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**Report of the CRFM Reef and Slope Fisheries Working Group**

# **IMPLEMENTATION REPORT (2013-2015): Regional Strategy for the Control of the Invasive Lionfish**

CRFM Secretariat  
2016

# **CRFM Technical & Advisory Document - Number 2016 / 02**

## **Implementation Report (2013-2015): Regional Strategy for the Control of the Invasive Lionfish in CRFM Member States**

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CRFM Secretariat  
Belize, 2016

## **CRFM TECHNICAL & ADVISORY DOCUMENT – Number 2016 / 02**

### **Implementation Report (2013-2015): Regional Strategy for the Control of the Invasive Lionfish in CRFM Member States**

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## ACRONYMS AND ABBREVIATIONS

ASM	Annual Scientific Meeting
CABI	Centre for Applied Biosciences International
CARICOM	Caribbean Community
CATS	Caribbean Aqua-Terrestrial Solutions
CERMES	Centre for Resource Management and Environmental Studies
CFF	Caribbean Fisheries Forum
CFO	Chief Fisheries Office
COMPACT	Community Management of Protected Areas for Conservation
CRFM	Caribbean Regional Fisheries Mechanism
CZMU	Coastal Zone Management Unit
DoF	Director of Fisheries
EC	Executive Committee
ECMMAN	Eastern Caribbean Marine Managed Areas Network
FAC	Fisheries Advisory Committee
FAO	Food and Agriculture Organization
FSP	Full-Sized Pilot
GCFI	Gulf and Caribbean Fisheries Institute
GEF	Global Environmental Facility
GIZ	German Society for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit)
IAS	Invasive Alien Species
ICRI	International Coral Reef Initiative
INFOPESCA	Services Center for information and advice on marketing of fishery products in Latin America (Centro para los servicios de información y asesoramiento sobre la comercialización de los productos pesqueros de América Latina)
Mar Fund	Mesoamerican Reef Fund
MPA	Marine Protected Area
MTIASIC	Mitigating the Threat of Invasive Alien Species in the Insular Caribbean
NGO	Non Governmental Organization
OECS	Organization of Eastern Caribbean States
PACT	Protected Areas Conservation Trust
PY	Programme Year
RMC	Resource Mobilization Committee
RSWG	Reef and Slope Fish Resource Working Group
SAP	Strategic Action Programme
SocMon	Global Socioeconomic Monitoring Initiative for Coastal Management
SPAW	Specially Protected Areas and Wildlife
UK	United Kingdom
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USA	United States of America
UWI	University of the West Indies
WECAFC	Western Central Atlantic Fishery Commission
WWF	World Wildlife Fund

## FOREWORD

The 6<sup>th</sup> Meeting of the CRFM Ministerial Council which was convened in the Bahamas, on 15 June 2012, noted the efforts of the International Coral Reef Initiative (ICRI) and other partners to develop and review a regional response strategy for the lionfish and to develop a “best practices” manual for control of the invasive lionfish. The Ministerial Council urged Member States, individually and through the CRFM, to ensure development and implementation of national response plans to control the invasion of lionfish, consistent with the findings and recommendations by the ICRI Working Group and the Gulf and Caribbean Fisheries Institute (GCFI) for the Wider Caribbean Region. The Ministerial Council similarly urged Member States to ensure that their response plans for controlling lionfish included the active maintenance of statistical sampling and reporting programs that facilitate review and evaluation of performance of the said plans. Subsequently, the ICRI developed a Regional Strategy for the Control of Invasive Lionfish (Regional Lionfish Strategy) and the GCFI developed a manual entitled – *Invasive Lionfish: Guide to Control and Management*. At its 7<sup>th</sup> Meeting convened in Barbados on 31 May 2013, the CRFM Ministerial Council endorsed drafts of both these documents and called upon Member States and stakeholders to implement the practices outlined in the manual.

This report presents preliminary findings on progress in implementation of the Regional Lionfish Strategy between 2013 and 2015 in CRFM Member States. Its content is based on: (a) responses of seven of the seventeen CRFM Member States (Belize, Dominica, Grenada, Montserrat, Saint Lucia, St Vincent and the Grenadines and Trinidad and Tobago) to a survey administered by the CRFM Secretariat; and (b) reporting on regional initiatives to coordinate the control of the invasive lionfish and conduct the requisite research. Most of the national responses reflect the experience of one of the five national target stakeholder groups of the Regional Lionfish Strategy – the Fisheries Division (resource manager), which in most instances was the lead agency, or one of the lead agencies with responsibility for controlling the lionfish invasion. This report also highlights the challenges experienced by the seven CRFM Member States in implementing the Lionfish Strategy and national lionfish response/control plans. It is expected that this report would be used by the Caribbean Fisheries Forum (including the technical and management levels of the Reef and Slope Fisheries Working Group) and CRFM Ministerial Council to improve implementation of the Regional Lionfish Strategy at the national and sub-regional levels as well as to improve overall management of reef and slope fisheries in the context of the Ecosystem Approach to Fisheries.

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## EXECUTIVE SUMMARY

The 6<sup>th</sup> Meeting of the CRFM Ministerial Council, which was convened in the Bahamas in 2012, noted the efforts of the International Coral Reef Initiative (ICRI) and other partners to develop and review a regional response strategy for the lionfish and to develop a “best practices” manual for control of the invasive lionfish. The Ministerial Council urged Member States, individually and through the CRFM, to ensure development and implementation of national response plans to control the invasion of lionfish, consistent with the findings and recommendations by the ICRI Working Group and the Gulf and Caribbean Fisheries Institute (GCFI) for the Wider Caribbean Region. It also urged Member States to ensure that their response plans for controlling lionfish included the active maintenance of statistical sampling and reporting programs that facilitate review and evaluation of performance of the said plans. Subsequently, the ICRI developed a Regional Strategy for the Control of Invasive Lionfish (Regional Lionfish Strategy) and the GCFI developed a document entitled – *Invasive Lionfish: Guide to Control and Management*. The 7<sup>th</sup> Meeting of the CRFM Ministerial Council, which was convened in Barbados in 2013, endorsed drafts of both these documents and called upon Member States and stakeholders to implement the practices outlined in the Guide.

The CRFM is obligated to periodically report to the CARICOM Secretariat on matters concerning the CARICOM Strategic and Work Plans. The work plan of the CARICOM’s Agricultural Health and Food Safety Systems Thematic Group considers issues regarding Invasive Alien Species with focus on the lionfish in marine fisheries in the context of food and nutrition security and health.

In light of the decisions and directives of the Ministerial Council, and considering the reporting obligations to the CARICOM Secretariat, as well as the decisions of the 24<sup>th</sup> Meeting of the Executive Committee and the 13<sup>th</sup> Meeting of the Caribbean Fisheries Forum, a survey was undertaken in PY 2015-2016 to assist in evaluating the status of implementation of the Regional Lionfish Strategy at the national level between mid-2013 to mid-2015. The survey targeted resource managers (Fisheries Divisions) which represent one of the target groups of the Regional Lionfish Strategy – the other groups being governments, academia, regional bodies and international organizations, non-governmental organizations, private sector, local communities and donors. The survey focused on the five general objectives of the Regional Lionfish Strategy: (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 using regionally coordinated, effective methods; and (5) Provide education, information and outreach mechanism to generate public support and foster stewardship in invasive lionfish programs. More specific objectives and strategies are also listed in the Regional Lionfish Strategy for each general objective (see Appendix 1).

This report outlines the methodology for conduct of the evaluation and presents the findings in distinct sections addressing the national (Section 3) and regional (Section 4) levels respectively. The findings are summarized, discussed and specific recommendations provided on the way forward in Section 5.

Based on the preliminary findings concerning the status of implementation of the Regional Lionfish Strategy in the seven CRFM Member States which responded to the survey (Belize, Dominica, Grenada, Montserrat, Saint Lucia, St Vincent and the Grenadine and Trinidad and Tobago) all countries had taken action to control the lionfish invasion, demonstrating national commitments towards implementation of the Strategy. Most countries, except Dominica and Montserrat, had developed national lionfish response/management plans, although only the plan for Grenada was approved. Based on information from other sources, Barbados also had a national lionfish response/management plan and the Bahamas

had endorsed the Regional Lionfish Strategy. As well, Saint Lucia had developed a National Invasive Species Strategy under which control of the invasive lionfish could also be managed.

*Facilitate collaboration:* Effective national coordination and collaboration among agencies with a role in implementing the respective national lionfish response/management plans and strategies was not always evident. Only Grenada had a functioning national committee/task force for implementing the respective plan. Reliance on external sources of funding for the control of invasive species in general, and lionfish in particular, resulted in similar committees established in Belize and Saint Lucia becoming dormant when the initiatives ended. Nevertheless there appeared informal mechanisms by which the agencies with responsibility for fisheries management coordinated control actions among direct stakeholders (e.g., fishers, divers). All countries had national focal points for monitoring and reporting on lionfish control measures. It was not evident that control of the invasive lionfish was being considered in the broader context of IAS, only Grenada and Saint Lucia had specific IAS protocols or national strategies that considered the lionfish. The issue of funding control measures is also of concern as none of the countries identified a national mechanism for sourcing the requisite funds. Most countries derived funding from a number of regional initiatives, only Montserrat and Trinidad and Tobago relied solely on national funding sources. At the regional level, the CRFM's structure provides a mechanism to facilitate political consensus and regional representation while the Resource Mobilization Committee provides a mechanism for sourcing the requisite funds for any agreed sub-regional actions to control/manage the lionfish. Although concerns have been voiced at various fora regarding the threat of the lionfish however, there have been little active, coordinated efforts on the ground among CRFM Member States in the area of lionfish management. Several regional fora exist for the sharing of information and best practices in lionfish control measures and scientific research, including the Caribbean Invasive Alien Species Network, the Caribbean Marine Protected Areas Managers Network and Forum, the GCFI's Annual Symposia and the Caribbean Fisheries Forum with its Reef and Slope Fisheries Working Group (management and technical level), but it was not evident that countries were aware of, or effectively utilizing, such fora.

*Coordinated research and monitoring agenda:* Although a number of universities have conducted lionfish research the level of coordination of such research and whether resource managers had access to scientific information to inform the decision-making concerning lionfish management could not be ascertained. Although the Gulf and Caribbean Fisheries Institute has played a pivotal role in the sharing of information, including research and monitoring, on its Lionfish Web Portal and at its annual symposia, it was not evident that resource managers were aware of the Web Portal or had access to the scientific research presented at the annual symposia. There was little research on development of safe harvesting and post-harvesting strategies (conducted only in Dominica) and testing of lionfish for the occurrence of ciguatera (conducted only in Trinidad and Tobago). Of all CRFM Member States most extensive lionfish research was conducted in the Bahamas. Generally, research focused mainly on the economic and ecological impacts of the lionfish invasion, predation on lionfish, lionfish abundance and density, foraging behavior, prey consumption as well as competition, habitat preferences and control strategies. The weakest area at the national level pertained to monitoring lionfish populations (abundance, density) and monitoring the effectiveness of control measures. Only Belize and Trinidad and Tobago conducted period surveys for this purpose and only Grenada, Saint Lucia and Trinidad and Tobago reported formal processes for collection of data on lionfish catches and sightings, with standardized data collection/reporting forms. Specific lionfish research activities were prioritized under the CRFM's Fisheries and Aquaculture Research Agenda with the Resource Mobilization Committee charged with the responsibility for sourcing funds to implement the Research Agenda.

*Review and amendment of relevant legislation, regulations, policies:* In most countries lionfish control programs appeared to be supported by some combination of policy, legislation or regulations. However, it

was not apparent that countries had undertaken any legislative review and developed new policies and regulations to control the lionfish. Only Montserrat alluded to the update of its legislation which is to be amended by mid-2016. However, relevant policies and legislation may extend beyond the fisheries sector, to include the environment and biodiversity, which may be outside the portfolio of resource managers targeted in this study. Legislation on the trade in fish and fish products could be used to control lionfish import and export. Some countries developed regulations to allow the use of specific gear (mainly pole spears/spear guns and SCUBA) by select groups to target lionfish in marine protected areas, otherwise closed to fishing (e.g. Belize and Saint Lucia). At the regional level, the recently endorsed Regional Plan of Action for Improving the Outlook of Caribbean Coral Reefs includes provisions for development of policies, legislation and strategies to address the management of risks from invasive species (Australia Caribbean Coral Reef Collaboration, 2014).

*Control invasive lionfish:* A number of control measures were implemented across the respective countries including promotion of commercial and recreational fishing of lionfish, promotion of consumption of the species, culling in MPAs and other critical habitat. The pole spear was the most common fishing technology used for culling apart from fish traps used by commercial fishers. Locations for application of control measures were in most cases prioritized, with coral reefs and MPAs being of highest priority. The main concern however, is the lack of monitoring to measure the effectiveness of such control measures. Efforts were also focused on training in proper lionfish handling and processing for human consumption but specific details were not available for all countries.

*Provide education, information and outreach mechanisms:* Generally considerable efforts were deployed for public awareness, education and outreach programmes using a range of communication tools (radio and television programmes, print media such as newspapers, brochures, pamphlets, community meetings and posting of information on social media. There was also some degree of integration of lionfish issues into school education programmes. The main concern again is the lack of monitoring of the effectiveness of such programs through changes in the knowledge, attitude and practices of the range of stakeholders.

Based on national responses to the survey and general findings of the evaluation, specific recommendations were provided for improving implementation of the Regional Lionfish Strategy. These specific recommendations are summarized in the following general recommendations:

- (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 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 engage 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 Management 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) 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) 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.

The findings, conclusions and recommendations of this study are based on feedback from only 41% of the membership of the CRFM, which excludes some countries for which reef and slope fisheries are of considerable socio-economic importance. Consequently it is uncertain whether the findings accurately reflect the current situation concerning implementation of the Regional Lionfish Strategy in CRFM Member States. For this reason it is recommended that the survey, with any required modifications, be repeated biennially. This will also facilitate the CRFM's reporting to the CARICOM Secretariat on the work plan of its Agricultural Health and Food Safety Systems Thematic Group, under which the control of the invasive lionfish is an activity.

## TABLE OF CONTENTS

<b>1.0</b>	<b>BACKGROUND AND RATIONALE .....</b>	<b>1</b>
<b>2.0</b>	<b>METHODOLOGY .....</b>	<b>2</b>
2.1	NATIONAL IMPLEMENTATION OF THE REGIONAL LIONFISH STRATEGY .....	2
2.2	REGIONAL IMPLEMENTATION OF THE REGIONAL LIONFISH STRATEGY .....	4
<b>3.0</b>	<b>RESULTS – NATIONAL INITIATIVES .....</b>	<b>4</b>
3.1	BARBADOS.....	5
3.2	THE BAHAMAS.....	5
3.3	BELIZE .....	6
3.4	DOMINICA.....	8
3.5	GRENADA .....	9
3.6	MONTSERRAT .....	11
3.7	SAINT LUCIA.....	13
3.8	ST VINCENT AND THE GRENADINES.....	15
3.9	TRINIDAD AND TOBAGO .....	16
3.10	TURKS AND CAICOS ISLANDS .....	18
<b>4.0</b>	<b>RESULTS - REGIONAL INITIATIVES.....</b>	<b>18</b>
4.1	FACILITATE COLLABORATION.....	18
4.2	ENCOURAGE COORDINATED RESEARCH AND MONITORING.....	19
4.3	ENCOURAGE LEGISLATION, REGULATIONS AND POLICIES FOR LIONFISH CONTROL.....	20
<b>5.0</b>	<b>SUMMARY FINDINGS, DISCUSSION AND RECOMMENDATIONS .....</b>	<b>20</b>
<b>6.0</b>	<b>CONSIDERATIONS FOR FUTURE EVALUATIONS.....</b>	<b>28</b>
<b>7.0</b>	<b>STUDY LIMITATIONS .....</b>	<b>29</b>
<b>8.0</b>	<b>CONCLUSIONS.....</b>	<b>29</b>
<b>9.0</b>	<b>REFERENCES .....</b>	<b>31</b>
	<b>APPENDIX 1. REGIONAL STRATEGY FOR THE CONTROL OF THE INVASIVE LIONFISH: SPECIFIC OBJECTIVES, STRATEGIES AND ACTIONS .....</b>	<b>33</b>
	<b>APPENDIX 2: QUESTIONNAIRE – MONITORING AND EVALUATION OF NATIONAL IMPLEMENTATION OF THE REGIONAL STRATEGY FOR CONTROL OF THE INVASIVE LIONFISH.....</b>	<b>39</b>
	<b>APPENDIX 3: NATIONAL RESPONDENTS TO THE SURVEY QUESTIONNAIRE .....</b>	<b>54</b>
	<b>APPENDIX 4: NATIONAL FOCAL POINTS FOR MONITORING AND REPORTING ON CONTROL ACTIONS.....</b>	<b>55</b>
	<b>APPENDIX 5: RESEARCH PAPERS LISTED ON THE GCFI’S WEB PORTAL FOR CRFM MEMBER STATES (BASED ON A SEARCH OF COUNTRY NAMES ONLY AS AT 4 DECEMBER 2015).....</b>	<b>56</b>

## 1.0 BACKGROUND AND RATIONALE

The Regional Strategy for the Control of the Invasive Lionfish (Regional Lionfish Strategy) was developed in 2012 by the Regional Lionfish Committee and a group of Lionfish experts to guide the action of stakeholders who were concerned with, and impacted by, the lionfish invasion (Gómez *et al.*, 2013). The impetus for development of this Regional Lionfish Strategy was the recognized severity of the lionfish invasion and its impacts on coral reefs and local communities at the 24<sup>th</sup> General Meeting of the International Coral Reef Initiative in January 2010. This Strategy seeks to build on existing programs and efforts to minimize the impacts of the lionfish in the region and to provide a framework for action towards a regionally coordinated response to the lionfish threat. It was designed to complement the lionfish best practices manual (Morris, 2012). The Strategy, which applies to the Wider Caribbean Region, has been presented at various regional and international fora. It takes into account recommendations put forward by a number of regional and international bodies such as the International Coral Reef Initiative (2009 recommendation on invasive alien species), the Aichi Target 9 (related to identification of IAS pathways, control and eradication), efforts of the Global Environment Facility (GEF/UNEP/CABI) Project *Mitigating the Threat of Invasive Alien Species in the Insular Caribbean*, the 6<sup>th</sup> Conference of the Parties to the SPAW Protocol, the 15<sup>th</sup> Intergovernmental Meeting on the Action Plan for the Caribbean Environment Program and the 12<sup>th</sup> Meeting of the Contracting Parties to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region.

