

**UPDATE ON THE IMPLEMENTATION STATUS
OF THE REGIONAL LIONFISH STRATEGY FOR
THE CONTROL OF THE INVASIVE LIONFISH IN
CRFM MEMBER STATES - 2017-2018**



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Update on the Implementation Status of the Regional Lionfish Strategy for the Control of the Invasive lionfish in CRFM Member States - 2017-2018

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TABLE OF CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS.....	IV
1. INTRODUCTION	1
2. METHODOLOGY.....	2
3. RESULTS.....	2
3.1 OBJECTIVE 1-FACILITATE COLLABORATION AMONG GOVERNMENTS, REEF-RELIANT INDUSTRIES, CIVIL SOCIETY, AND ACADEMIA BY PROVIDING MECHANISMS FOR COORDINATION OF EFFORTS ACROSS POLITICAL AND GEOGRAPHICAL BOUNDARIES	3
3.2 OBJECTIVE 2-ENCOURAGE A COORDINATED RESEARCH AND MONITORING AGENDA.....	3
3.3 OBJECTIVE 3-ENCOURAGE GOVERNMENTS TO REVIEW AND AMEND RELEVANT LEGISLATION AND, IF NECESSARY, DEVELOP NEW REGULATIONS AND POLICIES TO CONTROL LIONFISH	5
3.4 OBJECTIVE 4- CONTROL INVASIVE LIONFISH POPULATIONS USING REGIONALLY COORDINATED, EFFECTIVE METHODS.....	5
3.5 OBJECTIVE 5-PROVIDE EDUCATION, INFORMATION AND OUTREACH MECHANISM TO GENERATE PUBLIC SUPPORT AND FOSTER STEWARDSHIP IN INVASIVE LIONFISH PROGRAMS	6
4. DISCUSSION	7
5. REFERENCES.....	10

LIST OF ACRONYMS AND ABBREVIATIONS

CARICOM	Caribbean Community
CCCFP	Caribbean Community Common Fisheries Policy
CRFM	Caribbean Regional Fisheries Mechanism
EDRR	Early Detection and Rapid Response
IAS	Invasive Alien Species
ICRI	International Coral Reef Initiative
MPA	Marine Protected Areas
RLC	Regional Lionfish Committee
SPS	Sanitary and Phytosanitary
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

The invasive lionfish has negatively impacted the commercial fisheries and marine ecosystems in the region. In order to address this problem, the 7th Meeting of the Ministerial Council endorsed the Regional Strategy for Control of the Invasive Lionfish (Gomez-Lozano *et al.*, 2013) and the Best Practice Manual for the control and mitigation of the invasive lionfish in the Wider Caribbean Region (Morris, 2012), in May 2013. The endorsement of the Regional Strategy for Control of the Invasive Lionfish and the Best Practice Manual by the Ministerial Council is also in alignment with the The Caribbean Community Common Fisheries Policy (CCCFP). The CCCFP is a binding treaty focusing on cooperation and collaboration of Caribbean people, fishermen and governments in conserving, managing and sustainably utilising fisheries and related ecosystems. Through the integration of environmental, coastal and marine management considerations into fisheries policies, the CCCFP seeks to safeguard the fisheries and related ecosystems from threats and lessen impacts of climate change or natural disasters.

The CRFM Secretariat conducted a study in 2015 to review the progress made by Members States in the implementation of this Strategy at the national level between mid-2013 to mid-2015 (Mohammed, 2016). The findings, conclusions and recommendations of the study were based on feedback from 41% of the membership of the CRFM, and excluded some countries for which reef and slope fisheries are of considerable socio-economic importance. It was found that all the responding countries had taken action to control the lionfish invasion, demonstrating national commitments towards implementation of the Strategy. However, it was uncertain whether the findings accurately reflected the situation concerning implementation of the Strategy in all CRFM Member States.

For this reason, it was recommended that the survey, with any required modifications, be repeated biennially. This recommendation was also endorsed by the 10th Meeting of the Ministerial Council in May 2016 and seeks to facilitate the CRFM's reporting to CARICOM Member States and Institutions on the implementation of the CARICOM Strategic Plan (2015-2019) and specifically the strategic priority of environmental resilience. Additionally, the 31st General Meeting (2016) of the International Coral Reef Initiative (ICRI) declared 2018 as the third International Year of the Reef. ICRI encourages countries to identify and implement effective management strategies for conservation, increased resiliency and sustainable use of coral reefs and associated ecosystems and promoting best practices.

