ecological and ecosystem studies:
  - Conduct a study to determine the ecological impacts of the moored FAD fishery on target and non-target species (including trophic interactions among species e.g. changes in species composition, diet, abundance) and on the marine ecosystem (e.g. potential impacts of lost or damaged FADs).
  - Conduct a study to determine the impacts of FADs on the migration routes of key pelagic species.
  - Conduct a study (preferably following a Before-After-Control-Impact design) assessing the short, medium and long-term effects of the development of the moored FAD fishery on fishing pressure on near-shore/reef resources in selected localities or countries representing a diverse range of governance and socio-economic conditions.
  - Conduct research assessing fishing techniques/strategies that minimize juvenile catches and optimize catch selectivity on moored FADs.
  - Conduct research on aggregating dynamics and biological characteristics (sex/size/age) of target species around moored FADs.
  - Conduct research to assess the relative contribution of moored FADs to the overall fishing mortality of target species
  - Conduct research on stock delineation of target species to identify Member States which must be included in assessments and management.
  - Conduct research on the relationship between *Sargassum* and the harvest levels in FAD fisheries, given the recent increases in the occurrence of free-floating *Sargassum* patches in the region.
  - Conduct research on the currently used concept of Catch-Per-Unit-Effort on FADs to help develop improved standardized indicators of fishing effort on FADs.
  - Conduct research on possible impact on the resource of the interaction between the moored FAD fishery and other fisheries.

- Governance studies:
  - Conduct research seeking to identify most effective national governance arrangements and co-management regimes and actions to help improve the implementation of the management plan.
  - Conduct research aimed at improving information flow between fishers, researchers and fisheries managers (e.g. communication tools).
  - Conduct research on social customs that help to characterize formal and informal FAD governance arrangements.

Furthermore, the CRFM LPWG, at the 8th CRFM Annual Scientific Meeting (CRFM 2012b, c) recommended that research should be done on the impact of FADs on the fishery for each country. This implied that sampling and monitoring programmes appropriate to each country should be designed to collect relevant information on this topic and that studies need to be conducted to better understand migration patterns and stock structure in the region. The working group noticed relatively obvious patterns in peak landings on a monthly scale across islands and so indicated that further investigation of these patterns might provide insights as to migratory patterns within the region. In this context, it is recommended that countries collect length frequency data for their catches (CRFM 2012c).

Table 17. Management goals, objectives, indicators and suggested references points for the moored FAD fishery

Management Goals (category)	General objectives (sub category)	Operational Objectives	Indicators	Suggested reference points
1. Sustained fishery resource-biological	**1.1 Sustained resource** Ensuring that all large oceanic and coastal pelagics are available for future generations	Reduce catches of juveniles on FADs to a minimum for all exploited species	Percentage of juveniles in the FAD catch	Gradual decreases of percentage of juveniles landed
		Adjust current average catch rates on FADs for each species based on stock health status and landings from other fisheries	Total FAD landings for each species	Total landings for individual species within pre-established levels (catch allocation quota)
	1.2 Accurate information Ensuring that an effective data collection system is in place to provide accurate information and knowledge about the state of the fishery	National data collection improved and gaps filled	Sampling coverage	Adequate coverage of landing sites
			Sampling design	Adequate sampling design
	1.3 Effective management Ensuring that there is an effective system for adaptive and responsive management and enforcement	Establish a harmonized sub-regional FAD database	Sub-regional database operational	Harmonized sub-regional database established and maintained
		Timely submit moored FAD data and information to CRFM	Annual submission of data	Current data in database
		Establish authorized access to moored FAD fishery	License/permit system specifically for moored FADs	All sub-regional moored FAD fishers are registered and licensed
		Establish minimum requirements for moored FAD design and materials	FAD design quality	Minimum buoyancy and marking requirements of floating component
		Establish authorized areas within EEZ for moored FAD deployment	FAD geographic location	FAD location in relation to areas with minimum overlap with oil and gas, shipping lanes, and other fisheries
		Establish maximum number of moored FADs deployed within EEZ	Total number of FADs deployed	Recommended levels of FAD density to minimize dilution of aggregations
		Establish precautionary measures as required	Number of licensed FAD fishers; number of licensed FAD vessels; Number of authorized FADs deployed	Adjustment of related reference points