The Strategy is intended to facilitate regional collaboration by providing a framework to:

1. *Facilitate on-the-ground implementation of actions through regular exchanges of experiences, protocols, and tools;*
2. *Help reduce costs and avoid duplicative efforts by designing regional programs with pooled resources;*
3. *Enunciate roles and potential actions among different actors and sectors;*
4. *Guide researchers and donors by identifying projects that require action as top priority; and*
5. *Ensure actions are consistent and complementary at all levels and across all sectors.*

The Strategy is based on five objectives:

- (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 using regionally coordinated, effective methods, and*
- (5) *Provide education, information and outreach mechanism to generate public support and foster stewardship in invasive lionfish programs.*

Specific strategies and actions were outlined for each of the five objectives (Appendix 1) with specific stakeholders identified as possible implementers (governments, academia, regional bodies and international organizations, resource managers, non-governmental organizations, private sector, local communities and donors). It was intended that governments and other stakeholders would create plans to implement the actions identified, with set timelines and indicators for measuring effectiveness in achieving the objectives of the Regional Lionfish Strategy.

In light of the concerns expressed by CRFM Member States at various regional fora, the 6<sup>th</sup> Meeting of the CRFM Ministerial Council which was convened in the Bahamas, on 15 June 2012, noted the efforts of the International Coral Reef Initiative (ICRI) and other partners to develop and review a regional response

strategy for the lionfish and to develop a “best practices” manual for control of the invasive lionfish. The Ministerial Council urged Member States, individually and through the CRFM, to ensure development and implementation of national response plans to control the invasion of lionfish, consistent with the findings and recommendations by the ICRI Working Group and the Gulf and Caribbean Fisheries Institute (GCFI) for the Wider Caribbean Region. The Ministerial Council similarly urged Member States to ensure that their response plans for controlling lionfish included the active maintenance of statistical sampling and reporting programs that facilitate review and evaluation of performance of the said plans. Subsequently, the ICRI developed a Regional Strategy for the Control of Invasive Lionfish and the GCFI developed a document entitled – *Invasive Lionfish: Guide to Control and Management*. At its 7<sup>th</sup> Meeting convened in Barbados on 31 May 2013, the Ministerial Council endorsed drafts of both these documents and called upon Member States and stakeholders to implement the practices outlined in the Guide. In 2014 the 15<sup>th</sup> Session of the WECAFC also adopted a Resolution on the Regional Strategy for the Control of the Invasive Lionfish (FAO/WECAFC, 2014).

At the 9th and 10th CRFM Annual Scientific Meetings in 2013 and 2014 the Reef and Slope Fisheries Working Group (RSWG) discussed measures that were being implemented by some Member States to control the lionfish invasion, but the Working Group was unable to conduct a comprehensive analysis of the impacts of the lionfish. As a consequence, the 24<sup>th</sup> Meeting of the Executive Committee (EC) of the Caribbean Fisheries Forum (CFF), which was held in St Vincent and the Grenadines on 19 to 20 February 2015, approved the conduct of a survey in PY 2015-16 to evaluate the status of implementation of the Regional Lionfish Strategy (CRFM, 2015) in CRFM Member States. The EC also called on Member States to participate in the survey and to provide their responses and any other additional information required to facilitate timely completion of the respective report. The 13<sup>th</sup> Meeting of the CFF, which was convened from 30 to 31 March 2015 in Grenada, endorsed the respective conclusions, recommendations and decisions of the 24<sup>th</sup> Meeting of the EC (CRFM, 2015a).

## **2.0 METHODOLOGY**

### **2.1 National Implementation of the Regional Lionfish Strategy**

In accordance with the decision of the 24<sup>th</sup> Meeting of the Executive Committee, the CRFM Secretariat designed a survey questionnaire to assess implementation of the Regional Lionfish Strategy at the national level, by one of the eight stakeholder groups – the resource managers (at the level of the Fisheries Divisions). This stakeholder group represented a subset of the “government” stakeholder group. The survey questionnaire focused on the objectives, detailed strategies and actions reflected in the Regional Lionfish Strategy (Appendix 1). It was reviewed by the CRFM’s Reef and Slope Fisheries Working Group (RSWG) at an e-meeting on 25 March 2015 and was subsequently amended by the CRFM Secretariat based on the RSWG’s suggestions. The survey questionnaire (Appendix 2) was circulated on 29 April 2015 to gather the respective information from the Fisheries Divisions/Departments of all 17 CRFM Member States by 30 June 2015. Country submissions were required to be endorsed by the respective Director of Fisheries or Chief Fisheries Officer. Email reminders were sent to the respective Directors of Fisheries and Chief Fisheries Officers on 15 June 2015 regarding the impending deadline, and on 17, 24 and 30 July 2015 regarding the outstanding responses. Specific requests were made to the Directors of Fisheries of the Bahamas and Barbados on 24 November 2015 to complete the survey questionnaire, since these two countries were the focus of lionfish research.

The questionnaire was organized into six sections as follows:

- A. *Objective 1- Facilitate collaboration* – This section sought to determine whether there was an approved national response or action plan for the control of the invasive lionfish, to acquire copies of such plans if they existed, to identify the national mechanism in place to combat the lionfish invasion, to ascertain whether or not there was a national focal point for monitoring and reporting on control actions, whether there was an established national committee with specified roles and functions in respect of implementation of the Regional Lionfish Strategy or national plans and the composition of such a committee if it existed. It also sought to ascertain whether there was a national protocol for addressing invasive alien species in general and whether or not lionfish was being considered under such a protocol. The section also sought to determine whether there was a national mechanism for identifying funding for lionfish control programmes and the sources of existing funding for this purpose. This section also sought the respondents' opinions on what could be done to improve coordination among key agencies at both the national and regional levels to more effectively control the invasive lionfish.
- B. *Objective 2: Encourage coordinated research and monitoring* – This section sought to ascertain whether data on catches, fishing effort and sightings of lionfish as well as quantities of lionfish sold and the respective prices, number of cases of envenomation and data on the trade in lionfish as an ornamental species was being collected through a variety of sources and whether such data were computerized, analyzed and published. This section also sought to ascertain whether the data collected and related information were shared on the GCFI's web portal and whether the data collected were available for analysis by the CRFM's Reef and Slope Fisheries Working Group. It also sought to ascertain the details of any publication on the lionfish for the respective country. As well, the section sought to ascertain the range of stakeholders that were involved in reporting sightings of lionfish, whether there was a standard format for stakeholders to collect and report data on lionfish, whether there was monitoring of abundance or density of lionfish and where (e.g., MPAs, reefs, seagrass beds, mangrove ecosystems, marinas, beaches, etc.), and how often such monitoring was conducted. This section also sought to identify the agency with responsibility for reporting on the status of the lionfish, what control technologies were being used to control the lionfish, whether or not lionfish was consumed nationally and whether there was any research on safe lionfish harvesting and post-harvest strategies for seafood markets as well as testing of the species for ciguatera toxin.
- C. *Objective 3: Encourage legislation, regulations and policies for lionfish control* – This section sought to determine whether current legislation makes provisions for control of the invasive lionfish and if not, whether efforts were being made to review existing laws, regulations and policies accordingly, to prohibit lionfish imports as an ornamental species, if applicable, and to address invasive alien species in general. It also sought to identify the specific control strategies being implemented, identify the agency with responsibility for implementation, ascertain whether the strategies were supported by policy, legislation and regulations and whether or not there was effective monitoring and enforcement to ensure compliance with regulations.
- D. *Objective 4: Control invasive lionfish populations using regionally coordinated, effective methods* – This section sought to determine the national status of the lionfish population based solely on field observations (rather than a scientific survey), whether the areas of lionfish invasion were prioritized for implementation of control efforts and how the respective habitats were prioritized and to identify the specific control measures utilized. It also sought to ascertain whether the best practices identified in the Guide for the Control and Management of the Invasive Lionfish (Morris, 2012) were promoted among stakeholder groups and to identify which stakeholder groups were engaged in promoting best practices in lionfish control as well as

whether there was a legal basis for implementation of standards of best control practices and the respective level of enforcement.

- E. *Objective 5: Provide education, information and outreach mechanisms to generate public support and foster stewardship in invasive lionfish programs* – This section sought to ascertain whether there was a national communication strategy and/or education and outreach programme to raise public awareness on the lionfish issue, to identify the agency with responsibility for implementing the strategy or plan, to identify the various information tools used and the frequency of use and whether the effectiveness of the strategy and plan were monitored and evaluated. It also sought to determine how the strategy and plan were supported technically and financially and whether the lionfish issue was integrated into various educational programs.
- F. *General:* This section sought to acquire any additional information pertaining to implementation of the Regional Lionfish Strategy which countries wished to report.

Seven (41%) of the 17 Member States submitted their responses to the survey questionnaire at varying times between August and November 2015 (St Vincent and the Grenadines – 29 June 2015; Trinidad and Tobago – 30 June 2015; Dominica – 24 July 2015; Belize – 04 August 2015 and 24 November 2015; Grenada – 05 August 2015). These responses were either received directly from the Director of Fisheries (DoF) or Chief Fisheries Officer (CFO) as was the case for Grenada or from a member of staff of the respective Fisheries Division/Department and copied to the DoF or CFO as was the case for Belize, Dominica, Saint Lucia, St Vincent and the Grenadines and Trinidad and Tobago. The list of national respondents is provided in Appendix 3. The national reports submitted by Member States to the 13<sup>th</sup> Meeting of the Caribbean Fisheries Forum (CRFM, 2015a) were reviewed and pertinent information was also considered in this report. The first draft of this report was reviewed by the RSWG and Fisheries Departments of the respective Member States between January and February 2016. The review process also sought to clarify unclear responses as well as acquire additional information on national training programmes in first aid as well as safe fishing, handling and processing of the lionfish. The report was amended accordingly based on feedback received in the review process.

## **2.2 Regional Implementation of the Regional Lionfish Strategy**

Assessment of regional implementation of the Regional Lionfish Strategy was based on a review of reports of the meetings of the CRFM's Technical Working Groups, the Caribbean Fisheries Forum and the Ministerial Council, following from the relevant decision of the Ministerial Council in June 2012, as well as relevant CRFM reports. Given the critical role of the Gulf and Caribbean Fisheries Institute in developing a regional web portal for the sharing of data and information on the invasive lionfish, a review of published documents was also conducted through a search of the literature database available at <http://lionfish.gcfi.org/research-monitoring> on 3 December 2015 to identify research publications that were specific to CRFM Member States.

## **3.0 RESULTS – NATIONAL INITIATIVES**

The summarized survey responses provided by the national respondents and focal points (Appendices 3 and 4 respectively) are given below.

### 3.1 Barbados

Evaluation of the status implementation of the Regional Lionfish Strategy in Barbados was not based on an official response to the survey questionnaire but rather on that country's national report to the 13<sup>th</sup> Meeting of the Caribbean Fisheries Forum and information provided by the CERMES (UWI)<sup>1</sup> during the RSWG's review of the first draft of this report. The Fisheries Division continued its collaboration with the Coastal Zone Management Unit (CZMU) and the University of the West Indies (UWI) in efforts to control the invasive lionfish which were considered abundant and firmly established in Barbados (CRFM, 2015a). A lionfish invasion response plan was finalized in 2011 by the Government's Biodiversity Working Group (Biodiversity Working Group, 2011). Although this Response Plan was not yet formally approved, it was being followed through a collaborative effort among the University of the West Indies (focusing on research), the Coastal Zone Management Unit (focusing on provision of information for the general public, information and training for the SCUBA diving and tourism sector, and on culling) and the Fisheries Division (focusing on information and training for fishers)<sup>1</sup>. Control efforts to date focused on promoting the lionfish as a food fish and encouraging the respective fishery along with promotion of general culling by dive operators. The first lionfish derby was held in May 2014 and was led by the CZMU in collaboration with UWI and the Fisheries Division. It was a one-day event, given extensive coverage by the media and involved a number of top chefs preparing lionfish on site for local consumption, and onsite demonstration of lionfish handling and preparation. Consumption of the species was also promoted at the 2015 Agriculture Exhibition (Agrofest) by the Fisheries Division. A second, internationally advertised lionfish derby was held in December 2015. This was a week-long event organized by the private sector and involved two-days of competition and various local restaurants serving lionfish dishes and tasters throughout the week<sup>1</sup>.

Research conducted by the CERMES (UWI) on lionfish in Barbados was reported at the 13<sup>th</sup> Meeting of the CRFM Forum (CRFM, 2015a), with the following two publications:

Sealy, S., H.A. Oxenford and D. Browne. 2014. Mitochondrial DNA (mtDNA) Haplotype Diversity of the Invasive Lionfish (*Pterois volitans*) in Barbados. Proceedings of the Gulf and Caribbean Fisheries Institute 66: 204-205.

Oxenford, H.A. and H. Vallès. Invasive Lionfish in Barbados: Collaborative Response and Research. INFOPESCA / WECAFC Workshop on Lionfish and Sea Cucumbers. Havana, 29-30 Apr. 2014.

### 3.2 The Bahamas

Evaluation of the status implementation of the Regional Lionfish Strategy in the Bahamas was not based on an official response to the survey questionnaire but rather on the report of the Reef and Slope Fish Resource Working Group to the 9<sup>th</sup> CRFM Annual Scientific Meeting (CRFM, 2013). The Bahamas had endorsed the Regional Lionfish Strategy and in particular Objective 4 (Control). Several eradication programs were undertaken between the department with responsibility for fisheries and funding agencies to control the spread of the lionfish. Funding for eradication programs was sourced from external agencies, including the Global Environment Fund (GEF) and in conjunction with other countries. Programs to educate the public on how to address lionfish stings were implemented. Demonstrations on the processing and preparation of the lionfish were undertaken under several funded projects so as to facilitate establishment of a viable market in support of efforts to control the spread of lionfish. Discussions were undertaken to amend the legislation to allow for the use of the most appropriate gears

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<sup>1</sup> Dr Hazel Oxenford, personal communication, February 2016

(spear guns) to harvest the lionfish during fishing tournaments. The Bahamas also promoted public consumption of the lionfish through education and outreach programs and addressing the governance issue of capturing the lionfish.

### **3.3 Belize**

#### **3.3.1 Facilitate Collaboration**

Belize had an approved national Lionfish Response and Management Plan (2009 to 2013), a copy of which was provided along with the completed questionnaire. However, the national respondent did not clarify whether or not this Plan was updated or whether the period of its application was extended.

There was a national focal point at the Fisheries Division with responsibility for monitoring and reporting on lionfish control actions (Appendix 4). However, there was no national committee charged with the responsibility for implementing the Regional Lionfish Strategy or national response plan. There was also no protocol for invasive alien species in Belize, nor a mechanism for identifying funding for programmes to control the invasive lionfish. Funding to combat the lionfish invasion was derived from government agencies, non-governmental agencies, academic institutions, the private sector as well as external donors (Mar Fund, COMPACT and PACT).

The national respondent felt that improved national coordination among key agencies to more effectively control the invasive lionfish could be achieved by revitalizing and supporting the lionfish sub-committee formed under the National Coral Reef Monitoring Network. He also felt that, at the regional level this coordination could be improved by the exchange or sharing of experiences and coordinated efforts at sourcing funds for implementation of the Regional Lionfish Strategy.

#### **3.3.2 Encourage coordinated research and monitoring**

Data were collected on lionfish catches in commercial fisheries and at fishing derbies or tournaments. Researchers also collected data on lionfish sightings and gut content. The data on catches from derbies and tournaments and data collected by researchers were computerized. However, these data were not made available through the GCFI web portal. Although the computerized data were available for analysis by the CRFM's Reef and Slope Fisheries Working Group (RSWG), the national respondent noted that there was not much data from the Fisheries Division's field work, compared to data collected by researchers. Data were analyzed and the findings published in the following documents:

- Guy, J. 2014. Reef CI Annual Report 2014. Reef Conservation International. 36 p.
- Simmons, K. R. 2014. Evidence of the Enemy Release Hypothesis: Parasites of the Lionfish Complex (*Pterois volitans* and *P. miles*) in the Western North Atlantic, Gulf of Mexico and Caribbean Sea. Master of Science Thesis. Nova Southeastern University, Halmos College of Natural Sciences and Oceanography. 50 p.
- Braun, L.M. (year not provided). Spatial Distribution and Diet Composition of Invasive Lionfish (*Pterois volitans*) on Natural and Artificial Habitats in Belize.
- Lionfish Belize Report, Belize Fisheries Department 2009.

A number of stakeholder groups were involved in reporting lionfish sightings (divers, diving companies, members of the public, fishers, tourists, Fisheries Division's staff and NGOs). However, there was no standard format for stakeholders to collect and report lionfish sightings. Researchers had their own formats for collecting and reporting data while fishers simply reported the number of fish (or pounds of fillet) and divers reported sightings in certain areas, the numbers of fish and approximate sizes. These reports were made through personal communication, including phone calls. Monthly surveys were

conducted to determine the abundance/density of lionfish in marine protected and coral reef areas. The results of these surveys were published in the documents listed above.