The lionfish is an invasive species in the Caribbean, with no known predators, voracious appetites and high rates of reproduction, all of which give it a competitive advantage over native species (Albins, 2013; Rocha *et al.*, 2015). At heavily invaded sites, lionfish have reduced their fish prey by up to 90% and lionfish can reach densities over 200 adults per acre, consuming more than 460,000 prey fish/acre/year¹. The lionfish invasion has caused ecological impacts within the coral reef ecosystems and has also had economic and social impacts throughout the Wider Caribbean Region (Albins and Hixon, 2011). In addition to preying on or outcompeting commercially important species, lionfish may also impact the recreational and tourism sectors due to a perceived absence of attractive reef species (Green *et al.*, 2012). There has also been concern about the envenomation of humans from the neurotoxins contained in the spines and fins of the lionfish, which can require medical attention (Haddad *et al.*, 2015). In areas of high densities, this poses another challenge for recreational and tourism sectors as the high densities increase the probability of human contact. The diversity of these issues to be addressed makes management and control actions of lionfish challenging.

¹ CAR-SPAW-RAC-Vulnerability of the Caribbean region to lionfish invasion. <http://www.car-spaw-rac.org/?Vulnerabilite-de-la-grande-region,447>

2. METHODOLOGY

A short survey was designed based on the five objectives of the Strategy and associated actions to determine the implementation status by Member States. Select actions were chosen based on their broad nature and ease of assessing their achievement. The survey is attached as Appendix 1. The five objectives of the Strategy are summarized below.

1. Facilitate collaboration among governments, reef-reliant industries, civil society, and academia by providing mechanisms for coordination of efforts across political and geographical boundaries;
2. Encourage a coordinated research and monitoring agenda;
3. Encourage governments to review and amend relevant legislation and, if necessary, develop new regulations and policies to control lionfish;
4. Control invasive lionfish populations where possible using regionally coordinated, effective methods;
5. Provide education, information and outreach mechanisms to generate public support and foster stewardship in invasive lionfish programs.

The survey was circulated to the 17 CRFM Member States.

3. RESULTS

This report presents an update on the implementation status of the Regional Lionfish Strategy between 2017 and 2018 in CRFM Member States. Its content is based on responses of eight of the seventeen CRFM Member States (Antigua & Barbuda, Dominica, Grenada, Guyana, Montserrat, Saint Lucia, St Vincent and the Grenadines and Trinidad and Tobago). The lionfish invasion was considered as moderately extensive by the majority of the countries (4), and very extensive by three countries (Table 1). The lionfish was not reported in Guyana.

Table 1: Extent of lionfish invasion by country.

How extensive is the lionfish invasion in your country	Not reported	Moderately extensive (commonly seen)	Very extensive (very commonly seen)
Antigua & Barbuda		✓	
Dominica		✓	
Grenada			✓
Guyana	✓		
Montserrat			✓
St. Lucia			✓
St. Vincent & the Grenadines		✓	
Trinidad & Tobago		✓	

The five countries which have implemented the Regional Strategy to control lionfish were Antigua & Barbuda, Grenada, St. Lucia, St. Vincent & the Grenadines and Trinidad and Tobago. Dominica and Montserrat have not yet implemented the strategy (Table 2).

Table 2: Implementation status of the regional strategy to control lionfish by country

Implementation of regional strategy to control lionfish	Yes	No
Antigua & Barbuda	✓	
Dominica		✓
Grenada	✓	
Montserrat		✓
St. Lucia	✓	
St. Vincent & the Grenadines	✓	
Trinidad & Tobago	✓	

3.1 Objective 1-Facilitate collaboration among governments, reef-reliant industries, civil society, and academia by providing mechanisms for coordination of efforts across political and geographical boundaries

In contributing to the achievement of this objective, the local action plans have been designed to feed into a regional framework to allow others to benefit from lessons learned and best practices. All the countries except Montserrat had a national response/ action plan for lionfish control (Table 3).

Table 3: Existence of national response/action plan by country.

National response plan or action plan for lionfish control	Yes	No
Antigua & Barbuda	✓	
Dominica	✓	
Grenada	✓	
Montserrat		✓
St. Lucia	✓	
St. Vincent & the Grenadines	✓	
Trinidad & Tobago	✓	

3.2 Objective 2-Encourage a coordinated research and monitoring agenda

Research is essential to acquire a better understanding of the biology, ecology and potential impacts of the species and the response of the Caribbean ecosystems to the invasion. Monitoring the trends of the lionfish populations and the impacts of control programs are also required to assess and adjust actions as an adaptive management process.