		Establish national policy and management plans for FAD use	Policy statement defining national stand on use of public versus private FADs	Clear national policy on public versus private FADs
			Management plan in place	Management plan approved by all stakeholders
		Ensure ability to make and enforce management decisions	Legislation and regulations in place	Laws and regulations in place and enforced
			Compliance levels	Established level of compliance
		Ensure ability to collaborate effectively with stakeholders and other countries and organizations both vertically and horizontally	Level of stakeholder engagement (consultation and feedback)	Adequate level of stakeholder engagement
			Stakeholder network indicators from community-level to regional-level	Clear institutional arrangements among stakeholder groups
				Clear allocation of stakeholder responsibilities (e.g. rights and duties of fisherfolk organizations and Fisheries Divisions)
		Ensure ability to adaptation to external drivers/perturbation (e.g. hurricanes, storms)	Contingency plans for FAD replacement	Contingency plan exists
		Ensure adequate representation of all Member States involved in pelagic fisheries in ICCAT	Per cent of Member States members to ICCAT	All Member States involved in pelagic fisheries have joined ICCAT
2. Optimal use of fishery for long-term benefit – socio-economic	**2.1 Social benefits and economic/ financial returns** Optimal social, economic and financial benefits for all involved in the fishery	Increase FAD unit lifespan	Average FAD lifespan	Maximum lifespan relative to capital investment
		Reduce high capital investment and maintenance costs of FAD units	FAD construction and maintenance costs	Low capital investment per fisher
		Lower vessel operational costs around FADs	Operational costs of FAD fishing	Low operational costs
		Minimize seasonal variability in FAD fishing	Seasonal variability in landings	Low variability in landings
		Minimize competition with imports	Local versus import prices	Local prices lower than import prices
		Prevent market gluts	Variability in local prices	Maintain profitable prices at times of high abundance
	2.2 Affordable food source	Ensure that FAD fishery products remain an affordable and available source of food for the future	Per capita (fish) consumption	Preferred levels of consumption (health, dietary aspects)
			Percentage of population consuming FAD fishery products	Average market prices of FAD fishery products
			Market price of FAD fishery products	
			Relative market price	

	2.3 Fair access to fishing grounds	Ensure fair access to fishing grounds	Access indicators (e.g. number of vessels, fishers and licenses/ permits)	Degree of fair access to fishing grounds
		Minimize conflict among FAD users	Number of conflicts with other FAD users	Reduction in number of conflicts
		Minimize conflict with other resource sectors/users	Number of conflicts with other resource users	Reduction in number of conflicts
		Minimize IUU fishing	Bilateral/ multilateral access agreements	Resource sharing between countries.
	2.4 Optimal utilization/processing for domestic markets	Promote fish quality and safety for consumers	Fish and fishery products related SPS standards	Quality and safety standards and requirements met
		Promote value-addition to optimize economic benefits	Added value products	Increases in added value
		Promote switching of target species to take advantage of peak periods of abundance	Variability in supply of FAD fishery products	Supply of FAD fishery products remains stable intra- and inter-annually
	2.5 Adequate levels of safety at sea	Minimize safety risks during FAD deployment	Number of accidents during FAD deployment and fishing	Significant reduction of accidents
		Minimize safety risks during fishing		
	2.6 Best practices on FADs	Improve FAD construction, deployment and maintenance	Consistency in quality of FADs deployed	High consistency in FAD quality
		Improve fishing techniques on FADs	Fishing techniques used	Highly selective techniques used
3. Sustained ecosystem health – ecological	**3.1 Healthy offshore habitat** Healthy habitat with minimal degradation and minimal impact from pollution or other negative effects	Maintain off-shore pelagic habitat health	Water quality parameters	Maintain healthy water quality parameters
		Minimize habitat degradation	Number of FADs deployed, retrieved and lost	Minimize FADs lost; maximize FADs retrieved
			Other marine debris/ pollution occurrence	Minimize marine debris other than FADs
	3.2 Healthy nearshore/reef habitat Coastal/reef habitat with sustainable levels of fishing pressure	Reduce fishing pressure on coastal/reef resources	CPUE trends of coastal/reef resources	Gradual increases in CPUE
			Evolution of relationship between fishing effort on FADs and fishing effort on nearshore/reef resources	Increases in fishing effort on moored FADs are followed by decreases in fishing effort on nearshore/reef resources