The primary responsibility for reporting on the status of lionfish in Belize rests with the fisheries department. Spear fishing was the technology used to control lionfish. The species was consumed locally however, no national research had been conducted on development of safe lionfish harvesting and post-harvest strategies for seafood markets or testing for the occurrence of ciguatera in the species.

### 3.3.3 Encourage legislation, regulations and policies for lionfish control

The current legislation made provisions for the control of invasive lionfish as it allowed the Fisheries Administrator to provide a permit to scuba dive and use spears (the main control technology) and did not preclude the development of a fishery for the species. Specific lionfish control strategies were managed by the Fisheries Department (see section 3.3.4) and these strategies were supported by policy, legislation and regulations. There was also effective monitoring and enforcement to ensure compliance with regulations.

### 3.3.4 Control invasive lionfish populations using regionally coordinated, effective methods

The lionfish invasion in Belize was classified as moderately extensive (the species was commonly seen). Consequently, the locations of lionfish invasion were prioritized for implementation of control efforts, with highest priority afforded to marine protected areas and coral reefs, followed by seagrass beds, mangrove systems, marinas and beaches. A number of control measures were implemented: culling, promotion of commercial and recreational fishing of lionfish, promotion of lionfish consumption, design and implementation of marketing schemes, establishment of cooperation schemes between fishers, restaurants and hotels to encourage consumption of the species, removal of lionfish from MPAs by fisheries managers and promotion of spear fishing for the species. As well, best practices in lionfish control as articulated in the document *Invasive Lionfish: A Guide for Control and Management* were promoted among stakeholders. Fishers, restaurateurs and recreational divers are engaged to promote best practices in lionfish control. However, there was no legal basis for implementation of standards of best control practices.

### 3.3.5 Provide education, information and outreach mechanism to generate public support and foster stewardship in invasive lionfish programs

There was a national communication strategy as well as an education and outreach program to raise public awareness on the lionfish issue and the responsibility for implementation resides with the Fisheries Department. Radio and television programmes as well as print media (brochures/pamphlets) and community meetings were the main avenues for implementation of the communication strategy and education and outreach program. The effectiveness of these two mechanisms was monitored through questionnaires administered in the pre- and post- periods. In both instances the radio and television programmes were communicated every six months, brochures and pamphlets were distributed daily and community meetings were convened every six months. Technically both mechanisms were supported by the communications officer and staff stationed at the MPAs, with limited financial support provided through Government's fund allocation and grants. Lionfish issues were also integrated into the schools' natural science programs and in relevant tertiary courses.

### 3.3.6 General

There was partnership and collaborative efforts between the Government and co-managers of MPAs as well as the NGOs. The Universities were beginning to show interest in the situation. There was also an initiative to create a specialty in SCUBA diving for lionfish control for tourists, with some profits invested in culling activities in non-use areas of the barrier reef.

### **3.4     Dominica**

#### **3.4.1   Facilitate Collaboration**

Dominica did not have an approved national response plan or action plan for the control of the invasive lionfish. Through coordination among the Fisheries Department and the Watersports Association and divers the species was being targeted as a fishery to target the species and to provide data to the Fisheries Division.

There was a national focal point at the Fisheries Division with responsibility for monitoring and reporting on lionfish control actions (Appendix 4). However, there was no national committee charged with the responsibility for implementing the Regional Lionfish Strategy. There was also no protocol for invasive alien species in Dominica, nor a mechanism for identifying funding for programmes to control the invasive lionfish. No information was provided on any available sources of funding to combat the lionfish invasion.

The national respondent felt that increased reporting schedules, greater coordination and more public relations activities would improve the coordination among national agencies to combat invasive lionfish. However, he did not provide suggestions in respect of what could be done to improve similar coordination efforts at the regional level.

#### **3.4.2   Encourage coordinated research and monitoring**

Catch and effort data on lionfish were collected from divers/diving companies but these data were not computerized, they were not shared through the GCFI web portal and were not analyzed. Divers (individuals), diving companies, fishers and staff of the Fisheries Division were involved in reporting of lionfish sightings but there was no standard format for stakeholders to collect and report the lionfish sightings. Although the national respondent did not identify any lionfish data as being computerized, his response to the question on how the data on lionfish sightings by stakeholders was collected and reported suggested that there was a database but that it was not being maintained. The respondent also indicated that fishers did occasional reporting but provided no additional details as to whether this reporting was formal.

No surveys were conducted to determine the abundance or density of lionfish in reef areas. Instead monitoring was based on sightings by divers or dive operators and staff of the Fisheries Division. There were no publications on the status of the lionfish in Dominica and the responsibility for reporting on this matter rests primarily with the Fisheries Division.

Spears and fish traps were the technologies used to control lionfish. The species was consumed locally and national research was conducted on development of safe lionfish harvesting and post-harvest strategies for seafood markets but there was no testing for the occurrence of ciguatera in the species. The results of the research were not published, but the national respondent indicated that there were many lionfish recipes from primary schools and restaurants.

#### **3.4.3   Encourage legislation, regulations and policies for lionfish control**

Current legislation made no provisions for the control of the invasive lionfish and the respondent provided no information on efforts to review existing laws, regulations and policies to identify gaps and to address the issue of invasive alien species in general. It was noted however, that Dominica did not, and has never, imported lionfish (in reference to the aquarium trade in exotic species). Specific lionfish control strategies were implemented in Dominica (see Section 3.4.4). However the national respondent did not indicate the agency with responsibility for managing these strategies and whether or not the strategies were supported by policy, legislation or regulations.

#### 3.4.4 Control invasive lionfish populations using regionally coordinated, effective methods

The lionfish invasion in Dominica was classified as moderately extensive (the species was commonly seen). However, locations of lionfish invasion were not prioritized for implementation of control efforts. A number of control measures were implemented: culling, promotion of commercial and recreational fishing of lionfish, promotion of lionfish consumption, design and implementation of marketing schemes, establishment of cooperation schemes between fishers, restaurants and hotels to encourage consumption of the species, promotion of fishing for lionfish within MPAs, removal of lionfish from MPAs by fisheries managers, and promotion of spear fishing for the species. As well, best practices in lionfish control, as articulated in the document *Invasive Lionfish: A Guide for Control and Management*, were promoted among stakeholders. Fishers, processors, restaurateurs and recreational divers were engaged to promote best practices in lionfish control. However, there was currently no legal basis for implementation of standards of best control practices.

#### 3.4.5 Provide education, information and outreach mechanism to generate public support and foster stewardship in invasive lionfish programs

The national respondent did not indicate whether or not there was a national communication strategy to raise public awareness on the lionfish invasion, however, there was an education and outreach programme. The Fisheries Division and Dominica Water Sports Association shared responsibility for implementing the programme. Radio and television programmes as well as community meetings were the main avenues for implementation of the education and outreach program. However, the national respondent did not indicate how the effectiveness of the education and outreach programme were monitored and evaluated; nor the frequency of media programmes and community meetings. The national respondent also provided no information on how the education and outreach programme was supported technically and financially, and whether issues related to the lionfish invasion were integrated into various educational programmes. It was presumed that there was some level of integration into the primary school programme given the reference to lionfish recipes under section 3.4.2.

#### 3.4.6 General

The Fisheries Division had promotional programmes on “Eat Fish in Schools” and “Eat Fish Day” at which lionfish was served on the menu. The meals were cooked at the schools by the students. There were also cooking competitions among primary schools in support of original lionfish recipes.

### **3.5 Grenada**

#### 3.5.1 Facilitate Collaboration

Grenada had an approved national action plan for the control of the invasive lionfish. However, a copy of the plan was not submitted as requested in the questionnaire. The plan addressed eradication of the species, promotion of consumption as a food fish; bio-physical monitoring and a public awareness program (CRFM, 2015a).

There was a national focal point at the Fisheries Division with responsibility for monitoring and reporting on lionfish control actions (Appendix 4) and a national committee (the Grenada Lionfish Task Force) charged with the responsibility for implementing the Regional Lionfish Strategy and the national response plan and chaired by the national focal point. The respective Task Force was comprised of representatives of the Fisheries Division, Environment Division, the Grenada Fund for Conservation (NGO), the Grenada SCUBA Diving Association (private sector) and fishers. The functions of the Task Force and role of its members were clearly articulated and agreed upon. There was an approved protocol for invasive alien species in general and lionfish was included in this protocol. However, there was no mechanism for identifying funding for programs to control the invasive lionfish. Funding to combat the lionfish invasion

was derived from government agencies, non-government agencies and external donors (e.g., the Caribbean Aqua-Terrestrial Solutions Project funded by the German Government – *GIZ/CATS* - as well as through the UNDP).

The national respondent felt that although the Grenada Lionfish Task Force was established to coordinate all national activities for the effective management of the lionfish invasion, and there was significant improvement in coordination, there was still a few key agencies/departments (e.g., customs, St. George's University and the Ministry of Trade) which should be represented on the Task Force to ensure national coordination at all relevant levels. The national respondent felt that at the regional level coordination could be improved if there was an avenue for practitioners to meet and present their activities and share best practices and lessons learnt in the implementation of monitoring, communication, outreach and financing.

### 3.5.2 Encourage coordinated research and monitoring

Currently data were collected on lionfish catches from divers and diving companies. The Fisheries Division also collected lionfish catch and effort data from commercial fisheries and it is presumed that biometric data (size and weight) were also collected based on the list of data types identified as being computerized by the national respondent. These data were computerized but were not analyzed or shared on the GCFI's web portal. The computerized data were however, available for analysis by the CRFM's Reef and Slope Fisheries Working Group.

Divers (individuals), diving companies, members of the public, fishers, tourists and staff of the Fisheries Division were involved in reporting of lionfish sightings and there was a standard format for stakeholders to collect and report the lionfish sightings. However, no surveys were conducted to determine the abundance or density of lionfish in reef areas. There was no monitoring to determine whether or not control actions were effective except for data collected during culling activities which were restricted to MPAs and reefs directly adjacent to MPAs. During these activities attempts were made to collect data on all lionfish encountered (length and weight). The national respondent intimated that a management and control program was to be implemented which would broaden the scope of monitoring activities throughout the fisheries waters to include monitoring of abundance/density. There were no publications on the status of the lionfish invasion in Grenada. However, based on the distribution of reported sightings the national respondent believed that the lionfish had fully colonized all marine ecosystems/habitat types in Grenada's fishery waters. The Fisheries Division was the agency with responsibility for reporting on the status of the lionfish invasion. Spear guns, pole spears and hand nets were the technologies used to control lionfish during targeted culling activities. The species was consumed locally however, no national research was conducted on development of safe lionfish harvesting and post-harvest strategies for seafood markets or testing for the occurrence of ciguatera in the species.

### 3.5.3 Encourage legislation, regulations and policies for lionfish control

Current legislation made no specific provisions for the control of the invasive lionfish. However, since current fisheries legislation provided for regulation of imports of ornamental fish and imports and exports of fish and fish products such provisions could be used to control trade in lionfish. The national respondent indicated that, from a management and trade perspective, the current fisheries legislation, although it did not specifically address the issue of invasive species, was broad enough in scope to allow some level of control of invasive species as it empowered the fisheries management unit to do so. However, the national respondent was of the view that consideration could be given to conducting a review of the legislation with respect to its ability to directly address issues related to invasive species. The Task Force and Fisheries Department managed a number of control strategies (see Section 3.5.4). These strategies were supported by policy, legislation and regulations but there was no monitoring and enforcement to ensure compliance with the regulations.

### 3.5.4 Control invasive lionfish populations using regionally coordinated, effective methods

The lionfish invasion in Grenada was classified as moderately extensive (the species was commonly seen). Locations of lionfish invasion were prioritized for implementation of control efforts with highest priority afforded to marine protected areas and coral reefs, followed by mangrove systems and seagrass beds, and then beaches and marinas. A number of control measures were implemented: culling, promotion of commercial and recreational fishing of lionfish, promotion of lionfish consumption, design and implementation of marketing schemes, establishment of cooperation schemes between fishers, restaurants and hotels to encourage consumption of the species, promotion of fishing for lionfish within MPAs, removal of lionfish from MPAs by fisheries managers, and promotion of spear fishing for the species. As well, best practices in lionfish control as articulated in the document *Invasive Lionfish: A Guide for Control and Management* were promoted among stakeholders. Fishers, recreational divers and fish vendors were engaged to promote best practices in lionfish control. However, there was no legal basis for implementation of standards of best control practices.

### 3.5.5 Provide education, information and outreach mechanism to generate public support and foster stewardship in invasive lionfish programs

There was a national communication strategy as well as an education and outreach program to raise public awareness on the lionfish issue and the responsibility for implementation resided with the Fisheries Department and Task Force. Radio programmes, print media (brochures/pamphlets) and the posting of information on social media were the main avenues for implementation of the communication strategy and education and outreach program. However, television programmes and community meetings were also used to implement the education and outreach program. The national respondent indicated that implementation of the communication strategy and education and outreach program were in the early stages and it was anticipated that monitoring of their effectiveness would be determined by public surveys (e.g. SocMon). Nevertheless, he indicated that radio and television programmes were conducted annually, while information was published in newspapers every six months, distribution of brochures and community meetings occurred monthly and posting on social media was done weekly. Technically, both mechanisms were supported by the staff of the Fisheries Division, and financial support was obtained through Government funding and from external donors (GIZ/CATS and UNDP). Lionfish issues were also integrated into the schools' natural science programs, in relevant tertiary courses and community development programs.

### 3.5.6 General

At the 13<sup>th</sup> Meeting of the Caribbean Fisheries Forum in April 2015 Grenada reported on the management measures being implemented to control the invasive lionfish (CRFM, 2015a). These measures pertained to establishment of a national task force and development of an action plan, which included measures to eradicate the species, promote consumption of lionfish, conduct bio-physical monitoring and a public awareness program.

## **3.6 Montserrat**

### 3.6.1 Facilitate Collaboration

Montserrat did not have an approved national response plan or action plan for the control of the invasive lionfish. The Fisheries Unit was sensitizing the fishers on safe harvesting practices, with appropriate gear and how to market the species within communities.

There was a national focal point at the Fisheries Unit with responsibility for monitoring and reporting on lionfish control actions (Appendix 4). However, there was no national committee charged with the responsibility for implementing the Regional Lionfish Strategy. There was also no protocol for invasive alien species in Montserrat, nor a mechanism for identifying funding for programmes to control the

invasive lionfish. Funding for combating the lionfish invasion was derived from government and non-governmental agencies.

The national respondent felt that stakeholder sensitization regarding the impacts of lionfish and the socio-economic opportunities would improve the coordination among national agencies to combat invasive lionfish. He also felt that improved coordination at the regional level could be achieved by data sharing and training in lionfish control and data collection.

### 3.6.2 Encourage coordinated research and monitoring

Data were collected on lionfish catches from commercial fisheries and on the unit price of lionfish at fish markets. These data were computerized but were not analyzed or shared on the GCFI's web portal. The computerized data were however, available for analysis by the CRFM's Reef and Slope Fisheries Working Group.

Divers (individuals), diving companies and fishers were involved in reporting of lionfish sightings. However, there was no standard format for stakeholders to collect and report the lionfish sightings. Data on sightings were collected from fishers during landing of their multispecies catches while occasionally divers and diving companies reported sightings, but these data were not recorded.

No surveys were conducted to determine the abundance or density of lionfish in reef areas and the effectiveness of control measures in combating the lionfish invasion. Instead monitoring was based on sightings by divers or dive operators and staff of the Fisheries Division. There were no publications on the status of the lionfish in Montserrat. However, observations of lionfish landed and reported suggested that there was an abundance of the species on various reef systems around the island. The maximum weight of lionfish caught regularly was between 2 and 3 pounds. The responsibility for reporting on the status of lionfish rests primarily with the Fisheries Division.

No specific technology was used to control lionfish. The species was harvested from traps and was consumed locally. However, no national research was conducted on development of safe lionfish harvesting and post-harvest strategies for seafood markets or any testing for the occurrence of ciguatera in the species.

### 3.6.3 Encourage legislation, regulations and policies for lionfish control

Current legislation made no provisions for the control of the invasive lionfish and there were no specific efforts being made to regulate or prohibit imports of live lionfish for the ornamental fish trade, or to address invasive species in general. The legal framework was under review and expected to be updated by mid-2016.

Specific strategies were implemented for control of the invasive lionfish (See Section 3.6.4). However, the national respondent provided no information on the agency with responsibility for managing such strategies, whether such strategies were supported by policy, legislation and regulations and whether or not there was effective monitoring and enforcement to ensure compliance.

### 3.6.4 Control invasive lionfish populations using regionally coordinated, effective methods

The lionfish invasion in Montserrat was classified as very extensive (very commonly seen). The national respondent did not indicate whether or not the locations of lionfish invasion were prioritized for implementation of control efforts. A few control measures were implemented: promotion of commercial fishing of lionfish, promotion of lionfish consumption and establishment of cooperation schemes between fishers, restaurants and hotels to encourage consumption of the species. As well, best practices in lionfish control as articulated in the document *Invasive Lionfish: A Guide for Control and Management* were

promoted among stakeholders. Fishers were engaged to promote best practices in lionfish control. However, there was no legal basis for implementation of standards of best control practices.