Conducting surveys to determine the abundance/density of lionfish in reef areas by countries allows the extent of the invasion to be quantified and monitored over time. Four of the countries have not conducted surveys to determine the abundance/density of lionfish in reef areas. These were Dominica, Montserrat, St. Lucia and St. Vincent and the Grenadines (Table 4). In addition to having information on density, data

regarding catch and effort as well as economics, trade, and human health issues are necessary to achieve this objective.

Table 4: Conduct of surveys to determine the abundance/density of lionfish in reef areas by country.

Conduct surveys to determine the abundance/density of lionfish in reef areas	Yes	No
Antigua & Barbuda	✓	
Dominica		✓
Grenada	✓	
Montserrat		✓
St. Lucia		✓
St. Vincent & the Grenadines		✓
Trinidad & Tobago	✓	

The majority of countries collected data on catch of lionfish; unit price of lionfish; fishing effort targeted at lionfish and number sighted (Table 5). Data on the quantity of lionfish sold, quantity of meals sold, quantity consumed locally, and revenue from sale of lionfish meals were also collected by some countries (Table 5). None of the countries collected data on the ornamental trade or envenomation of contact poisoning. (Table 5). Of the countries which collected data, three countries indicated that there had been some analysis of these data (Table 6).

Table 5: Types of data collected on lionfish by country

Data collection	Antigua & Barbuda	Dominica	Grenada	Montserrat	St. Lucia	SVG	Trinidad & Tobago
Catch of lionfish	✓	✓		✓	✓	✓	✓
Fishing effort targeted at lionfish	✓	✓			✓		✓
No. of lionfish sighted	✓		✓			✓	✓
Quantity of lionfish sold	✓		✓			✓	
Unit price of lionfish	✓	✓	✓	✓	✓		
Quantity of lionfish meals sold						✓	
Revenue from sale of lionfish meals						✓	
Cases of poisoning from contact at sea							
No. of cases of envenomation							
Quantity imported in ornamental trade							
Cost of lionfish imports in ornamental trade							
Quantity of lionfish consumed locally	✓						

Table 6: Analysis of lionfish collected by country

Analysis of collected data	Yes	No
Antigua & Barbuda	✓	
Dominica	✓	
Grenada		✓
Montserrat		✓
St. Lucia	✓	
St. Vincent & the Grenadines		✓
Trinidad & Tobago		✓

3.3 Objective 3-Encourage governments to review and amend relevant legislation and, if necessary, develop new regulations and policies to control lionfish

The majority of the countries (5) did not have current legislation for the control of lionfish (Table 7). Amending legislative instruments typically requires time, and it is therefore particularly important for Caribbean countries to start this process as soon as possible in order to enable the implementation of control actions in a timely manner. The invasion of lionfish throughout the Caribbean region has highlighted a number of gaps and inconsistencies among policies, pieces of legislation and regulations governing the management of marine resources and in particular marine invasive alien species in Caribbean countries.

Table 7: Existence of legislation to control the lionfish by country.

Current legislation make provisions for the control of the invasive lionfish	Yes	No
Antigua & Barbuda	✓	
Dominica		✓
Grenada		✓
Montserrat		✓
St. Lucia		✓
St. Vincent & the Grenadines	✓	
Trinidad & Tobago		✓

3.4 Objective 4- Control invasive lionfish populations using regionally coordinated, effective methods

Strategies and tools for lionfish control differ depending on local variables and the spatial scale at which control is enacted. Therefore, in order to achieve this objective sharing knowledge of removal tools and techniques is necessary to ensure the more widespread use of best practices around the region. Collaborative efforts among stakeholders and partnerships with reef-reliant industries such as fisheries and tourism have promoted buy-in and enhanced resources for lionfish removal. All of the countries except Dominica promoted the adoption of best practices in lionfish control (Table 8). The most common control/mitigation efforts being implemented by the countries were promotion of consumption, spearfishing, commercial fishing and culling (Table 9). Removal of lionfish from MPAs, promotion of fishing for lionfish in MPAs and recreational fishing were also common methods being each identified by

5 countries. Cooperation schemes between fishers, restaurants and hotels, and design and implementation of marketing schemes were each identified by four countries.