			Percentage of juveniles in the nearhsore/reef catch	Gradual decreases of percentage of nearhsore/reef juveniles landed
	3.3 Healthy and resilient ecosystem (with balanced trophic levels)	Maintain aquatic biodiversity and balances ecosystem	Species composition of catches (including size)	
		Adaptation to climate change and weather extremes	Trophic levels (predator-prey composition)	

12. MANAGEMENT ADVICE AND IMPLEMENTATION OF THE PLAN

12.1. MANAGEMENT ADVICE

12.1.1. PRECAUTIONARY APPROACH

In keeping with the recommendations of the CRFM-JICA CARIFICO / WECAFC-IFREMER MAGDELESA workshop of December 2013 with regard to the development of a moored FAD fishery in the eastern Caribbean (Appendix 10 in CRFM 2013c), **any further development of the fishery in the sub-region should commit to the application of a precautionary approach to fisheries management**.

The precautionary approach to fisheries management [3]recognizes that:
- all fishing activities have significant impacts;
- fisheries impacts are not negligible unless proved otherwise;
- the complex and changing fishery system will never be perfectly understood;
- scientific advice for management is therefore always affected by uncertainty;
- management decision processes and sector's compliance add their own uncertainties;
- impacts of fisheries on the system are therefore difficult to predict accurately; and,
- consequences of management errors may be only slowly reversible.

As a consequence, and recognizing that the conduct of fisheries requires that decisions are still made with incomplete knowledge, the approach requires *inter alia* that:
- a level of precaution commensurate to risk be applied at all times to all fisheries;
- it be applied systematically, i.e. in research, management and fishing operations;
- potentially irreversible changes be avoided (to maintain options for future generations);
- undesirable outcomes be anticipated and measures be taken to reduce their likelihood;
- corrective measures be applied immediately and be effective within an acceptable time;
- priority be given to conserving the productive capacity of the resource;
- precautionary limits be put on fishing capacity on highly uncertain resources;
- all fishing activities be subjected to prior authorization and periodic review;
- the burden of proof be appropriately (realistically) placed;
- standards of proof commensurate with the potential risk to the resource be established; and,
- the approach is formalized in a comprehensive legal and institutional framework.

12.1.2. INSTITUTIONAL AND LEGAL ARRANGEMENTS AT THE SUB-REGIONAL/REGIONAL LEVEL

In line with Berry and Tietze (2012) recommendations, **for tunas and tuna-like species typically caught on moored FADs and which are currently actively managed by ICCAT, CRFM Member States engaged in the moored FAD fishery and not yet party to the ICCAT, should either become parties individually, or mandate CARICOM itself to become a party to facilitate their active engagement in**

[3] http://www.fao.org/fishery/topic/13302/en

the decision-making process for those species that are currently actively managed by ICCAT. The latter possibility would allow collective, or pooled, representation, which would be more cost effective and also would allow collective access to regional expertise. Importantly, Berry and Tietze (2012) also pointed out that if CARICOM Member States wish to replace their individual membership with regional (CARICOM) membership, they should seek to negotiate a greater voting weight for CARICOM than that provided for in Article III of the Convention.

Moreover, with regard to those small tuna or tuna-like species that also fall under the ICCAT mandate and are caught on moored FADs, but which are not currently actively managed by ICCAT despite their importance to the Caribbean (e.g. blackfin and bullet tunas, dolphinfish, wahoo, cero, mackerels), management will be best achieved through a formal management partnership arrangement between ICCAT and one or more Regional Fisheries Bodies (RFBs), e.g. CRFM, OSPESCA and WECAFC, as recommended in the draft for the sub-regional management plan for blackfin tuna (Tietze and Singh-Renton 2012), and in line with CRFM/CLME Strategic Action Programme (SAP) for the Effective Governance and Management of Large Pelagic Fisheries in the CLME.