#### 3.6.5 Provide education, information and outreach mechanism to generate public support and foster stewardship in invasive lionfish programs

There was a national education and outreach program to raise public awareness on the lionfish issue and the responsibility for implementation resided with the Fisheries Division. There was however, no broader national communication strategy. Radio programmes and individual communication with fishers on a daily basis were the main avenues used in the education and outreach program. Since implementation of this program there was an increase in the lionfish landed as fishers were no longer leaving the fish in their traps or discarding them at sea. Public demand for the species was also increasing. No information was provided on how the program was supported technically and financially.

#### 3.6.6 General

Monitoring of lionfish was a challenge due to the depths of some of the reef areas (about 450 ft) where lionfish were harvested in traps.

### **3.7 Saint Lucia**

#### 3.7.1 Facilitate Collaboration

Saint Lucia developed a national response plan for the control of the invasive lionfish but this plan was still in draft form. A copy of the plan was not provided as requested in the survey but the draft plan was available online.

There was a national focal point at the Department of Fisheries with responsibility for monitoring and reporting on lionfish control actions (Appendix 4). However, there was no functioning national committee charged with the responsibility for implementing the Regional Lionfish Strategy or draft national response plan. An Ad-Hoc Lionfish Task Force was established under the previous GEF-UNEP Project on *Mitigating the Threat of Invasive Alien Species in the Insular Caribbean*. This Task Force comprised relevant agencies and stakeholder groups (Fisheries Department, Environment Department, Saint Lucia Divers Association, Ministry of Tourism, the Information and Communication Unit of the Ministry of Agriculture) with the roles of the respective members clearly articulated. The Task Force focused on core issues concerning the lionfish threat. However, the Task Force was not sustained beyond the end of the project. Although there was no specific protocol for invasive alien species in Saint Lucia, a comprehensive National Invasive Species Strategy was developed (2012 – 2021) under which the lionfish was also considered. Copies of the Strategy document and an associated brochure were submitted to the CRFM Secretariat.

There was no mechanism for identifying funding for programmes to control the invasive lionfish. Funding for combatting the lionfish invasion was derived from government agencies, private sector and external donors (The Nature Conservancy, UNEP-GEF).

The national respondent felt that revitalization of the Lionfish Task Force that was established under the GEF-UNEP Project on *Mitigating the Threat of Invasive Alien Species in the Insular Caribbean*, would improve the coordination among national agencies to combat invasive lionfish. She also felt that there was need to establish a mechanism for accessing funds to support effective control of the lionfish. The national respondent also felt that at the regional level there was need for establishment of a regional group comprising experts and national focal points to share and develop a regional level plan and activities to control the invasive lionfish.

### 3.7.2 Encourage coordinated research and monitoring

Data were collected on lionfish catches and fishing effort (though not specific to lionfish but rather in relation to the pot fishery in general) from commercial fisheries and on lionfish sightings from recreational fisheries, divers and diving companies. As well, data on catches and sightings were collected at fishing derbies/tournament. Data from commercial fisheries, recreational fisheries, divers and diving companies were computerized and analyzed, with findings recorded in unpublished reports of the Department of Fisheries (annual estimated landings), which are shared with the CRFM. The respective data were not shared on the GCFI's web portal but were however, available for analysis by the CRFM's Reef and Slope Fisheries Working Group.

Divers (individuals), diving companies, members of the public, fishers and staff of the Fisheries Division were involved in reporting of lionfish sightings and there was a standard format for stakeholders to collect and report the lionfish sightings. However, no surveys were conducted to determine the abundance or density of lionfish in reef areas and there was no monitoring to determine whether or not control actions were effective. There were no publications on the status of lionfish in Saint Lucia. However, the national respondent noted that based on reports by divers and fisheries staff it appeared that the lionfish population had continued to grow exponentially since its invasion in 2012. The Department of Fisheries was the agency with responsibility for reporting on the status of the lionfish invasion. The pole spear was the technology used to control lionfish, the use of which was under licensed control, with licenses issued to dive establishments for removal of lionfish particularly in marine reserves. Lionfish was also caught by pot fishers. The species was consumed locally, however, no national research was conducted on development of safe lionfish harvesting and post-harvest strategies for seafood markets or testing for the occurrence of ciguatera in the species.

### 3.7.3 Encourage legislation, regulations and policies for lionfish control

Current legislation made provisions for the control of the invasive lionfish. However, the response of the national respondent suggested that the legislation was still in draft form – as a National Invasive Species Bill existed. The national respondent also indicated that supporting regulations were not developed due to funding limitations. The Department of Fisheries, Environment Department and Saint Lucia Diver's Association were the agencies with collective responsibility for management of lionfish control strategies (see Section 3.7.4). These control measures were supported by policy and legislation but regulations were not yet developed.

### 3.7.4 Control invasive lionfish populations using regionally coordinated, effective methods

The lionfish invasion in Saint Lucia was classified as moderately extensive (commonly seen). Locations of lionfish invasion were prioritized for implementation of control efforts. Highest priority was afforded to control efforts in marine protected areas, followed by coral reefs, then beaches, mangrove systems and seagrass beds. A number of control measures were implemented: culling, promotion of commercial fishing of lionfish, promotion of lionfish consumption, removal of lionfish from marine protected areas by fisheries managers and promotion of spear fishing for lionfish (restricted to dive establishments and fisheries managers). As well, best practices in lionfish control as articulated in the document *Invasive Lionfish: A Guide for Control and Management* were promoted among stakeholders. Fishers, processors, restaurateurs and recreational divers were engaged to promote best practices in lionfish control. Although there was a legal basis for implementation of standards of best control practices, the respective legislation was seldom enforced.

### 3.7.5 Provide education, information and outreach mechanism to generate public support and foster stewardship in invasive lionfish programs

There was a national education and outreach program to raise public awareness on the lionfish issue and the responsibility for implementation resided with the Department of Fisheries and the Department of the

Environment. There was however, no broader national communication strategy, and the national respondent provided no information as to when such a strategy would be developed. Radio and television programmes and print media (newspapers and brochures/pamphlets) were the main avenues used in the education and outreach program. However, the national respondent did not indicate how the effectiveness of the education and outreach program was monitored and evaluated. The various communication tools were used in an ad hoc manner. The program was supported technically by staff of various agencies but the national respondent provided no information on the financial support for the program. Lionfish issues were integrated into the schools' natural science programs.

#### 3.7.6 General

At the 13<sup>th</sup> Meeting of the Caribbean Fisheries Forum in April 2015, Saint Lucia reported that lionfish data were being collected and that an estimated 2.2 tonnes of lionfish was landed in 2014 (CRFM, 2015a). The report indicated that lionfish continued to be monitored. In 2014, licenses were issued to dive institutions throughout the island to use pole spears (only) within marine reserves in response to the growing numbers of the species being reported. Collaboration with the dive industry resulted in two (2) lionfish derbies, where several lionfish were removed at several locations around the island. There was also an increase in the use of lionfish at several restaurants. The Fisheries Department took part in several public awareness initiatives to raise awareness of the use of the lionfish as a food. A public awareness video was also produced to be aired on local television channels.

### **3.8 St Vincent and the Grenadines**

#### 3.8.1 Facilitate Collaboration

St Vincent and the Grenadines developed a national response plan for the control of the invasive lionfish but this document was still in draft form. A copy of the document was not provided as requested in the questionnaire.

There was a national focal point at the Fisheries Division with responsibility for monitoring and reporting on lionfish control actions (Appendix 4). However, there was no national committee charged with the responsibility for implementing the Regional Lionfish Strategy or national response plan. There was also no protocol for invasive alien species in St Vincent and the Grenadines, nor a mechanism for identifying funding for programmes to control the invasive lionfish. Funding to combat the lionfish invasion was derived from government agencies, private sector and external donors (ECMMAN and CATS).

The national respondent felt that improved national coordination among key agencies to more effectively control the invasive lionfish could be achieved by more frequent meetings. He however, provided no recommendations for improvement in coordination at the regional level.

#### 3.8.2 Encourage coordinated research and monitoring

Data were collected on lionfish catches from divers and diving companies as well as fishing derbies/tournaments. These data were computerized but not analyzed or shared on the GCFF's web portal. The computerized data were however, available for analysis by the CRFM's Reef and Slope Fisheries Working Group.

Divers (individuals), diving companies, fishers and staff of the Fisheries Division were involved in reporting of lionfish sightings. However, there was no standard format for stakeholders to collect and report the lionfish sightings. Data on sightings were reported verbally.

No surveys were conducted to determine the abundance or density of lionfish in reef areas and there was no monitoring otherwise to determine the effectiveness of control measures in combating the lionfish

invasion. There were also no publications on the status of lionfish in St Vincent and the Grenadines. Regarding the question to ascertain the status of lionfish in the country the respondent simply indicated that lionfish were present.

The pole spear was the only specific technology used to control lionfish. Lionfish was consumed locally but no national research was conducted on development of safe lionfish harvesting and post-harvest strategies for seafood markets nor was there any testing for the occurrence of ciguatera in the species.

### 3.8.3 Encourage legislation, regulations and policies for lionfish control

Current legislation made no provisions for the control of the invasive lionfish and there were no specific efforts made to regulate or prohibit imports of live lionfish for the ornamental fish trade and to review existing laws, regulations and policies to identify gaps. Efforts to address invasive species in general were focused on lionfish derbies implemented through an established programme of the Ministry with responsibility for agriculture. The national respondent noted that lionfish was never traditionally imported and there were no reports of such activity. Public education was used to regulate any potential of importation of lionfish. Specific lionfish control strategies were managed by the Fisheries Division, Community Groups and NGOs (see section 3.8.4). The national respondent also reported that these strategies were not supported by policy or legislation but they were supported by regulations. There was effective monitoring and enforcement to ensure compliance with regulations.

### 3.8.4 Control invasive lionfish populations using regionally coordinated, effective methods

The national respondent was uncertain about the extent of the lionfish invasion in St Vincent and the Grenadines. However, the locations of lionfish invasion were prioritized for implementation of control efforts. Highest priority was given to coral reefs, followed by marine protected areas, seagrass beds, beaches and marinas, with mangrove systems given the least priority. A number of control measures were implemented: culling, promotion of commercial fishing of lionfish, promotion of lionfish consumption, establishment of cooperation schemes between fishers, restaurants and hotels to encourage consumption of the species and removal of lionfish from MPAs by fisheries managers. Best practices in lionfish control as articulated in the document *Invasive Lionfish: A Guide for Control and Management* were however, not promoted among stakeholders. The national respondent did not indicate whether any specific stakeholder groups were engaged to promote best practices in lionfish control. There was also no legal basis for implementation of standards of best control practices.

### 3.8.5 Provide education, information and outreach mechanism to generate public support and foster stewardship in invasive lionfish programs

There was a national education and outreach program to raise public awareness on the lionfish issue and the responsibility for implementation resided with the Fisheries Division. There was however, no broader national communication strategy. Television programmes, print media (newspapers, brochures, pamphlets), posting of information on social media and school visits were the main avenues used in the education and outreach program. The effectiveness of the education and outreach program was monitored and evaluated through the Fisheries Division's work programme evaluations. The national respondent provided no information on the periodicity of use of the various communication avenues and was uncertain as to whether or not the issues regarding the lionfish invasion were integrated into national education programs (natural science, tertiary level courses and community development programs).

## **3.9 Trinidad and Tobago**

### 3.9.1 Facilitate Collaboration

Trinidad and Tobago did not have an approved national response plan or action plan for the control of the invasive lionfish.

There is a national focal point at the Institute of Marine Affairs (a government research facility) with responsibility for monitoring and reporting on lionfish control actions (Appendix 4). The national respondent was uncertain as to whether there was a national committee charged with the responsibility for implementing the Regional Lionfish Strategy but indicated that there was no such committee established to implement a national response plan. There was a protocol for invasive alien species in Trinidad and Tobago, and more specifically a draft National Alien Invasive Species Strategy. Although lionfish is not included explicitly under the strategy, provisions are made for addressing invasive alien species generally. The national respondent was uncertain as to whether there was a national mechanism for identifying funds for programmes to control the invasive lionfish. Funding for combatting the lionfish invasion was derived from government agencies and the private sector.

The national respondent felt that through synergizing work plans towards a common goal the coordination among key local agencies to control the invasive lionfish could be improved. However, he did not provide any suggestions in respect of what could be done to improve coordination efforts for the same purpose at the regional level.

### 3.9.2 Encourage coordinated research and monitoring

Data were collected on catches and fishing effort targeted at lionfish as well as lionfish sightings in recreational fisheries, by divers and diving companies and at fishing derbies/tournaments. In addition, data on the number of cases of lionfish envenomation were collected from health agencies. All data were computerized, except for data from health agencies. These data were analyzed but the reports were unpublished. The data were not shared on the GCFI's web portal but were available for analysis by the CRFM's Reef and Slope Fisheries Working Group.

Divers (individuals), diving companies, members of the public, fishers, fisher organizations, tourists and staff of the Fisheries Division (i.e. the Department of Marine Resources and Fisheries, Tobago) were involved in reporting lionfish sightings. There was a standard format for stakeholders to collect and report data on lionfish sightings.

Monthly surveys were conducted in marine protected areas and coral reefs off Tobago to determine the abundance and density of lionfish. However, there were no publications on the status of lionfish in Trinidad and Tobago. The national respondent indicated that help was required to publish the information, which suggests that the survey data were analyzed. He also noted that the lionfish population was growing steadily but was not yet having a negative impact on fisheries or tourism. The Institute of Marine Affairs was the agency with responsibility for reporting on the status of the lionfish invasion. The pole spear was the technology used to control the lionfish. Lionfish was consumed locally but no national research was conducted on development of safe lionfish harvesting and post-harvest strategies for seafood markets. The species was however, tested for ciguatera. Consumption of the lionfish was impacted by consumers' fears of the effects of the lionfish venom as well as cultural diet preferences.

### 3.9.3 Encourage legislation, regulations and policies for lionfish control

The national respondent was uncertain as to whether current legislation made provisions for the control of the invasive lionfish. However, lionfish was blacklisted and its importation and sale in the aquarium trade were banned. The Institute of Marine Affairs was the agency with responsibility for managing the lionfish control measures (see Section 3.9.4). The national respondent indicated that the control measures were supported by policy and regulations but not by legislation. There was no effective monitoring and enforcement to ensure compliance with the regulations.

#### 3.9.4 Control invasive lionfish populations using regionally coordinated, effective methods

The lionfish invasion in Trinidad and Tobago was classified as moderately extensive (commonly seen). Locations of lionfish invasion were prioritized for implementation of control efforts. Highest priority was afforded to control efforts in marine protected areas and coral reefs, followed by beaches, then mangrove ecosystems, seagrass beds and marinas. A number of control measures were utilized: culling, promotion of commercial and recreational fishing of lionfish, promotion of lionfish consumption, design and implementation of marketing schemes, promotion of fishing for lionfish within marine protected areas, removal of lionfish from marine protected areas by fisheries managers and promotion of spear fishing. As well, best practices in lionfish control, as articulated in the document *Invasive Lionfish: A Guide for Control and Management* was promoted among stakeholders. Fishers, processors, restaurateurs and recreational divers and health workers were engaged to promote best practices in lionfish control. However, there was no legal basis for implementation of standards of best control practices.

#### 3.9.5 Provide education, information and outreach mechanism to generate public support and foster stewardship in invasive lionfish programs

There was a national communication strategy as well as an education and outreach program to raise public awareness on the lionfish issue and the responsibility for implementation resided with the Institute of Marine Affairs. Radio and television programmes as well as print media (newspapers and brochures/pamphlets), community meetings and posting of information on social media were the main avenues for implementation of the communication strategy and education and outreach program. The effectiveness of these two mechanisms was monitored through public surveys on knowledge, attitudes and practices. In both instances, radio and television programmes and print material were communicated monthly, community meetings were convened every six months and posting on social media occurred on a daily basis. Technically, both mechanisms were supported by staff of the Institute of Marine Affairs and financial support was obtained from the Government's Environmental Fund (Green Fund). Lionfish issues were also integrated into the schools' natural science programs and in relevant tertiary courses.

### **3.10 Turks and Caicos Islands**

Based on the report of the Turks and Caicos Islands to the 13<sup>th</sup> Meeting of the Caribbean Fisheries Forum, special licenses were issued and fishing gear allowed for persons who were engaged in the capture of lionfish (CRFM, 2015a).

## **4.0 RESULTS - REGIONAL INITIATIVES**

### **4.1 Facilitate Collaboration**

The CRFM is structured as a convening mechanism to facilitate political consensus and representation of the region on issues related to fisheries and aquaculture conservation and management, consequently issues related to the lionfish invasion are relevant. The Reef and Slope Fisheries Working Group of the Caribbean Fisheries Forum (which comprises technical and management components), provides a forum for the conduct of regional research on lionfish and analysis of the respective fisheries as well as for the sharing of best practices in lionfish control and monitoring. The Ministerial Council, by virtue of being the highest policy decision-making body within the CRFM, is able to facilitate political consensus regarding management of the lionfish invasion and in October 2012 endorsed the Regional Lionfish Strategy for implementation in CRFM Member States. The CRFM's Resource Mobilization Committee (CRFM, 2015) is charged with the responsibility for sourcing finances for implementation of the CRFM's Programmes and Projects.