Table 8: Promotion to adopt best practices in lionfish control by country

Promotion to adopt best practices in lionfish control	Yes	No
Antigua & Barbuda	✓	
Dominica		✓
Grenada	✓	
Montserrat	✓	
St. Lucia	✓	
St. Vincent & the Grenadines	✓	
Trinidad & Tobago	✓	

Table 9: Control/mitigation efforts being implemented by country.

Control/mitigation efforts being implemented	Antigua & Barbuda	Dominica	Grenada	Montserrat	St. Lucia	SVG	Trinidad & Tobago
Culling	✓		✓	✓	✓	✓	✓
Promotion of commercial fishing	✓	✓	✓	✓	✓	✓	✓
Promotion of recreational fishing	✓	✓	✓			✓	✓
Promotion of consumption	✓	✓	✓	✓	✓	✓	✓
Design and implementation of marketing schemes	✓		✓		✓	✓	✓
Cooperation schemes between fishers, restaurants and hotels	✓		✓			✓	✓
Promotion of fishing for lionfish in MPAs	✓	✓	✓		✓	✓	
Removal of lionfish from MPAs	✓	✓	✓		✓	✓	
Promotion of spearfishing for lionfish	✓	✓	✓	✓	✓	✓	

3.5 Objective 5-Provide education, information and outreach mechanism to generate public support and foster stewardship in invasive lionfish programs

All countries had a national communication strategy (Table 10). This is important since this has raised the overall awareness about the invasion.

Table 10: Existence of a national communication strategy by country.

National communication strategy	Yes
Antigua & Barbuda	✓
Dominica	✓
Grenada	✓
Montserrat	✓
St. Lucia	✓
St. Vincent & the Grenadines	✓
Trinidad & Tobago	✓

4. DISCUSSION

The lionfish has invaded all the Greater Antilles, the major part of the Lesser Antilles, and the continental countries bordering the Gulf of Mexico down to Central America. This study found that lionfish has not been reported in Guyana, however this deserves further investigation and careful monitoring as it has been predicted that the invasion will eventually become established there (Morris and Whitfield, 2009). Lionfish populations have been increasing and reaching high population densities, and in some cases have become one of the most abundant species on some Caribbean reefs (Morris and Whitfield, 2009). The high colonization rate of the lionfish and important connectivity among lionfish populations in the region make consistency in actions critical to achieve a shared objective: controlling the spread of lionfish to minimize and mitigate its impacts on important ecosystems.

Current lionfish removal efforts are insufficient to effectively suppress lionfish populations and based on current technologies, management mechanisms, and available science, eradication of lionfish in the wider Caribbean is not likely (Barbour *et al.*, 2011). There is also the possibility that lionfish have already irreversibly changed these marine ecosystems. However, these ecological systems can exist in multiple steady states rather than a single equilibrium (Ludwig *et al.*, 2002). Therefore, in response to a perturbation like the lionfish invasion, these marine ecosystems might shift to an alternative steady state rather than return to the prior equilibrium².

The results of this survey and the previous one show that there have been successful efforts at the national levels to implement the Regional Strategy and at least one of the associated actions.

Even though two countries indicated that they had not implemented the Strategy, they had still taken actions to address the invasion. Overall, the actions undertaken by the countries included:

- 1.) Development of national response/action plans;
- 2.) Conducting surveys to determine the abundance/density of lionfish in reef areas;
- 3.) Data collection on lionfish catches, fishing effort and marketing, and data analysis;
- 4.) Legislation which makes provisions for lionfish/marine invasive species;
- 5.) Promotion and adoption of best practices in lionfish control;
- 6.) Implementation of control/mitigation efforts;
- 7.) Development of a national communication strategy.

² Rebecca M. Bratspies, *Lionfish as a Metaphor for Governance in an Era of Climate Change*, 58 N.Y.L. Sch. L. Rev. 829, 851–54 (2013–2014).

However, one of the challenges associated with monitoring the implementation status of the Regional Strategy for the Control of Invasive Lionfish in the Wider Caribbean is that it lacks an assessment and evaluation tool to guide and report on collaboration.

A study conducted by Graham and Fanning (2017) indicated that the Wider Caribbean Regional Strategy for the Control of Invasive Lionfish should be revised and formally endorsed by countries in the region to include an assessment framework. These authors recommended using the 2008 US Environmental Protection Agency Aquatic Invasive Species framework (USEPA, 2008) since the management activities and categories included four additional factors that were lacking in the Regional Strategy. These factors were leadership; prevention; early detection and rapid response; restoration.