For those species not actively managed by ICCAT, the CRFM/CLME Strategic Action Programme (SAP) for the Effective Governance and Management of Large Pelagic Fisheries in the CLME, and in line with Tietze and Singh-Renton (2012), **support the creation of a formal management partnership agreement between the aforementioned RFBs and ICCAT, through a Memorandum of Understanding (MOU)**. As Tietze and Singh-Renton (2012) point out, the SAP suggests that "*WECAFC takes the lead in these negotiations as it has the broadest membership among the RFBs and hence many more of its members are also members of ICCAT. Furthermore, WECAFC is also a subsidiary body of FAO and could seek assistance from FAO regarding the preparation of a MOU. WECAFC should do so in close consultation and cooperation with other RFBs such as the CRFM and OSPESCA*".

Once the MOU has been concluded, the relevant **RFBs within the sub-region would cooperate in the preparation of management plans for specific small tunas and tuna-like species,** as well as in the coordination of plan implementation across the region. **Importantly, these species-specific sub-regional fishery management plans would then inform the sub-regional management plan for the moored FAD fishery, which would operate transversally across the range of exploited species.**

12.1.3. LEGAL AND POLICY INTERVENTIONS AT THE NATIONAL LEVEL

12.1.3.1. OVERARCHING FISHERIES NATIONAL LEGAL AND POLICY INTERVENTIONS

In order to make the above management arrangements comprehensive it will be necessary to implement the legal and policy interventions below, which have been recommended by the CRFM/CLME review of existing policy, legal and institutional arrangements for governance and management of large pelagic fisheries in the CLME and the CRFM/CLME Strategic Action Programme for the Effective Governance and Management of Large Pelagic Fisheries in the CLME:

- **Review of national fisheries laws of all of the states to ensure that they conform to modern fisheries management standards.** Where fisheries laws do not formally require the provision of data to national authorities by fishers, this should be mandated.

- **Ensure the national laws fully implement the treaty obligations assumed by each state.**

- **National Regulations related to fisheries statutes should be enacted and implemented (as permitted by the relevant Fisheries Act), and updated where necessary.**

- **Review and update fisheries management plans, and where no such management plan exists, one should be created and brought into force as a matter of urgency.**

- F**ormally set out the principles and best practices from non-binding instruments in national legislation** – including the FAO Code of Conduct for Responsible Fisheries and the Castries Declaration on Illegal, Unreported and Unregulated Fishing. Such principles include: using the best available scientific information, applying the precautionary and ecosystem based approaches to fisheries management, the principle of sustainable use, the participatory approach and principles of good governance.

- **Harmonize national fisheries and environmental legislation within the region.** Technical assistance, as needed, should be provided for this purpose.

- **Delimit all maritime boundaries**. In the interim, if boundary delimitation is not possible at present, neighbouring states should enter into bilateral or multilateral agreements allowing joint monitoring, control and surveillance (MCS). The OECS Common Fisheries Surveillance Zone could be used as a model, but ideally the scope should embrace the Wider Caribbean Sea (for further details, see Tietze and Singh-Renton 2012).

12.1.3.2. NATIONAL LEGAL AND POLICY INTERVENTIONS SPECIFIC TO THE FAD FISHERY

In line with ICCAT (2014)'s recommendations, CRFM Member States should prepare national level FAD fishery management plans, and put in place appropriate legislation to support the implementation of these plans. Provisions specifically regulating the use of moored FADs need to be incorporated into national legal instruments and should be aligned with a clear policy stand on the use of private individual, private collective and public FADs, while keeping in mind that an uncontrolled multiplication of FADs is highly undesirable (Table 11). These provisions should explicitly address the following elements adapted from the recommendations given by Pelagic Fisheries Working Group (CRFM 2014a):

- FAD design, including:
  - Minimum standards ensuring a sufficient mooring weight and an adapted buoy volume to resist currents;
  - Minimum standards for identification and marking of FADs (e.g. lighting requirements; radar reflectors; visible distance during the night and day) so as to prevent navigational hazards;
  - Prohibition of use of certain materials in FAD construction, including:
    - Materials that can entangle non-target species (e.g. certain type of aggregators)
- Authorization for deployment of FADs;
- Registration of FADs;
- FAD user license and license fees;
- FAD users' responsibilities in resource management, including:
  - Required provision of catch and effort data;
- Fishing on FADs, including:
  - Fishing techniques allowed and/or prohibited;
  - Rules governing fishing operations near FADs;

    - Distance from FAD to which rules apply;
- Responsibilities of (national and community level) management organizations in the FAD fishery, including;
    - Constructing, deploying, maintaining, monitoring and replacing FADs.