## 4.2 Encourage coordinated research and monitoring

### 4.2.1 Activities of the CRFM's Reef and Slope Fisheries Working Group

The CRFM's Reef and Slope Fisheries Working Group (previously the CRFM's Reef and Slope Fish Resource Working Group), discussed and made recommendations concerning management of the invasive lionfish at the 8<sup>th</sup>, 9<sup>th</sup> and 10<sup>th</sup> CRFM Annual Scientific Meetings - ASMs (CRFM, 2012; 2013; 2014). At the 8<sup>th</sup> ASM the Working Group explored options of density and non-density dependent fishing mortality among possible control strategies and recommended implementation of monitoring programs to facilitate estimation of maximum growth rate and population carrying capacity in order to inform development and evaluation of control strategies. It also recommended a review of lionfish national response plans and coordination of efforts to enhance such plans during the 2012-2013 inter-sessional period. At the 9<sup>th</sup> ASM the Working Group reviewed the Regional Lionfish Strategy and reported on the status of implementation in St Vincent and the Grenadines, Dominica and the Bahamas. *It recommended scientific research on the occurrence of ciguatera in the lionfish as well as collection of data on the lionfish as a new fishery resource in the Caribbean.* At the 10<sup>th</sup> ASM the Working Group identified broad activities that were being conducted regionally in respect of the lionfish but did not identify country-specific activities. It also discussed the issue of management of the lionfish as a sustainable fishery while at the same time keeping the respective population at a level that would minimize ecosystem impacts. The Working Group put forward the following recommendations:

1. Review, develop and implement harmonized legislation and regulations to deal with all IAS in CRFM member states;
2. Improve and centralize lionfish data collection and information systems;
3. Train Fisheries staff in the collection of lionfish biological data;
4. Develop a National Action plan for the monitoring and control of lionfish;
5. Intensify the campaign to promote lionfish as a commercial fishery for local and regional consumption;
6. Seek internal and external funding to assist research, monitoring and control of IAS;
7. Develop a draft harmonized survey questionnaire (to be done by CRFM Secretariat), to evaluate status of implementation of action plans and agreement on data entry format;
8. Provide incentives for fishers to target lionfish;
9. Regular update of Working Group Chair by Member States on the progress being made to adopt and implement the Regional Lionfish Strategy and Action Plan;
10. Agree upon and make available lionfish data sets from member states for analysis at the next CRFM Scientific meeting.

All reports of the respective ASMs including the recommendations for research, statistics and management were considered and endorsed by the Caribbean Fisheries Forum (CRFM 2013a; 2014a; 2015a).

### 4.2.2 High Priority Research Activities identified in CRFM's Fisheries and Aquaculture Research

#### Agenda

In 2015, the CRFM developed its Fisheries and Aquaculture Research Agenda (CRFM, 2015b). This Research Agenda, developed in collaboration with several regional and international academic and research institutions among other agencies and endorsed by the First Special Meeting of the Executive Committee (CRFM, 2015b), identified a number of high priority research activities pertaining to invasive alien species in general and the lionfish in particular: (1) *promote and provide assistance for the development and implementation of national monitoring plans for IAS*; (2) *identify priority habitats or ecosystems severely impacted by IAS for rehabilitation or restoration*; (3) *adopt or develop protocols for rehabilitation or restoration of IAS impacted sites*; (4) *assess and develop safe lionfish harvesting strategies for seafood markets*; (5) *record and assess existing technologies to control lionfish invasion and*

identify the most successful ones. Significant material in the various subject areas was already available in the GCFI's web portal and access to the respective documents could inform the way forward.

#### 4.2.3 Country-specific literature search of GCFI's web portal

Based on a search of the literature database on lionfish available at <http://lionfish.gcfi.org/research-monitoring> on 4 December 2015, 35 publications were identified for CRFM Member States (Appendix 5). This search was not a comprehensive one, only those documents identified for specific countries were considered, but there were other general documents pertaining to the Caribbean and southern Caribbean which may also be relevant. Of the 35 documents on lionfish research, 29 pertained to the Bahamas, 3 pertained to Jamaica, 2 pertained to the Turks and Caicos Islands and one to the Bahamas, Virgin Islands and Turks and Caicos Islands combined. These publications focused mainly on the economic and ecological impacts of the lionfish invasion, predation on lionfish, lionfish abundance and density, lionfish foraging behavior and prey consumption as well as competition, lionfish habitat preferences and control strategies.

### **4.3 Encourage legislation, regulations and policies for lionfish control**

There was no focus at the sub-regional level concerning legislation, regulations and policies for lionfish control. However, the CRFM Ministerial Council approved a Regional Plan of Action for Improving the Outlook of Caribbean Coral Reefs (2014-2019) at its 8<sup>th</sup> meeting. This Plan of Action includes provisions for addressing the management of risks from invasive species and calls for development of policy and legislation to support integrated management of invasive species and mitigation of new introductions, development of mitigation strategies for reducing or preventing the introduction of invasive species, developing control strategies and establishing or enhancing regional programs and response teams (Australia Caribbean Coral Reef Collaboration, 2014).

### **4.4 Control populations using regionally coordinated, effective methods**

There have been little active, coordinated efforts on the ground among CRFM Member States in the area of lionfish management except for discussions and recommendations of the Reef and Slope Fisheries Working Group as outlined under Section 4.2.1.

### **4.5 Provide education, information and outreach mechanism to generate public support and foster stewardship in invasive lionfish responses**

The CRFM through funding from the Technical Centre for Agriculture and Rural Cooperation the CRFM has produced a brochure *on Lionfish Control and the Private Sector* to raise awareness of the role of the private sector in controlling the lionfish invasion and to seek the necessary support. This brochure is available online ([http://ftp.crfm.net/~uwohxjxf/images/Lionfish\\_Brochure\\_-\\_Final.pdf](http://ftp.crfm.net/~uwohxjxf/images/Lionfish_Brochure_-_Final.pdf)) and has been widely distributed at a number of regional fora.

## **5.0 SUMMARY FINDINGS, DISCUSSION AND RECOMMENDATIONS**

Preliminary conclusions on the general status of implementation of the Regional Lionfish Strategy in CRFM Member States were based on the responses of only seven (41%) of the 17 CRFM Member States (Belize, Dominica, Grenada, Montserrat, Saint Lucia, St Vincent and the Grenadines and Trinidad and Tobago), as well as CRFM Reports (Barbados, the Bahamas and Turks and Caicos Islands) and personal communication (Barbados). Of the remaining 59% of the Member States which did not participate in the survey, reef fisheries are extremely important to at least five countries (Anguilla, Antigua and Barbuda,

the Bahamas, Jamaica and the Turks and Caicos Islands). Since the national surveys were directed at Fisheries Divisions/Department, a subset of the full range of stakeholders<sup>2</sup> targeted by the Regional Lionfish Strategy, the survey responses may not fully reflect the national situation, as may be gleaned from collaborative inputs and the sharing of information among governmental agencies, non-governmental organizations, private sector and local communities. However, in most cases the Fisheries Division/Department (resource managers) was the lead agency, or one of the lead agencies, with responsibility for controlling the invasive lionfish. The findings are listed, to the extent possible, in accordance with the specific objectives, strategies and actions of the Regional Lionfish Strategy as listed in Appendix 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***

National Response Plans for the Control of Invasive Lionfish and Plan Implementation

Of the seven countries that responded to the survey questionnaire only Grenada had an approved national action plan for control of the invasive lionfish and only Belize and Saint Lucia shared copies of their draft lionfish response/action plans or national strategy for invasive alien species. However, it was uncertain whether this approval was at the level of the Cabinet, which may increase the likelihood of securing the necessary resources for its implementation. Belize had a lionfish response and management plan for the period 2009 to 2013 but it was uncertain whether the plan was updated or the period of its application extended. Saint Lucia, St Vincent and the Grenadines and Trinidad and Tobago all had draft plans or plans that were not yet approved while Dominica and Montserrat had no response or action plan. Barbados had a final lionfish invasion response plan but it was not yet approved<sup>1</sup>. The extent to which draft or unapproved national plans could be effectively implemented was uncertain, as was the level of national commitment to provision of the respective resources.

Countries have realized that the complete eradication of the lionfish was not feasible and instead have focused on promoting development of fisheries for the species. This approach brings with it the challenge to balance a sustainable lionfish fishery with the need to control the population to a level that would mitigate the negative ecosystem impacts. Management of reef and slope fisheries must therefore be considered holistically and consistent with the CRFM's commitment to application of the precautionary, participatory and ecosystem approaches to fisheries management. *It is recommended that CRFM Member States develop new, or update existing, management plans for reef and slope fisheries and associated ecosystems, which consider the management of the lionfish as a sub-component, and which are consistent with existing national response or action plans for controlling the species.*

Designation of National Focal points with responsibility for monitoring and reporting on control actions

All seven countries that responded to the survey had designated national focal points for monitoring and reporting on control actions and except for Trinidad and Tobago, the focal point was a member of staff of the Fisheries Division/Department. In Trinidad and Tobago the focal point was a member of staff of a national research institution, the Institute of Marine Affairs. In a few instances the responses of the national focal points to the survey questionnaire suggested that they were not fully aware of all national matters of pertinence to control of the lionfish. This situation was likely due to weaknesses in the national coordination mechanism, for which recommendations are provided in the following section.

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<sup>2</sup> The "full range of stakeholder" targeted by the Regional Lionfish Strategy comprises governments, academia, regional bodies and international organizations, resource managers, non-governmental organizations, private sector, local communities and donors.

National Committee for coordinated implementation of Regional Strategy, national response/action plans and lionfish control strategies

Of the seven countries that responded to the survey only Grenada had a national Task Force that was operational and which focused on implementing its national action plan. The Task Force was represented by a range of stakeholders and its roles and functions were clearly articulated. In Saint Lucia an Ad-Hoc Lionfish Task Force was established under the previous GEF-UNEP Project on *Mitigating the Threat of Invasive Alien Species in the Insular Caribbean* (MTIASIC) but the activities of the committee were not sustained following the end of the Project. While in Belize a national committee was established under the National Coral Reef Monitoring Network, but was no longer operational. In Barbados there was collaboration among the Fisheries Division, the Coastal Zone Management Unit and the University of the West Indies to implement the lionfish invasion response plan. Despite the absence of a national coordinating committee in several countries however, there appeared other means (perhaps informal) of coordinating control efforts among direct stakeholders as many countries reported collaboration with divers, processors, restaurateurs, members of the public and tourists in such efforts. *Suggestions for improved coordination among national agencies included revitalizing defunct committees, increased public awareness, expanding the representation of existing committees, and greater synergies in the work plans of the respective national agencies.* Several CRFM Member States have established Fisheries Advisories Committees (FACs) or similar bodies, in some cases supported by legislation, to coordinate the inputs and participation of the full range of stakeholders in the management process. These FACs may be able to address coordination of lionfish control or management, perhaps with some expansion of their composition, in situations where there are no functioning National Committees established to address lionfish control specifically. This approach seems more feasible in addressing the general situation of marine IAS which is directly linked to resource and biodiversity management. *Membership on the FACs should include representation of the full range of stakeholder groups necessary for implementation of existing national response/action plan for the invasive lionfish. As well, where they exist, fisheries managers should be represented on any National Committee established to address invasive alien species in general.*

Funding of national control programs

The national respondents of six of the seven countries noted that there was no national mechanism for identification of funds in support of lionfish control programs, the respondent in Trinidad and Tobago was uncertain of any such arrangement. Four of the six countries (Belize, Grenada, Saint Lucia and St Vincent and the Grenadines) identified a number of regional initiatives under which funding was being sourced for national lionfish control efforts. These initiatives included the Mesoamerican Reef Fund, Community Management of Protected Areas Conservation Programme (COMPACT), Protected Areas Conservation Trust (PACT), the Caribbean Aqua-Terrestrial Solutions (CATS - Funded by the German Government), the United Nations Development Programme (the United Nations Environment Programme- Global Environment Facility), The Nature Conservancy and the Eastern Caribbean Marine Managed Areas Network (ECMMAN). Montserrat and Trinidad and Tobago however, derived funding from national sources only - the government, non-governmental organizations and the private sector. While it is apparent that some countries have greater access to a wider range of funding opportunities from external donors it should be noted that at least two countries indicated that Committees established for national control of the lionfish went defunct after the externally-funded projects ended. *It is therefore recommended that Member States seek sustainable sources of funding for the continued long-term management of the lionfish under the broader fisheries management portfolio.*

### Inclusion of Lionfish on the Agenda of Invasive Species Protocols

The Regional Lionfish Strategy was preceded by a Strategy and Action Plan for Invasive Alien Species in the Caribbean Region (IAS-SAP - 2011 to 2016) which was developed in July 2011 as an output of the GEF-UNEP Project: MTIASIC<sup>3</sup> that was implemented between October 2009 and August 2013 (<http://www.car-spaw-rac.org/?Invasive-alien-species,215>). The Project focused on implementing recommendations of the Convention on Biological Diversity (Conference of the Parties) and included developing strategies and action plans for addressing IAS, developing national capacity to address such issues, developing national coordinating mechanisms for implementing the respective programs, review of the policy and legislative framework and enhanced cooperation among the full range of stakeholder groups in addressing IAS issues (see the Full Project Document on the GEF's website).

Based on responses to the survey, three countries (Grenada, Saint Lucia and Trinidad and Tobago) had national strategies for invasive alien species. Through MTIASIC strategies and action plans were to be developed in the Bahamas, Jamaica, Saint Lucia and Trinidad and Tobago. It is uncertain whether such strategies and action plans were approved for national implementation. Based on the national responses it appeared that the lionfish was mentioned specifically in the plans for Grenada and Saint Lucia. Since key elements of the national framework for addressing IAS (lionfish being one such species) were developed under the MTIASIC Project, issues related to the lionfish could also be addressed under the IAS-SAP and associated national strategies and action plans for a more coordinated effort nationally.

### Regional Collaboration to Control the Invasive Lionfish

The CRFM's structure provides a mechanism to facilitate political consensus and regional representation while the Resource Mobilization Committee provides a mechanism for sourcing the requisite funds for any agreed sub-regional actions to control/manage the lionfish. However, despite expressions of concern of CRFM Member States regarding the lionfish invasion at various regional and internal fora there has been very limited active collaboration and coordination among CRFM Member States to date to inform control and management measures for the species. In 2013 and 2014 the CRFM's Reef and Slope Fisheries Working Group (RSWG - technical component) sought to ascertain the status of lionfish control activities sub-regionally but there was limited participation of Member States in this exercise (CRFM 2013, 2014). Consequently, the RSWG recommended specific actions to improve data collection, research and management of the lionfish which were considered and endorsed by the Caribbean Fisheries Forum, but many recommendations remain to be implemented. The RSWG also planned to conduct a regional analysis of lionfish catches in 2015 but several Member States advised that there was insufficient data, notwithstanding that all respondents to the survey in this study have indicated the data collected are available for analysis by the Reef and Slope Fisheries Working Group.

The national respondents of three Member States (Grenada, Belize and Montserrat) identified the need for a forum for sharing of best practices, lessons learnt in the implementation of monitoring, communication, outreach and financing of lionfish control programs as a means of strengthening regional coordination. There are at least three such fora currently existing: the Caribbean Invasive Alien Species Network; Annual Symposia of the Gulf and Caribbean Fisheries Institute and the Caribbean Marine Protected Areas Managers Network and Forum. The Caribbean Invasive Alien Species Network (<http://www.ciasnet.org/>) includes experts from all CRFM Member States (excluding the UK Overseas Territories) as well as several regional agencies (excluding the CRFM). An ICRI Ad Hoc Committee on the Caribbean Regional

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<sup>3</sup> The Bahamas, Jamaica, Saint Lucia and Trinidad and Tobago participated in this US\$6.1 Mn project (along with Cuba and the Dominican Republic) that was executed by the Latin America Regional Center of the Centre for Applied Biosciences International (CABI) along with national executing agencies (in most instances government agencies with responsibility for the environment, biodiversity, agriculture and fisheries).