Leadership and coordination within the region on invasive species and climate change issues are essential not only for improving effectiveness of management efforts under changing conditions, but also for increasing awareness and understanding of these issues more generally (USEPA, 2008). Effective marine invasive species prevention efforts must also include identification of ecosystems that may be more vulnerable to invasion under changing environmental conditions. Restoration of ecosystems is another important aspect to comprehensive prevention strategies since robust habitats are less vulnerable to invasion (USEPA, 2008). Identifying vulnerable ecosystems and reducing their vulnerability through restoration requires further research and should include climate change interactions. Research to inform coordination and prevention also will help improve early detection and rapid response (EDRR) efforts and should include evaluation of the existing EDRR capacities in order to determine effectiveness in addressing invasive threats resulting from changing conditions (USEPA, 2008).

In moving forward to address the invasion of lionfish, the recommendations based on national responses to the survey and general findings of the evaluation, which were developed in the first review by Mohammed (2016) remain relevant and are provided below.

- 1.) CRFM Member States should develop new, or update existing, management plans for reef and slope fisheries and associated ecosystems, to comprehensively consider all aspects of the management of the lionfish as a sub-component, and to ensure that such plans are consistent with existing national lionfish response/action/management plans and the ecosystem approach to fisheries management;
- 2.) Membership on Fisheries Advisory Committees should include representation of the full range of stakeholder groups (e.g. fisherfolk; fisheries managers; Ministers or their representatives) necessary for implementation of existing national lionfish response/management plans and, fisheries managers should also be represented on any National Committee established to address invasive alien species in general;
- 3.) National resources should be provided and sustained for continued long-term management of the lionfish under the broader fisheries management portfolio;
- 4.) Member States should strengthen engagement with existing regional fora to facilitate information exchange in best practices in IAS, including lionfish control and management;
- 5.) Member States should take advantage of the opportunities presented through the Caribbean Fisheries Forum, and its restructured Fisheries Working Groups to conduct lionfish research in accordance with the agreed CRFM Fisheries and Aquaculture Research Agenda and to coordinate management/control measures; and through the restructured CRFM Resource Mobilisation Committee to seek the requisite funding;
- 6.) Academic and research institutions should ensure that the best scientific information is made available to resource managers to inform management decision-making on reef and slope fisheries and related ecosystems;
- 7.) Where it is not yet done, Fisheries Divisions should engage diving companies to identify cost-effective solutions to implementing regular lionfish monitoring programmes and provide the

requisite training, data collection protocols and equipment to facilitate effective execution of such programmes;

- 8.) If not yet done, a review of existing policy and legislation should be conducted. This review should be holistic in nature, focusing on regional and international commitments and best practices in fisheries and biodiversity management generally, with the proposed amendments being general enough to address current issues as well as issues likely to arise in the near future;
- 9.) Management and restorative efforts across a range of regional and national initiatives should be coordinated so as to effectively address issues related to the invasive lionfish, among other marine invasive species;
- 10.) Lionfish should be tested for ciguatera and other food borne diseases on a regular basis, especially if the species is being promoted as a food fish. Such testing should be integrated into the regular SPS monitoring programmes for fish and fish products in the respective countries;
- 11.) Regular evaluation of communication strategies, education and outreach programs should be conducted to assess their impacts on the knowledge, attitudes and practices of the range of stakeholders involved in lionfish control/management.

In addition to the findings of the previous review by Mohammed (2016), this study highlights that the timelines for many of the actions set out in the Regional Strategy have passed and that there is a need for effective monitoring and evaluation of the actions undertaken by the countries. Many of these actions are of critical importance in addressing the lionfish invasion and other marine invasive alien species. In the short-term it is therefore recommended that:

- 1.) The CRFM Secretariat should develop a simple monitoring and evaluation tool based on this study to guide and report on these actions taken by CRFM Member States regarding the lionfish invasion.