In addition to the above, additional provisions should be considered in relation to the following:

- Reporting and disposal of unauthorized FADs;
- Reporting of FAD losses and replacement;
- Designating areas within the EEZ closed to FAD fishing (e.g. shipping lanes; high boat traffic areas) and/or where only FAD fishing is allowed;
- Designating the maximum total number of FADs within the authorized areas (i.e. maximum FAD density);
- Establishing arbitration mechanisms to address cases of conflict;
- Designating the minimum distance separating moored FADs;
- Establishing rules governing commercial versus recreational fishing on FADs;
- Specifying the vessel characteristics for FAD transport and deployment;
- Prohibiting the transshipment at sea of fish caught on FADs;
- Regulating the composition of the catch on FADs, including:
    - Minimizing the capture of juveniles;
- Controlling fishing pressure on nearshore/reef resources by FAD users;
- If applicable, establishing rules governing user access to private and public FADs, including;
    - Priority of access to private FADs;
- If applicable, designating the maximum number of private FADs per fisher.

Importantly, **all the provisions addressing the elements above should reflect current knowledge of *best practices* on the use of moored FADs (e.g. Table 12), should be aligned to the extent possible with ICCATs requirements for the recording of catch and fishing activities on FADs (ICCAT 2014), and should be established through consensus with all stakeholders, and be mindful of local context.**

Member States should, as far as practically possible, utilize current legislation to the fullest extent towards implementation of the management measures recommended above while in the process of amending current legislation to give full effect to this sub-regional plan.

12.1.4. LICENSE SYSTEM FOR FAD FISHING

A licensing system for FAD fisheries should be implemented. Fishers making use of moored FADs should register as FAD fishers at the appropriate Fishery agency, apply for a license to fish on FADs, and pay for the respective license. Moreover, all vessels exploiting FADs should be registered and have a registration number. In that regard, management of the moored FAD fishery should benefit from on-going efforts to harmonize and improve national vessel registration and licensing systems in some CRFM Member States. Adequate licensing and registration systems are needed to identify vessels fishing for large oceanic and coastal pelagics species, track change of ownership, base of operation and use of vessels, and provide information to the CRFM to be incorporated in sub-regional/regional data bases.

The license to fish on FADs could play, when necessary and appropriate, three critical roles in the management of the moored FAD fishery:

- Firstly, it could be used to control fishing effort on target species so that the FAD fishery is no longer an open access fishery. This could be accomplished by regulating the number of fishers authorized to exploit the fishery resources around FADs. Alternatively, in line with the permit proposed by Tietze

and Singh-Renton (2012) for the blackfin tuna fishery (which is based on the NMFS Highly Migratory Species Commercial Caribbean Small Boat Permit for the US Caribbean), the license could help control effort by specifying the target species, daily catch limits, minimum size, fishing season and/or area, and authorized fishing gear used to fish around moored FADs, irrespective of FAD ownership. In all cases, grating of a license to fish around FADs should require provision of data and information on fishing activities by the fishers.

- Secondly, by regulating the number of authorized fishers and/or prescribing fishing season and/or area, the license system could contribute to reduce user conflicts as well as fisher overcrowding on FADs and associated reduction in catches per fishing trip.
- Thirdly, through the collection of a license fee, the licensing system could contribute to generate funds to help monitor, deploy, repair and replace FADs, so as to minimize financial dependence of FAD activities on government and/or aid agencies.

12.1.5. POST-HARVEST AND INFRASTRUCTURE SUPPORT

So as to optimize the use of pelagic fishery resources exploited on moored FADs for long-term socio-economic benefits, national fisheries authorities, in close cooperation with other government agencies, civil society, the private sector, sub-regional and regional fisheries bodies as well as multi- and bilateral donors, funds and development partners, will **undertake efforts to improve fisheries infrastructure at landing and market sites so as to increase sanitary and phytosanitary (SPS) standards and value addition of target species, as well as to improve the access of the pelagic fisheries sector to adequate institutional credit and insurance facilities**. **Furthermore, efforts should also be undertaken to provide appropriate training in fish handling and SPS measures for target species to all actors involved in fish handling along the chain of commercialisation**.