Response to the Lionfish Invasion was also established in November 2010 (<http://www.icriforum.org/groups/our-committees/regional-lionfish-committee>) with the mandate to assist countries to develop national strategies as well as awareness-building on matters related to the lionfish and seeking to broaden its portfolio to address other marine invasive species. However, the current status of this Committee is not known. Also, within the CRFM the Caribbean Fisheries Forum and its Reef and Slope Fisheries Working Group (technical and management components) could also serve as fora for such exchanges while a reconstituted CRFM Resource Mobilization Committee (RMC) could assist in sourcing the requisite funds (CRFM, 2015 a – Appendices VII and IX). *It is therefore recommended that Member States engage existing regional fora to facilitate information exchange in best practices in the control and management of IAS, in particular the lionfish, and through the Caribbean Fisheries Forum, take advantage of the opportunities presented through the restructuring of the CRFM's Working Groups to assess lionfish fisheries and coordinate management/control measures (CRFM, 2015c).*

## ***Objective 2: Encourage coordinated research and monitoring***

### **Monitoring of lionfish fisheries and populations**

The monitoring of lionfish fisheries and populations was one of the weakest areas of the Fisheries Divisions in the region, at least based on the survey responses from the seven CRFM Member States. Although all countries reported collection of lionfish data (catches, number of sightings, effort) from a varying range of sources (commercial fisheries, recreational fisheries, divers, diving companies, fishing tournaments or derbies), it was uncertain whether the data collected was comprehensive enough to facilitate analysis of the respective lionfish fisheries. Grenada, Saint Lucia and Trinidad and Tobago had standardized formats for stakeholders (excluding researchers) to report data and in the other countries it appeared that the reporting was through informal processes and possibly undocumented in some cases. Only Belize, Saint Lucia and Trinidad and Tobago analyzed the respective data, from which Saint Lucia derived an estimate catches of lionfish (*Pterois volitans*) in 2014 of about 2.2 tonnes. The analyses for lionfish in Trinidad and Tobago were not published and those for Belize were published by researchers. All national respondents, except the respondent from Dominica, indicated that the data collected were available for analysis by the CRFM's Reef and Slope Fisheries Working Group (RSWG). Regarding access to information, it was not apparent that national respondents were aware of the GCFI's web portal through which information on education and outreach, research and monitoring, control and management of the lionfish could be accessed. Knowledge of the content of this website, and access to published material could inform the respective national lionfish management and response programmes (monitoring, awareness-building, control strategies etc.), prevent duplication of effort and consequently facilitate most effective use of limited national resources. A search of the Lionfish Web Portal in December 2015 identified some 35 documents pertaining to lionfish research in CRFM Member States, most research being conducted in the Bahamas. *Access to published scientific information may pose a challenge for Fisheries Divisions which are without the resources to subscribe to scientific journals. This situation could result in scientific information not being considered in lionfish management decision-making. Consequently there is need to make scientific information available to resource managers.*

With respect to monitoring of lionfish populations, to assess abundance and density of the species as well as the effectiveness of control efforts, surveys were conducted on a monthly basis in marine protected areas and coral reef areas in Belize and Trinidad and Tobago. While biological and catch data were collected during culling events in Grenada it was uncertain whether these data were being used to assess the effectiveness of lionfish control measures. It was also uncertain how the other countries were monitoring the effectiveness of control measures implemented. It should be noted that in six of the 7 countries the responsibility for reporting on lionfish status resided with the Fisheries Departments/Divisions, while such responsibility resided with the Institute of Marine Affairs in Trinidad and Tobago. A range of stakeholders were engaged in reporting on lionfish sightings, but the main

contributors were divers and diving companies. However, the cost of implementing structured monitoring surveys on a regular basis is likely to be prohibitive. *It is recommended that Fisheries Divisions 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.*

*In light of the above findings, and mindful of the recommendations of the CRFM's RSWG at section 4.2.1, it is recommended that the CRFM's RSWG:*

- 1. undertakes a comprehensive literature review on the lionfish;*
- 2. identifies, accesses through collaborative arrangements with regional research institutions, and shares documents of relevance to lionfish management, monitoring and control efforts as well as standardized survey methods for the species among CRFM Member States (drawing on the experiences from those Member States that conduct regular monitoring surveys);*
- 3. develops standard formats for the collection of the range of lionfish data, drawing on the experiences from those Member States that already collect such data and information available on the GCFI's lionfish web portal;*
- 4. conducts a comprehensive review of available lionfish fisheries data for CRFM Member States;*
- 5. analyzes lionfish fisheries data at (3), if feasible, and produces a report with recommendations for management of the fishery, statistics and data collection and specific research required to inform management;*
- 6. explores at the national level the possibility of engaging dive companies in regular monitoring surveys and identifies sustainable sources of funding and requisite training to do so; and*
- 7. familiarizes itself with the content of the GCFI's lionfish web portal and shares its findings at the GCFI's annual conferences and other research-related fora.*

#### Lionfish Control Technologies

The main control technologies utilized were pole spears and spear guns, perhaps also with the use of SCUBA for targeting deeper waters. In Grenada hand nets were also used. Fishers also caught lionfish in traps. The main concern is that at least five of the countries which participated in the survey did not implement the appropriate monitoring systems to be able to assess the effectiveness of these technologies to control the lionfish population.

#### Consumption of lionfish

Lionfish was consumed in all seven countries that responded to the survey. However, research was not conducted on developing safe lionfish harvesting and post-harvesting practices, except in Dominica. Only Trinidad and Tobago tested for the occurrence of ciguatera neurotoxin in lionfish. The Bahamas identified the need for such testing (CRFM, 2014). There is an inextricable link among promotion of lionfish as a viable fishery, promotion of consumption of the species, development of safe lionfish harvesting and processing practices, training in safe lionfish harvesting, handling and processing, development and implementation of marketing strategies to promote sale of the species. *National management plans for reef and slope fisheries and related ecosystems should address all matters related to the lionfish comprehensively, including matters related to safe harvesting, handling, processing as well as development and implementation of marketing strategies.*

#### Research Programmes

Within the CRFM framework, apart from this evaluation study, no specific regional research has been conducted on the lionfish. However, relevant research was being conducted through various academic and research institutions and researchers (See Appendix 5) including the University of the West Indies (CERMES). As well, the Gulf and Caribbean Fisheries Institute is the lead regional agency for the sharing of information on lionfish research and management, with a specific session devoted to lionfish at its

annual symposia and an Invasive Lionfish Web Portal for sharing of information. Both Belize and Trinidad and Tobago have reported on the conduct of monitoring surveys in the respective countries and based on the literature similar research has been conducted in Jamaica, the Bahamas, Barbados and Turks and Caicos Islands. The CRFM Secretariat also developed a Research Agenda which identifies and prioritizes the relevant research on lionfish (CRFM, 2015b). *It is recommended that Member States, through the Caribbean Fisheries Forum, take advantage of the opportunities presented through the restructuring of the CRFM's Working Groups (CRFM, 2015c) and its agreed Research Agenda (CRFM, 2015b).*

### ***Objective 3: Encourage legislation, regulations, and policies for lionfish control***

#### Current policies, legislation and regulations in support of lionfish control

In most countries lionfish control programs appeared to be supported by some combination of policy, legislation or regulations, although the situation was uncertain in Dominica and Montserrat. However, the study findings did not definitively indicate whether national policies and the respective legislative frameworks were comprehensively reviewed and updated so as to effectively address the lionfish issue (or marine IAS in general). Only the national respondent from Montserrat indicated that the current legal framework was under review and should be revised by mid-2016 and current legislation in Belize and Saint Lucia specifically provide for lionfish control. It should be noted however, that the relevant policies and legislation may extend beyond the fisheries sector, to include the environment and biodiversity, which may be outside the portfolio of resource managers targeted in this study. Notwithstanding this situation, in the majority of cases the responsibility for implementing lionfish control measures resided with the Fisheries Divisions/Departments in collaboration with other agencies. At times the responses of countries to questions on policy and legislation were conflicting, necessitating further clarification. However, it should be noted that current fisheries legislation in Belize and Saint Lucia made specific provisions for lionfish control through the licensing of use of spear guns and SCUBA gear, and pole spears respectively in marine protected areas to control the increase in lionfish population. Similar situation is likely to exist in the Bahamas and Dominica. The importation of lionfish was prohibited in the ornamental fish trade in Trinidad and Tobago and current legislation in Grenada could be used to regulate lionfish trade if the situation arose. Belize, Grenada and Saint Lucia indicated that lionfish control strategies were supported by policy and legislation. While appropriate regulations were in place in Belize and Grenada, such regulations were not yet developed in Saint Lucia. In most countries it appeared that current legislation did not preclude development of a fishery for the species, commercial fishers caught lionfish in traps mainly. At the regional level the recently endorsed Regional Plan of Action for Improving the Outlook of Caribbean Coral Reefs includes provisions for development of policies, legislation and strategies to address the management of risks from invasive species (Australia Caribbean Coral Reef Collaboration, 2014).

Review and update of policy and legislation were usual recommendations to ensure that agreed regional measures (for fisheries management, biodiversity management, etc.) could be implemented nationally. However, amendment of legislation is a time consuming exercise, which cannot be reinitiated or repeated each time a new recommendation is made to suit a specific purpose. Furthermore, in order to embark on a legislative review exercise there must be evidence that the desired changes cannot be effected through current legislation. *Since it was not evident that CRFM Member States have undertaken a review of existing policy and legislation to ascertain whether or not measures to control the invasive lionfish were supported it is recommended that such a review be conducted. However, 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.*

#### ***Objective 4: Control invasive lionfish populations using regionally coordinated, effective methods***

##### Lionfish Control Measures

The countries which participated in the survey implemented a range of lionfish control measures, though for the most part the monitoring systems to assess the effectiveness of these measures were not instituted. Generally, national respondents felt that the lionfish invasion in the waters of their respective countries was moderately extensive (lionfish are commonly seen), while the respondent from Montserrat felt that the invasion was very extensive (lionfish are very commonly seen), and the respondent from St Vincent and the Grenadines was uncertain as to the extent of the invasion. Except for Dominica and Montserrat (no response given), countries generally prioritized the locations of lionfish invasion for implementation of control measures, with marine protected areas and coral reefs being afforded the highest priority. A range of control measures were used to varying degrees among countries: (1) culling of lionfish; (2) promotion of commercial fishing; (3) promotion of recreational fishing; (4) promotion of lionfish consumption; (5) promotion of fishing for lionfish in MPAs; (6) removal of lionfish from MPAs by fisheries managers; (7) promotion of spearfishing for lionfish. Belize, Dominica, Grenada and Trinidad and Tobago utilized all measures, while Montserrat promoted commercial fishing and consumption of lionfish and St Vincent and the Grenadines promoted culling, commercial fishing, consumption of lionfish and removal of lionfish from MPAs by fisheries managers. Except for St Vincent and the Grenadines, the other six countries promoted the adoption of best practices in lionfish control as articulated in the document *Invasive Lionfish: A Guide for Control and Management*, to varying degrees among a range of stakeholder groups (fishers, processors, restaurateurs, recreational divers, fish vendors and health workers). There was a legal basis for implementation of standards of best lionfish control practices in Saint Lucia only but the respective legislation was seldom enforced.

##### Enhancing ecosystem resilience through management and restoration programs

Although the survey questionnaire did not seek information specifically in respect of restoration programs it should be noted that the Regional Plan of Action for Improving the Outlook of Caribbean Coral Reefs (2014-2019) – (Australian Caribbean Coral Reef Collaboration, 2014), approved by the 8<sup>th</sup> Meeting of the CRFM Ministerial Council in May 2014 makes provisions for various management and restorative programs. Although the main focus of the Plan of Action is to build the resilience of Caribbean Coral Reefs to the impacts of climate change, one of the objectives focuses on managing risks from invasive species. As well, six OECS countries - Antigua and Barbuda, Dominica, Grenada, Saint Lucia, St Kitts and Nevis and St Vincent and the Grenadines, are currently involved in the Eastern Caribbean Marine Managed Areas Network (ECMMAN) Project between 2013 and 2017. This 4 million Euro project, implemented by The Nature Conservancy has as one of its four objectives – the establishment of new Marine Managed Areas and strengthening of existing Marine Managed Areas. *It is recommended that management and restorative efforts across a range of regional and national initiatives be coordinated so as to effectively address issues related to the invasive lionfish, among other marine invasive species.*

##### Promotion of Human Consumption of Lionfish

All seven countries promoted the consumption of lionfish. Generally these countries also focused on designing and implementing marketing schemes (except Montserrat, Saint Lucia and St Vincent and the Grenadines) and establishing cooperative schemes between fishers, restaurants and hotels to encourage consumption (except Saint Lucia). Only Dominica conducted research to develop safe lionfish harvesting and post-harvest practices while Trinidad and Tobago was the only country that tested the lionfish for the occurrence of the ciguatera neurotoxin. The safety of lionfish for human consumption is a key determinant in development of a viable fishery for the species. Although training in safe processing of the species could allay consumer reservations concerning possible envenomation, the presence of the ciguatera neurotoxin in the species would impact any efforts to promote the species as a food fish. *Given the tendency for higher occurrence of ciguatera in fish of the northern countries of the region it is*

*recommended that testing of the lionfish be conducted 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.*

***Objective 5: Provide education, information and outreach mechanisms to generate public support and foster stewardship in invasive lionfish programs.***

#### National Communication Strategies, Education and Outreach Programmes

All countries appeared to have focused significant efforts in public awareness, education and outreach. All seven countries implemented national education and outreach programmes, although only Belize, Grenada and Trinidad and Tobago also implemented a national communication strategy, to raise public awareness on the lionfish issue. In all instances except Trinidad and Tobago the Fisheries Division/Department was responsible, in collaboration with other agencies, for implementation of these programmes. In Trinidad and Tobago the responsibility rests with the Institute of Marine Affairs. A range of communication tools were used (radio programmes, television programmes, print media (newspapers/brochures/pamphlets), community meetings and posting of information on social media. As with the monitoring of effectiveness of control measures, monitoring of the effectiveness of communication strategies, education and outreach programs was another area where countries fell short. Of the seven countries, only Belize and Trinidad and Tobago conducted such monitoring mainly through public surveys. Technical support for the respective programs was drawn from staff of the respective agencies while financial support was received from the Government and grants from external donors.

#### Integration of the lionfish issue into education programs

National respondents indicated that lionfish issues were integrated into education programs in Belize, Grenada, Saint Lucia and Trinidad and Tobago, specifically in school natural science programs and in relevant tertiary level course in Belize, Grenada and Trinidad and Tobago as well as community development programs in Grenada.

*In order to ascertain whether communication strategies, education and outreach programs are bringing about the necessary improvements in knowledge, attitudes and practices of direct stakeholders in the fisheries and environment sectors, as well as the general public, it is recommended that regular evaluation of such programs be conducted. Since such programs could be costly, assessment of their impacts is critical towards ensuring most efficient use of limited resources and to inform adjustments to the respective programs to bring about the desired effects.*

## **6.0 CONSIDERATIONS FOR FUTURE EVALUATIONS**

This being the first evaluation of the status of implementation of the Regional Lionfish Strategy a simple survey was designed to collect basic information concerning activities at the national level. It may be necessary to refine the survey in future to focus more closely on specific areas based on the findings of, and gaps in, this first evaluation and to consider whether or not a quantitative evaluation is necessary. Although the Ministerial Council endorsed the Regional Lionfish Strategy and urged Member States to ensure development and implementation of national response plans to control the invasion of lionfish and ensure that these response plans included the active maintenance of statistical sampling and reporting programs that facilitate review and evaluation of performance of the plans, it did not specifically mandate periodic reporting on the status of implementation of the Regional Lionfish Strategy or national lionfish response/management plans to the CRFM. However, the CRFM is obligated to periodically report to the CARICOM Secretariat on matters concerning the CARICOM Strategic and Work Plans. The work plan of the CARICOM's Agricultural Health and Food Safety Systems Thematic Group considers issues

regarding Invasive Alien Species with focus on the lionfish in marine fisheries in the context of food and nutrition security and health. CRFM Member States also have opportunity to report on any significant achievements in implementation of the Regional Lionfish Strategy in their national reports to the CFF.

## **7.0 STUDY LIMITATIONS**

The most critical limitation in this study was the apparent low priority assigned to the evaluation exercise by some Member States, which ultimately impacted their level of participation in the survey, the quality of the survey responses and uncertainty as to whether the responses were endorsed at the fisheries directorate's level before submission to the Secretariat. At times the responses for this evaluation exercise were ambiguous, conflicting, gave the impression that the respondent was uncertain, or were not provided for all questions. Endorsement of the survey responses at the fisheries directorate's level was critical as many of the survey questions required comprehensive knowledge of national fisheries policy and legislation. Other limitations pertain to the untimely delivery of completed surveys by Member States, general unresponsiveness to queries or requests for clarification on survey submissions as well as requests to review the draft evaluation report.

## **8.0 CONCLUSIONS**

Based on the preliminary findings concerning the status of implementation of the Regional Lionfish Strategy in the seven CRFM Member States which responded to the survey (Belize, Dominica, Grenada, Montserrat, Saint Lucia, St Vincent and the Grenadine and Trinidad and Tobago) all countries had taken action to control the lionfish invasion, demonstrating national commitments towards implementation of the Strategy. Most countries, except Dominica and Montserrat, had developed national lionfish response/management plans, although only the plan for Grenada was approved. Based on information from other sources, Barbados also had a national lionfish response/management plan and the Bahamas had endorsed the Regional Lionfish Strategy. As well, Saint Lucia had developed a National Invasive Species Strategy under which control of the invasive lionfish could also be managed.

*Facilitate collaboration:* Effective national coordination and collaboration among agencies with a role in implementing the respective national lionfish response/management plans and strategies was not always evident. Only Grenada had a functioning national committee/task force for implementing the respective plan. Reliance on external sources of funding for the control of invasive species in general, and lionfish in particular, resulted in similar committees established in Belize and Saint Lucia becoming dormant when the initiatives ended. Nevertheless there appeared informal mechanisms by which the agencies with responsibility for fisheries management coordinated control actions among direct stakeholders (e.g., fishers, divers). All countries had national focal points for monitoring and reporting on lionfish control measures. It was not evident that control of the invasive lionfish was being considered in the broader context of IAS, only Grenada and Saint Lucia had specific IAS protocols or national strategies that considered the lionfish. The issue of funding control measures is also of concern as none of the countries identified a national mechanism for sourcing the requisite funds. Most countries derived funding from a number of regional initiatives, only Montserrat and Trinidad and Tobago relied solely on national funding sources. At the regional level, the CRFM's structure provides a mechanism to facilitate political consensus and regional representation while the Resource Mobilization Committee provides a mechanism for sourcing the requisite funds for any agreed sub-regional actions to control/manage the lionfish. Although concerns have been voiced at various fora regarding the threat of the lionfish however, there have been little active, coordinated efforts on the ground among CRFM Member States in the area of lionfish management. Several regional fora exist for the sharing of information and best practices in

lionfish control measures and scientific research, including the Caribbean Invasive Alien Species Network, the Caribbean Marine Protected Areas Managers Network and Forum, the GCFI's Annual Symposia and the Caribbean Fisheries Forum with its Reef and Slope Fisheries Working Group (management and technical level), but it was not evident that countries were aware of, or effectively utilizing, such fora.