Taking into account the time that it will take to complete the following activities, the long-term recommendations of this study are that:

- 1.) The Regional Lionfish Committee (RLC) or another mechanism should revise the Regional Strategy to include an assessment framework which would allow monitoring and evaluation of actions. Additionally, in the future, actions related to: leadership; prevention; early detection and rapid response; and restoration of coral reefs and associated ecosystems should be identified and included in the revised Strategy.
- 2.) The revised Regional Strategy should be formally endorsed by the CRFM Member States. Where necessary, the necessary regulatory and/or legislative instruments should be updated to facilitate implementation of the revised strategy.
- 3.) The role of climate change and ocean acidification in increasing the vulnerability of coral reefs and associated ecosystems should be taken into account when reviewing/amending policies, legislation and management plans related to marine invasive alien species.
- 4.) There should be a thorough review of the data currently being collected by Member States. This review should be used to:
 - a. Guide the development and implementation of an integrated set of market-based approaches (e.g. promotion of lionfish as food, and development of value-added products e.g. lionfish jewelry or reconstituted fish products) to address the invasion according to specific country needs.
 - b. Conduct a preliminary assessment of lionfish catch and effort data and examine whether there has been an influence on the catches of commercially important reef species.
 - c. Determine the impacts of lionfish on human health (envenomation and ciguatera incidences).

Implementation of the recommendations made by Mohammed (2016), Graham and Fanning (2017) and this study will also be in alignment with the Action Plan of the International Coral Reef Initiative (ICRI) Secretariat (2016-2018)³. This Action Plan covers five themes:

- 1.) Help raise awareness of how coral reefs and related ecosystems help to fight climate change;
- 2.) Meet international requirements regarding coral reefs;
- 3.) Help to reduce human threats to coral reefs and associated mangroves and seagrass, by making greater use of regulatory tools;
- 4.) Monitor the state of reefs in order to better manage them;
- 5.) Progress via education.

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³ ICRI. 2016. Action plan of the International Coral Reef Initiative (ICRI) Secretariat (2016-2018) https://www.icriforum.org/sites/default/files/ICRI_Plan_Action_2016-18_0.pdf

Appendix 1



Survey Instrument for the Monitoring & Evaluation of Progress on Implementation of the Regional Lionfish Strategy

Name and Post of respondent:

Email:

Country:

Date:

Table 1: Updated survey instrument to monitor and evaluate progress on implementation of the Regional Strategy for Control of the Invasive Lionfish in the Wider Caribbean during the mid-2015 to mid-2017 period (adapted from Mohammed, 2016). Mark the appropriate responses with an X.

1. How extensive is the lionfish invasion in your country?	Not reported	
	Not extensive (reported but not well established)	
	Lightly extensive (seen occasionally)	
	Moderately extensive (commonly seen)	
	Very extensive (very commonly seen)	
2. Has your country conducted any surveys to determine the abundance/density of lionfish in reef areas?	Uncertain	
	Yes	
3. Does current legislation in your country make provisions for the control of the invasive lionfish?	No	
	Yes	
4. Has the Regional Strategy to Control the Invasive Lionfish been implemented in country?	No	
	Yes	
5. Is the adoption of best practices in lionfish control as identified in the	Yes	

document “Invasive Lionfish: A Guide for Control and Management” promoted among stakeholder groups?	No	
6. Is there a national response plan or action plan for the control of the invasive lionfish?	Yes	
	No	
7. Is there a national communication strategy or education and outreach program to raise public awareness on the lionfish issue?	Yes	
	No	
8. Are the following data on lionfish collected in your country?	Catch of lionfish	
	Fishing effort targeted at lionfish	
	Number of lionfish sighted	
	Quantity of lionfish sold	
	Unit price of lionfish	
	Quantity of lionfish meals sold	
	Revenue from sale of lionfish meals	
	Number of cases of human poisoning from contact at sea	
	Number of cases of envenomation	
	Quantity of lionfish imported in ornamental trade	
	Cost of lionfish imports in ornamental trade	
9. Has there been any analysis of the data indicated in the previous question and publication of results?	Yes	
	No	
10. Indicate which kinds of control or mitigation efforts are being implemented in your country for the invasive lionfish.	Culling in any form (derbies, activities by management agencies)	
	Promotion of commercial fishing	
	Promotion of recreational fishing	
	Promotion of consumption	
	Design and implementation of marketing schemes	
	Establishment of cooperation schemes between fishers, restaurants and hotels to encourage consumption	
	Promotion of fishing for lionfish within MPAs	
	Removal of lionfish from MPAs	
	Promotion of spearfishing for lionfish	
	None	

The CRFM is an inter-governmental organization whose mission is to “Promote and facilitate the responsible utilization 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.

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