12.2. IMPLEMENTATION

The broad steps, activities, responsible party and timeframe for the finalization, adoption, evaluation and revision of this management plan are consistent with those proposed by Tietze and Singh-Renton (2012) for the sub-region blackfin tuna fishery management plan and are shown in Table 18. **During implementation of the FAD fishery management plan, consultative processes will be used to facilitate participation of stakeholders in the monitoring and adaptation or adjustment of the management plan**. Feedback will be provided to stakeholders on results of the implementation of the plan including information of catch and effort trends, number of licenses/permits issued/renewed, results of stock assessments, industry performance evaluations, etc. **This FAD fishery management plan will be in effect for a period of 5 years from the date of endorsement by the CRFM Ministerial Council.** It will be renewed/updated on a regular basis and inputs from stakeholders will be encouraged and given due regard.

12.3. CO-MANAGEMENT

The present functioning and structure of national Fisheries Advisory Committees (FAC) should be revised to assure participation of all fisheries sub-sectors. Stakeholders from other sectors than fisheries, who have an impact or interest in species targeted on moored FADs and the related pelagic ecosystem, should also be represented. This could be facilitated through national inter-sectorial committees that are established under the CLME project for promoting the ecosystem approach to fisheries. The selection process for members of Fisheries Advisory Committees should be made

transparent and carried out in close consultation with the groups which are to be represented on the FAC. The structure and functioning of the FACs should be more clearly defined and operational ensuring, among other things, that the chairperson of the committees has sufficient time to fulfil her/his tasks.

Impact and outcomes of management decisions on fish stocks exploited on moored FADs, stakeholders and marine ecosystem should be regularly reviewed at the national and regional levels. Evaluation of the impacts and outcomes should be conducted together with concerned stakeholders who should be representative of the entire ecosystem affecting moored FAD fisheries. Depending on the outcome of these evaluations, management plans and measures should be adjusted on a regular basis consistent with ecosystem approach to fisheries management.

12.3.1. STRENGTHENING OF FISHERFOLK ASSOCIATIONS AND COOPERATIVES

As highlighted in Sections 8.4.5.6, 8.4.6 and 8.4.7, a **better integration and participation of fishers in the decision-making process as well as in the management activities is necessary if the moored FAD fishery is to be managed effectively and efficiently.** At the community level, **fisherfolk associations should play a critical role in defining institutional roles and stakeholder rights and duties within the FAD fishery and in identifying and implementing best management practices**, including collection and reporting of catches on FADs, joint FAD programme planning, elaboration of code of conducts (Table 12), and the drafting of national FAD fishery management plans (CRFM/JICA 2011). These participatory approaches involving fisher communities should be supported by the sub-regional plan.

As such national fisheries authorities, in close cooperation with other government agencies, civil society, the private sector, sub-regional and regional fisheries bodies as well as multi- and bilateral donors, funds and development partners, will make efforts to strengthen fisherfolk associations and cooperatives involved in the moored FAD fishery so that they can fully participate in the sustainable management and conservation of fishery resources and optimize the socio-economic benefits derived from these resources. **In that line, Member States should make use of existing legal provisions for engagement of fisher organizations in the governance of fisheries. Such mechanisms may include designation of local fisheries management areas and Local Fisheries Management Authorities with capacity to make fishing regulations in the local fishery management areas** (e.g. Section 18 and 19 of the 1987 Fisheries Act of Dominica).

Furthermore, to help achieve effective and efficient co-management, and as stated in Section 8.4.6, due considerations should be given to:

- Non-regulatory options that contribute to fostering positive synergies between government and fisher stakeholders;
- Consensus-based options derived from direct consultation with fishers;
- Data-driven options.