*Coordinated research and monitoring agenda:* Although a number of universities have conducted lionfish research the level of coordination of such research and whether resource managers had access to scientific information to inform the decision-making concerning lionfish management could not be ascertained. Although the Gulf and Caribbean Fisheries Institute has played a pivotal role in the sharing of information, including research and monitoring, on its Lionfish Web Portal and at its annual symposia, it was not evident that resource managers were aware of the Web Portal or had access to the scientific research presented at the annual symposia. There was little research on development of safe harvesting and post-harvesting strategies (conducted only in Dominica) and testing of lionfish for the occurrence of ciguatera (conducted only in Trinidad and Tobago). Of all CRFM Member States most extensive lionfish research was conducted in the Bahamas. Generally, research focused mainly on the economic and ecological impacts of the lionfish invasion, predation on lionfish, lionfish abundance and density, foraging behavior, prey consumption as well as competition, habitat preferences and control strategies. The weakest area at the national level pertained to monitoring lionfish populations (abundance, density) and monitoring the effectiveness of control measures. Only Belize and Trinidad and Tobago conducted period surveys for this purpose and only Grenada, Saint Lucia and Trinidad and Tobago reported formal processes for collection of data on lionfish catches and sightings, with standardized data collection/reporting forms. Specific lionfish research activities were prioritized under the CRFM's Fisheries and Aquaculture Research Agenda with the Resource Mobilization Committee charged with the responsibility for sourcing funds to implement the Research Agenda.

*Review and amendment of relevant legislation, regulations, policies:* In most countries lionfish control programs appeared to be supported by some combination of policy, legislation or regulations. However, it was not apparent that countries had undertaken any legislative review and developed new policies and regulations to control the lionfish. Only Montserrat alluded to the update of its legislation which is to be amended by mid-2016. However, relevant policies and legislation may extend beyond the fisheries sector, to include the environment and biodiversity, which may be outside the portfolio of resource managers targeted in this study. Legislation on the trade in fish and fish products could be used to control lionfish import and export. Some countries developed regulations to allow the use of specific gear (mainly pole spears/spear guns and SCUBA) by select groups to target lionfish in marine protected areas, otherwise closed to fishing (e.g. Belize and Saint Lucia). At the regional level, the recently endorsed Regional Plan of Action for Improving the Outlook of Caribbean Coral Reefs includes provisions for development of policies, legislation and strategies to address the management of risks from invasive species (Australia Caribbean Coral Reef Collaboration, 2014).

*Control invasive lionfish:* A number of control measures were implemented across the respective countries including promotion of commercial and recreational fishing of lionfish, promotion of consumption of the species, culling in MPAs and other critical habitat. The pole spear was the most common fishing technology used for culling apart from fish traps used by commercial fishers. Locations for application of control measures were in most cases prioritized, with coral reefs and MPAs being of highest priority. The main concern however, is the lack of monitoring to measure the effectiveness of such control measures. Efforts were also focused on training in proper lionfish handling and processing for human consumption but specific details were not available for all countries.

*Provide education, information and outreach mechanisms:* Generally considerable efforts were deployed for public awareness, education and outreach programmes using a range of communication tools (radio and television programmes, print media such as newspapers, brochures, pamphlets, community meetings and posting of information on social media. There was also some degree of integration of lionfish issues into school education programmes. The main concern again is the lack of monitoring of the effectiveness of such programs through changes in the knowledge, attitude and practices of the range of stakeholders.

The findings, conclusions and recommendations of this study are based on feedback from only 41% of the membership of the CRFM, which excludes some countries for which reef and slope fisheries are of considerable socio-economic importance. Consequently it is uncertain whether the findings accurately reflect the current situation concerning implementation of the Regional Lionfish Strategy in CRFM Member States. For this reason it is recommended that the survey, with any required modifications, be repeated biennially. This will also facilitate the CRFM's reporting to the CARICOM Secretariat on the work plan of its Agricultural Health and Food Safety Systems Thematic Group.

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**APPENDIX 1. REGIONAL STRATEGY FOR THE CONTROL OF THE INVASIVE LIONFISH: SPECIFIC OBJECTIVES, STRATEGIES AND ACTIONS** (Excerpt: only actions of relevance to government, regional bodies and resource managers listed here)

Objective	Strategy	Actions (timeline)	Govt.	RB/IO	RM
1. Facilitate collaboration among governments, reef – reliant industries, civil society, and academia by providing mechanisms for coordination of efforts across political and geographical boundaries	Create a mechanism to promote coordination of control and management of lionfish in the Wider Caribbean through existing regional bodies and international organizations	Amend the current mandate of the Regional Lionfish Committee or establish another mechanism to coordinate the implementation of this strategy (2013)		√	
		Provide a convening mechanism to facilitate political consensus and represent the region (2013-14)		√	
		Identify national focal points tasked with monitoring and reporting on control actions (2013-14)	√		
		Identify functions and roles of committee members (2013-14)	√	√	√
		Provide technical support to governments (2014-15)			
		Mobilize resources (2014-15)		√	√
		Coordinate actions within the country through the establishment of working groups (2014-15)	√		
		Include lionfish on the agenda of invasive Alien Species protocols (2014-15)	√		
		Identify potential funding sources to implement control programs (2014-15)	√	√	√
2. Encouraging a coordinated research and monitoring agenda	Promote the adoption of existing standardized survey methods for lionfish and incorporate into relevant monitoring programs (fisheries, reefs,	List and assess existing survey methods (including ecological and economic impact studies) (2013-14)		√	
		Disseminate best survey methods and encourage their use in a standardized manner at the local, national and regional levels (2014)	√	√	

Objective	Strategy	Actions (timeline)	Govt.	RB/IO	RM
	etc.)	Collect and provide data (ongoing)	√	√	√
		Facilitate and support the organization of training of trainers on these issues (especially in the Spanish speaking countries of the Caribbean) (2014-15)		√	
		Investigate the feasibility of centralizing the data collected (e.g., an online data-base) (2014)		√	
		Identify appropriate institutions to produce regular reports on the status of the lionfish invasion in the region for public education and decision-making (2014)		√	
		Promote the application of monitoring and evaluation activities of the programs implemented, to determine their effectiveness (2015)	√	√	√
		Encourage targeted socio-economic impact surveys (2013-17)	√	√	
	Promote a coordinated research agenda at regional level	Facilitate discussions among researchers and resource managers to share information and encourage complementary and coordinated studies (2013-14)	√	√	√
		Help prioritize research agenda (2013-14)	√		
	Encourage and support research to develop technological solutions for lionfish control	Record and assess existing technologies and identify most successful ones (ongoing)	√	√	
		Where relevant, develop new control technologies (ongoing)	√	√	√
	Create mechanisms for the dissemination of scientific information about lionfish	Encourage use of web portal (currently hosted by GCFI with US support) that consolidates information available on the spread of the lionfish and provides a forum for information sharing (2013)	√	√	
		Support regular conferences where new scientific progress are presented	√	√	

Objective	Strategy	Actions (timeline)	Govt.	RB/IO	RM
		and shared within and beyond the scientific community (ongoing)			
	Promote studies to ensure that human consumption of lionfish is safe	Assess and develop safe lionfish harvesting strategies for seafood markets (2014)	√	√	
		Support studies on ciguatera and other potential food-borne illness that may be associated with lionfish (2013-14)	√		
3. Encourage governments to review and amend relevant legislation and, if necessary, develop new regulations and policies to control lionfish	Promote close collaboration among national, regional and international bodies on invasive species of which the lionfish invasion is an exemplar	Work in regional and international bodies to identify ways to strengthen the prevention and control of invasive species, e.g., a listing of invasive species based on Article 12 of the SPAW Protocol (2015-16)	√	√	
	Encourage governments to review and/or amend exiting regulations/legislation that inhibit or restrict lionfish control	Facilitate workshops/meetings to review existing legislation to identify gaps related to lionfish efforts, and in particular with respect to the prohibition of lionfish introduction/import (2013-14)	√		√
		Propose coordination among countries to harmonize national regulatory standards. Two situations should be distinguished: import of lionfish from abroad; and possible export of captured lionfish (2014)	√	√	
	Encourage the incorporation of lionfish control strategies into government programs	Identify appropriate agencies to manage lionfish programs, e.g., environmental management, fisheries, trade and tourism related agencies as relevant (2014)	√		
		Allocate resources for lionfish programs (2014-17)	√		
	Encourage governments to develop specific laws, policies, and/or regulations	Inform decision-makers of existing national laws and policies and international work that may be relevant to controlling lionfish in order to determine what could be incorporated into the national laws, regulations,	√	√	

Objective	Strategy	Actions (timeline)	Govt.	RB/IO	RM
	where these currently do not exist	and policies (e.g. aquatic invasive species law) (2014)			
		Facilitate capacity building with the support of regional organizations where appropriate (2013-15)	√	√	
	Encourage consistency among national legislation, policies and regulations	Review existing, amended and projected policies and regulations and provide advice on their gaps if any, and on option to strengthen their consistency (2014)	√	√	√
		Facilitate capacity building with the support of regional organizations where appropriate (2013-15)	√	√	
	Monitor and enforce regulations	Provide appropriate domestic resources for monitoring compliance and enforcement (2014-15)	√		
		On-ground monitoring and enforcement (2015-17)			√
Control invasive lionfish populations using regionally coordinated, effective methods	Prioritize locations for lionfish control efforts	Support process for site prioritization to help countries identify priority areas for lionfish control efforts (2013-14)	√	√	
		Develop and allocate sustainable funding to increase capture in deep sea and other inaccessible areas, and other control associated activities (2014)	√	√	
	Implement effective and efficient lionfish control programs	Identify and allocate sustainable funding for local control mechanisms (2014)	√	√	
		Promote the adoption of best practices in control among various stakeholder groups, as identified in the document: “ <i>Invasive Lionfish: A Guide for Control and Management</i> ” (2013-15)	√	√	√
		Encourage and promote the use of the best equipment and tools available for control and mitigation (with the organization of workshops, trainings, exchange of experiences) (2013-15)	√	√	

Objective	Strategy	Actions (timeline)	Govt.	RB/IO	RM
		Help countries design control and mitigation plans by selecting the best array of tools (consumption, fishing tournaments, etc.) depending on their particular situation with respect to invasion and local capacities (2014-15)	√	√	
		Verify the enforcement of standards of best control practice (2015-20)	√	√	√
	Enhance ecosystem resilience through management and restoration programs	Implement protection and restoration programs for mitigating lionfish impacts (e.g. design and creation of new MPAs) (2015-17)	√		√
	Promote human consumption of lionfish, if safe, as a control Strategy	Establish cooperation schemes between fishermen, restaurants and hotels to encourage consumption of lionfish (2013-14)		√	
		Design marketing schemes in the community to encourage the consumption of lionfish (2014-15)		√	
4. Provide education, information and outreach mechanisms to generate public support and foster stewardship in invasive lionfish programs	Develop a regional communication Strategy to raise public awareness on the lionfish issue	Identify key messages and target audience (2013)	√	√	
		Identify effective communication channels and direct target audience for the best use of information and resources (2013)	√	√	
		Implement monitoring and evaluation methods to determine effectiveness of communication strategies (2015-16)	√	√	
		Securing the endorsement of the various sectors to support the communication scheme (e.g., funding support, design, distribution) (2014-20)	√	√	√
	Promote the adoption of lionfish education tools and their integration in	Encourage governments to include invasive alien species in general, and the lionfish in particular, in the school natural science programs (2014-15)	√	√	
		Integrate invasive alien species in general, and the lionfish in particular,			

Objective	Strategy	Actions (timeline)	Govt.	RB/IO	RM
	school curricula	into relevant tertiary courses (2014)			
		Use the contact list developed by the RLC to disseminate relevant education tools (2013-15)	√	√	
	Promote the consumption of lionfish, if safe	Compile and encourage standardized analyses of ciguatera throughout affected countries to make sure that lionfish are not ciguatoxic and thus improper for human consumption (2013-15)	√	√	
		Promote the consumption of lionfish as one of the most efficient means to control through awareness and communication campaigns targeting the general public and restaurants (to encourage them to serve lionfish) (2014-15)	√	√	
	Provide appropriate training to end users	Support the training of fishermen and reef reliant industries staff on first aid, safe fishing, and handling of lionfish (2015-17)	√		√
		Identify and disseminate best control practices (2014-20)	√	√	√
Govt. = governments; RB/IO = Regional bodies/International Organizations; RM = Resource Managers					

## APPENDIX 2: QUESTIONNAIRE – MONITORING AND EVALUATION OF NATIONAL IMPLEMENTATION OF THE REGIONAL STRATEGY FOR CONTROL OF THE INVASIVE LIONFISH

### CRFM Survey to Monitor and Evaluate Progress on Implementation of Regional Strategy for the Control of the Invasive Lionfish in the Wider Caribbean

The sixth meeting of the Ministerial Committee in the Bahamas, on 15 June 2012, urged Member States, individually and through the CRFM, to ensure development and implementation of national response plans to control the invasion of lionfish, consistent with the findings and recommendations by the ICRI Working Group and GCFI for the Wider Caribbean Region. **The Ministerial Council similarly urged Member States to ensure that their response plans for controlling lionfish include the active maintenance of statistical sampling and reporting programs that facilitate review and evaluation of performance of the said plans. These national response plans are intended to facilitate implementation of the 2013 Regional Strategy for the Control of the Invasive Lionfish<sup>4</sup>.**

At the Ninth and Tenth Annual Scientific Meetings in 2013 and 2014 respectively, the Reef and Slope Fisheries Working Group (RSWG) discussed measures being implemented by some Member States to control the lionfish but was unable to conduct a comprehensive analysis. **Due to limited data on the species the RSWG has not yet been able to analyze data on the lionfish resource in the region.**

The Executive Committee (EC) of the Caribbean Fisheries Forum (CFF), at its 24<sup>th</sup> meeting in February 2014 in St Vincent and the Grenadines, acknowledged the continuing threat of the invasive lionfish to the health of reef ecosystems as well as associated public health and socio-economic impacts, and noted that the species is also becoming important commercially in some Member States. **The EC recalled the above-mentioned directive of the Ministerial Council and authorized the conduct of a survey in 2015 to monitor and evaluate implementation of the regional strategy and associated national response plans.** The survey is intended to identify areas of success to be shared regionally and areas or critical gaps requiring priority attention for the control of the lionfish populations in the region. **The survey questionnaire is designed to ascertain the level of achievement of the five major objectives contained in the strategy: (1) facilitate collaboration, (2) encourage coordinated research and monitoring; (3) encourage legislation, regulations and policies for lionfish control; (4) control; and (5) education, information and outreach.**

The EC also called on Member States to participate fully in the survey and to provide the necessary and timely feedback to facilitate reporting to the Ministerial Council in 2016. As a consequence your timely completion of the attached questionnaire and submission to the CRFM Secretariat by **30 June 2015** would be greatly appreciated.

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<sup>4</sup>Gomez Lozano, R., L. Anderson, J.L. Akins, D.S.A. Budd, Garcia-Moliner, F. Gourdin, M. Laurent, C. Lilyestrom, J.A. Morris, Jr., N. Ramnanan and R. Torres. 2013. Regional Strategy for the Control of Invasive Lionfish in the Wider Caribbean. International Coral Reef Initiative, 31 pp.

## Questionnaire

### A. Facilitate collaboration

1. Does your country have an approved national response plan or action plan for the control of the invasive lionfish? (tick or embolden appropriate response)

yes/ no/ unsure/ being developed/ developed but still in draft form/ not yet approved

*If you answered yes, or that the plan is developed but still in draft form, please attach a copy of the national response plan with your completed questionnaire when submitting to the CRFM Secretariat.*

2. If you answered “no” to question (1) indicate the national mechanism currently used to combat the threat of the invasive lionfish. (type response here)
3. Is there a designated national focal point who has responsibility for monitoring and reporting on control actions? (tick or embolden appropriate response) Yes/ no/ unsure
4. If you answered “yes” to question (3), indicate
  - (a) the name of the focal point:  
First Name \_\_\_\_\_ Surname \_\_\_\_\_
  - (b) the agency/ministry/ or other entity with which the focal point is affiliated (type response here)
  - (c) the contact email of the focal point (type response here)
  - (d) the contact telephone number of the focal point, including country code (type response here)
5. Is there a national committee charged with the responsibility for implementing:
  - (a) the regional strategy to control the invasive lionfish (tick or embolden appropriate response)  
yes/ no/ unsure
  - (b) the national response plan (tick or embolden appropriate response)  
yes/ no/ unsure/ not applicable
6. If you answered “yes” to question 5 (a) or (b), indicate
  - a. the name of the national committee: (insert response here)  
\_\_\_\_\_
  - b. the name of the Chairperson of the national committee:  
First Name \_\_\_\_\_ Surname \_\_\_\_\_
  - c. the agency /ministry/ or other entity with which the Chair is affiliated (insert response here)

- d. the contact email of the Chair of the committee (insert response here)
- e. the contact telephone number of the Chair of the committee (insert response here)
7. If you answered “yes” to question 5 (a) or (b), indicate the agency composition of the committee (tick or embolden all that apply)
- a. Fisheries division/department ☐
  - b. Environmental division/department ☐
  - c. Customs and Excise Department ☐
  - d. Ministry with responsibility for Trade ☐
  - e. National research institution ☐
  - f. NGOs (please specify) ☐ \_\_\_\_\_
  - g. Private Sector (please specify) ☐ \_\_\_\_\_
  - h. Other (please specify) ☐ \_\_\_\_\_
8. If you answered “yes” to question 5 (a) or (b), are the agreed functions and roles of committee members clearly articulated? (tick or embolden appropriate response) yes/ no
9. Is there a protocol for invasive alien species in general in your country? (tick or embolden appropriate response)  
yes/ no/ unsure/ not yet approved/ being developed/ developed but still in draft form
10. If you answered “yes” or “not yet approved” or “being developed” or “developed but still in draft form” to question (9), is lionfish included on this protocol? (tick or embolden appropriate response) yes/ no/ unsure
11. Is there a national mechanism for identifying funding for programmes to control the invasive lionfish? (tick or embolden appropriate response) yes/ no/ unsure/ being developed
12. If you answered “yes” or “being developed” to question (11) please:
- a. describe the mechanism (insert response here)
  - b. identify the respective agencies responsible for resource mobilization. (insert response here)
13. Indicate the sources of funding accessed to combat the lionfish invasion in your country (tick or embolden all that apply)
- a. Government agencies ☐
  - b. Non-governmental agencies ☐
  - c. Academic institutions ☐
  - d. Private sector ☐
  - e. External donors ☐ Please identify donors here: \_\_\_\_\_