12.4 MONITORING, CONTROL, SURVEILLANCE AND ENFORCEMENT

Control and surveillance of moored FAD fisheries will be carried out by the national fisheries authorities in close cooperation with the Caribbean Fisheries Forum, and eventually any agreed management partnership arrangement with ICCAT. The functions of CRFM will include the development of a harmonized control and inspection scheme to ensure compliance with management and conservation measures, to review compliance with adopted conservation and management measures and to implement adopted control, surveillance and enforcement measures.

Table 18. Broad steps towards finalization, adoption, evaluation and revision of sub-regional FAD fishery management plan

Broad Steps	Activities	Responsible Party
1. Finalization and adoption of draft Plan by RFB's	1.1 Finalization of Plan	CRFM/WECAFC
2. Finalization and adoption of draft Plan by broader membership and stakeholders	2. Reviewed by stakeholders at the national and regional level through consultative processes including public hearings, public postings of management plans and comment periods by FACs	National fisheries authorities, CRFM, WECAFC
3. Finalization and adoption of plan by RFBs and information of ICCAT	3. Adjustment of Plan by incorporating inputs from consultations	CRFM/WECAFC/ICCAT
4. Formal adoption of Plan	Discussion and approval of Plan by Caribbean Fisheries Forum and CRFM Ministerial Council	Caribbean Fisheries Forum and CRFM Ministerial Council
5. Putting Plan into action, implementation	5.1 Change, creation or implementation of legislation, regulations or management plans to allow for application of proposed management measures, as necessary	National fisheries authorities
	5.2 Adoption of Plan at national level	CRFM Member States
6. Formal adoption of Plan by other non-CRFM Member States making use of moored FADs such as the French overseas territories, the Dominican Republic, and Curacao	6. Formal adoption of Plan by non-CRFM Member States	Relevant national fisheries authorities
7. Plan evaluation and revision	7. Annual review and adjustment of Plan	National fisheries authorities in consultation with stakeholders, CRFM, WECAFC

12.5 INSTITUTIONAL STRENGTHENING

National fisheries authorities as well as national monitoring, control, surveillance and enforcement agencies will have to be provided with the requisite resources to facilitate effective implementation of the plan. At the regional level, the CRFM Secretariat is also to be provided with the requisite resources to facilitate establishment, management and reporting on the respective sub-regional moored FAD fishery catch and effort and vessel registry databases.

12.6 FINANCING

Financing the implementation of this sub-regional moored FAD fishery management plan will largely be done at the national level. However, additional funding will be required for the establishment and maintenance of regional data bases as well as for carrying out regional management functions of advisory and MCS nature. This funding will be secured with support of multi- and bilateral donor agencies and funds.

12.7 MONITORING AND EVALUATION OF THE IMPLEMENTATION PLAN

The schedule specified in Table 18 will guide the monitoring of the steps outlined for finalization, adoption and updating of the sub-regional plan. **The monitoring of the plan will be coordinated initially by the CRFM through its Pelagic Fisheries Working Group, supported by the participation of States having a real interest in moored FADs, together with scientific observers and representatives of both the CRFM and WECAFC Secretariats**. For each step, the responsible parties will be asked to submit brief progress reports to CRFM and WECAFC, outlining the level of achievement with regard to the specific activities identified.

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The CRFM is an inter-governmental organisation whose mission is to "Promote and facilitate the responsible utilisation of the region's fisheries and other aquatic resources for the economic and social benefits of the current and future population of the region". The CRFM consists of three bodies – the Ministerial Council, the Caribbean Fisheries Forum and the CRFM Secretariat. CRFM members are Anguilla, Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago and the Turks and Caicos Islands.

This version of the *2015 Draft Sub-regional Management Plan for FAD Fisheries in the Eastern Caribbean (Stakeholder Working Document)* was circulated to CRFM Member States on 30 July 2015 for national review, through consultation with the broad range of stakeholders. Reports of the national consultations are expected from Member States by late December 2015. Thereafter, the CRFM's Pelagic Fisheries Working Group would review the respective reports, make the necessary amendments to the management plan and submit the revised document to the next meeting of the Caribbean Fisheries Forum for review. Once approved by the Forum the management plan would be submitted to the next meeting of the Ministerial Council for consideration and endorsement for implementation by CRFM Member States. The final endorsed FMP would be published as a CRFM Special Publication.

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