14. In your opinion, what can be done to improve the level of coordination among key agencies in your country to more effectively control the invasive lionfish? [\(insert response here\)](#)
15. In your opinion, what can be done to improve the level of coordination among key entities regionally to more effectively control the invasive lionfish? [\(insert response here\)](#)

**B. Encourage coordinated research and monitoring**

1. Are the following data on lionfish collected from the respective sources in your country? [\(tick or embolden all that apply\)](#)

Sources	Data types (tick all that are collected) – specify any other data types collected in blank cells				
<b>commercial fisheries</b>	Catch of lionfish <input type="checkbox"/>	Fishing effort targeted at lionfish <input type="checkbox"/>	# lionfish sighted <input type="checkbox"/>		
<b>recreational fisheries</b>	Catch of lionfish	Fishing effort targeted at lionfish	# lionfish sighted		
<b>divers/diving companies</b>	Catch of lionfish <input type="checkbox"/>	Fishing effort targeted at lionfish <input type="checkbox"/>	# lionfish sighted <input type="checkbox"/>		
<b>fishing derbies or tournaments</b>	Catch of lionfish <input type="checkbox"/>	Fishing effort targeted at lionfish <input type="checkbox"/>	# lionfish sighted <input type="checkbox"/>		
<b>fish markets</b>	Quantity of lionfish sold <input type="checkbox"/>	unit price of lionfish <input type="checkbox"/>			
<b>restaurants</b>	Quantity of lionfish meals sold <input type="checkbox"/>	revenue from sale of lionfish meals <input type="checkbox"/>			
<b>health agencies</b>	# cases of human poisoning from contact	# cases of envenomation <input type="checkbox"/>			

Sources	Data types (tick all that are collected) – specify any other data types collected in blank cells				
	with lionfish at sea <input type="checkbox"/>				
<b>customs divisions</b>	quantity of lionfish imported in ornamental fish trade <input type="checkbox"/>	cost of lionfish imports in ornamental fish trade <input type="checkbox"/>			
<b>trade ministries</b>	quantity of lionfish imported in ornamental fish trade <input type="checkbox"/>	cost of lionfish imports in ornamental fish trade <input type="checkbox"/>	quantity of lionfish consumed locally <input type="checkbox"/>		
<b>* Other sources</b> (please specify)					

2. If you ticked any of the data sources and types in question (1) indicate below which data are computerized (tick or embolden all that apply).

Sources	Data types (tick all that are collected) – * specify any other data types computerized in blank cells				
<b>commercial fisheries</b>	Catch of lionfish <input type="checkbox"/>	Fishing effort targeted at lionfish <input type="checkbox"/>	# lionfish sighted <input type="checkbox"/>		
<b>recreational fisheries</b>	Catch of lionfish <input type="checkbox"/>	Fishing effort targeted at lionfish <input type="checkbox"/>	# lionfish sighted <input type="checkbox"/>		

Sources	Data types (tick all that are collected) – * specify any other data types computerized in blank cells				
<b>divers/diving companies</b>	Catch of lionfish <input type="checkbox"/>	Fishing effort targeted at lionfish <input type="checkbox"/>	# lionfish sighted <input type="checkbox"/>		
<b>fishing derbies or tournaments</b>	Catch of lionfish <input type="checkbox"/>	Fishing effort targeted at lionfish <input type="checkbox"/>	# lionfish sighted <input type="checkbox"/>		
<b>fish markets</b>	Quantity of lionfish sold <input type="checkbox"/>	unit price of lionfish <input type="checkbox"/>			
<b>restaurants</b>	Quantity of lionfish meals sold <input type="checkbox"/>	revenue from sale of lionfish meals <input type="checkbox"/>			
<b>health agencies</b>	# cases of human poisoning from contact with lionfish at sea <input type="checkbox"/>	# cases of envenomation <input type="checkbox"/>			
<b>customs divisions</b>	quantity of lionfish imported in ornamental fish trade <input type="checkbox"/>	cost of lionfish imports in ornamental fish trade <input type="checkbox"/>			
<b>trade ministries</b>	quantity of lionfish imported in ornamental fish trade <input type="checkbox"/>	cost of lionfish imports in ornamental fish trade <input type="checkbox"/>	quantity of lionfish consumed locally <input type="checkbox"/>		
<b>* Other sources</b>					

3. Are the computerized data available for analysis by the CRFM Reef and Slope Fisheries Working Group? (tick or **embolden appropriate response**) yes/ no
4. If you ticked any of the answers to question (2) are the data shared on the web portal currently hosted by the Gulf and Caribbean Fisheries Institute? (tick or **embolden appropriate response**) yes/ no/ not aware of this portal
5. If you ticked any of the answers to questions (1) or (2) have the data been analyzed? (tick or **embolden appropriate response**) yes/ no
6. If you answered “yes” to question (5) please list below the full citations of all reports, publications, etc. pertaining to the data analyzed. (insert response here)
7. Are the following stakeholders involved in the reporting of sightings of lionfish? (tick or **embolden all that apply**)
  - a. Divers (individuals) ☐
  - b. Diving companies ☐
  - c. Members of the Public ☐
  - d. Fishers ☐
  - e. Fisher organizations ☐
  - f. Tourists ☐
  - g. Fisheries Division’s staff ☐
  - h. Others ☐ (please specify)

---
8. If you ticked any of the answers to question (7) is there a standard format for stakeholders to collect and report lionfish sightings? (tick or **embolden appropriate response**) yes/ no/ unsure
9. If you answered “no” to question (8), how are data on sightings of lionfish by stakeholders collected and reported? (insert response here)
10. Has your country conducted any surveys to determine the abundance/density of lionfish in reef areas? (tick or **embolden appropriate response**) yes/ no/ unsure
11. If you answered “yes” to question (10), where are these surveys conducted? (tick or **embolden all that apply**)
  - a. marine protected areas (MPAs) ☐
  - b. beaches ☐
  - c. marinas ☐
  - d. mangrove systems ☐

- e. coral reefs ☐
  - f. sea grass beds ☐
  - g. other ☐ [please specify:](#)
- 

12. If you answered “yes” to question (10), how often are these surveys conducted? ([tick or embolden one answer](#))

- a. Once monthly ☐
  - b. Once a fortnight ☐
  - c. Once every six months ☐
  - d. Annually ☐
  - e. Other ([please specify](#)) ☐
- 

13. If you answered “no” to question (10), what type of monitoring is conducted to determine whether or not control actions are effective in combating the lionfish invasion? ([insert response here](#))

14. Are there any publications on the status of lionfish in your country? ([tick or embolden appropriate response](#)) yes/ no/ unsure

15. If you answered “yes” to question (14), [please list the full citations of the publications below.](#)

16. If you answered “no” to question (14), what is believed to be the status of lionfish in your country? ([insert response here](#))

17. Which national entity is responsible for reporting on the status of lionfish in your country? ([tick or embolden all that apply](#))

- a. National committee established to implement the regional strategy and/or national response plan ☐
- b. Fisheries Department ☐
- c. Environment Department ☐
- d. Other ([please specify](#)) ☐

18. What technologies are currently used to control lionfish in your country? ([insert response here](#))

19. Is lionfish consumed in your country? ([tick or embolden appropriate response](#)) yes/ no/ unsure

20. If you answered “yes” to  
question (19), has there been any research in your country to ([tick or embolden appropriate response](#)):

- a. Develop safe lionfish harvesting strategies for seafood markets - yes/ no
  - b. Develop safe lionfish post-harvest strategies for seafood markets - yes/ no
  - c. Test for the occurrence of ciguatera in lionfish harvested in your country - yes/ no
  - d. If you answered yes to (a) and/or (b) *please list the full citations of the publications below.*
21. If you answered “no” to question (19), could you indicate why lionfish is not consumed in your country? *(tick or embolden all that apply)*
- a. Consumers’ fears of the effects of lionfish venom ☐
  - b. Lionfish are infected with ciguatera ☐
  - c. Cultural preferences ☐
  - d. Other ☐ *please specify:*
- 

### ***C. Encourage legislation, regulations and policies for lionfish control***

1. Does current legislation in your country make provisions for the control of the invasive lionfish? *(tick or embolden appropriate response)* yes/ no/ unsure
2. If you answered “yes” to question (1) *please provide details below related to the respective provisions.*
3. If you answered “no” to question (1) what efforts are being made to:
  - a. regulate or prohibit imports of live lionfish for the ornamental fish trade *(insert response here)*
  - b. review existing laws, regulations and policies to identify gaps *(insert response here)*
  - c. address the issue of invasive alien species in general *(insert response here)*
4. Are there specific lionfish control strategies or programs being implemented in your country? *(tick or embolden appropriate response)* yes/ no/ unsure
5. If you answered “yes” to question (4), which entity is responsible for managing these strategies/programs? *(tick or embolden one answer)*
  - a. National committee established to implement the regional strategy and/or national response plan ☐
  - b. Fisheries Department ☐
  - c. Environment Department ☐
  - d. Other agency *(please specify)* ☐

6. If you answered “yes” to question (4), are these lionfish control strategies and programs supported by (tick or embolden appropriate response)
  - a. policy - yes/ no
  - b. legislation/laws - yes/ no
  - c. regulations - yes/ no
7. If you answered “yes” to question (6c) is there effective monitoring and enforcement to ensure compliance with the regulations? (tick or embolden appropriate response) yes/ no/ unsure

***D. Control invasive lionfish populations using regionally coordinated, effective methods***

1. How extensive is the lionfish invasion in your country? (tick or embolden one answer)
  - a. Not reported ☐
  - b. Not extensive (reported but not well established) ☐
  - c. Lightly extensive (seen occasionally ) ☐
  - d. Moderately extensive (commonly seen) ☐
  - e. Very extensive (very commonly seen) ☐
  - f. Unsure ☐
2. If you answered “yes” to question (4) in section C, are locations of lionfish invasion prioritized for implementation of the control efforts? (tick or embolden appropriate response) yes/ no/ unsure
3. If you answered “yes” to question (2) indicate the level of prioritization of each location below (1 is highest priority and 5 is lowest priority)
  - a. marine protected areas (MPAs)
  - b. beaches
  - c. marinas
  - d. mangrove systems
  - e. coral reefs
  - f. sea grass beds
  - g. Other (please specify and prioritize accordingly)

---
4. What kinds of control or mitigation efforts are implemented in your country? (tick or embolden all that apply)
  - a. Culling in any form, including derbies and activities by management agencies ☐
  - b. Promotion of commercial fishing for lionfish ☐
  - c. Promotion of recreational fishing for lionfish ☐
  - d. Promotion of lionfish consumption ☐

- e. Design and implementation of marketing schemes for lionfish ☐
  - f. Establishment of cooperation schemes between fishers, restaurants and hotels to encourage consumption of lionfish ☐
  - g. Promotion of fishing for lionfish within MPAs ☐
  - h. Removal of lionfish from MPAs by fisheries managers ☐
  - i. Promotion of spear fishing for lionfish ☐
  - j. Others (please specify) ☐
- 
5. Is the adoption of best practices in lionfish control – as identified in the document *Invasive Lionfish: A Guide for Control and Management* - promoted among stakeholder groups? (tick or embolden appropriate response) yes/ no/ unsure
6. If you answered “yes” to question (5) – which stakeholders have been engaged to promote best practices in lionfish control? (tick or embolden all that apply)
- a. Fishers ☐
  - b. Processors ☐
  - c. Restaurateurs ☐
  - d. Recreational Divers ☐
  - e. Health workers ☐
  - f. Others (please specify) ☐
- 
7. Is there a legal basis for implementation of standards of best control practices for lionfish? (tick or embolden appropriate response) yes/ no/ unsure
8. If you answered “yes” to question (7), how well is the legislation enforced? (tick or embolden one answer)
- a. Rigorously ☐
  - b. Moderately ☐
  - c. Occasionally ☐
  - d. Seldom ☐

***E. Provide education, information and outreach mechanisms to generate public support and foster stewardship in invasive lionfish programs***

1. Is there a national communication strategy or education and outreach programme to raise public awareness on the lionfish issue? (tick or embolden appropriate response)
- a. National communication strategy - yes/ no/ unsure
  - b. Education and outreach programme - yes/ no/ unsure

2. If you answered “yes” to question (1a) or 1(b) which agency is/agencies are responsible for implementing the communication strategy or education and outreach programme? (tick all that apply)

Agency	Communication Strategy (tick below if applicable)	Education & Outreach Programme (tick below if applicable)
Fisheries Division/Department		
Environment Division		
Ministry of Trade		
Ministry of Tourism		
National Committee established to control the invasive lionfish		
Other (please specify)		

3. If you answered “yes” to question (1a) or 1(b) what media are used to implement the communication strategy or education and outreach programme? (tick all that apply)

Media	Communication Strategy (tick below if applicable)	Education & Outreach Programme (tick below if applicable)
a. Radio Programmes		
b. Television programmes		
c. Print media - newspaper		
d. Print media – brochures/pamphlets		
e. Community meetings		
f. Posting of information on social media (facebook/twitter/youtube/ etc.)		

Media	Communication Strategy (tick below if applicable)	Education & Outreach Programme (tick below if applicable)
g. Other (please specify)		

4. If you answered “yes” to question (1a), how is the effectiveness of the communication strategy monitored and evaluated?

- Public surveys on knowledge, attitudes and practices (insert response here)
- Other (please specify here)

5. If you answered “yes” to question (1b), how is the effectiveness of the education and outreach programme monitored and evaluated?

- Public surveys on knowledge, attitudes and practices (insert response here)
- Other (please specify here)

6. If you answered “yes” to question (1a), how often is information communicated to stakeholders? (tick appropriate response)

Media	Daily	Weekly	Monthly	Every 6 months	Annually
a. Radio programmes					
b. Television Programmes					
c. Print media - newspapers					
d. Print media – brochures/pamphlets					
e. Community meetings					
f. Posting on social media					
g. Other (please specify)					

7. If you answered “yes” to question (1b), how often is information communicated to stakeholders? (tick appropriate response)

Media	Daily	Weekly	Monthly	Every 6 months	Annually
h. Radio programmes					
i. Television Programmes					
j. Print media - newspapers					

Media	Daily	Weekly	Monthly	Every 6 months	Annually
k. Print media – brochures/pamphlets					
l. Community meetings					
m. Posting on social media					
n. Other (please specify)					

8. If you answered “yes” to question (1a), how is the communication strategy:
- supported technically? (insert response here)
  - supported financially? (insert response here)
9. If you answered “yes” to question (1b), how is the education and outreach programme:
- supported technically? (insert response here)
  - supported financially? (insert response here)
10. If you answered “no” to question (1a), when do you anticipate that a communication strategy would be developed? (tick or embolden one answer)
- Within a month ☐
  - Within 2 months ☐
  - Within 6 months ☐
  - Within one year ☐
  - Within 1 to 2 years ☐
  - Never ☐
11. If you answered “no” to question (1b), when do you anticipate that an education and outreach programme would be developed? (tick or embolden one answer)
- Within a month ☐
  - Within 2 months ☐
  - Within 6 months ☐
  - Within one year ☐
  - Within 1 to 2 years ☐
  - Never ☐
12. Indicate whether lionfish is integrated into the following educational programs (tick or embolden all that apply)
- School natural science programs ☐
  - Relevant tertiary courses ☐
  - Community development programs ☐

- d. Don't know ☐
- e. Other programs, please list: ☐ \_\_\_\_\_

### ***General***

Please indicate any additional information of pertinence to the monitoring and evaluation exercise which you feel were not covered in the questions above but which are of particular significance to your country. [\(insert response here\)](#)

### APPENDIX 3: NATIONAL RESPONDENTS TO THE SURVEY QUESTIONNAIRE

COUNTRY	RESPONDENT	POST
Belize	Isaias Majil	Marine Protected Areas Coordinator
Dominica	Norman Norris	Senior Fisheries Officer
Grenada	Justin Rennie	Chief Fisheries Officer
Montserrat	Alwyn Ponteen	Chief Fisheries Officer
Saint Lucia	Allena Joseph	Fisheries Biologist
St Vincent and the Grenadines	Kris Isaac	Senior Fisheries Officer
Trinidad and Tobago	Lara Ferreira	Senior Fisheries Officer

**APPENDIX 4: NATIONAL FOCAL POINTS FOR MONITORING AND REPORTING ON CONTROL ACTIONS**

COUNTRY	DIRECTOR OF FISHERIES/CHIEF FISHERIES OFFICER	RESPONDENT	AFFILIATION	CONTACT
Belize	Beverly Wade	Isias Majil	Ministry of Agriculture, Forest, Fisheries and Sustainable Development	<a href="mailto:im.emu@ffsd.gov.bz">im.emu@ffsd.gov.bz</a> 501 2244552
Dominica	Riviere Sebastien	Norman Norris	Fisheries Division, Ministry of Environment, Natural Resources, Physical Planning and Fisheries	<a href="mailto:nojnorris@gmail.com">nojnorris@gmail.com</a> 767 265 5766
Grenada	Justin Rennie	Olando Harvey	Marine Protected Area Unit, Fisheries Division, Ministry of Agriculture, Lands, Forestry, Fisheries and the Environment	<a href="mailto:landokeri@yahoo.com">landokeri@yahoo.com</a> 473 440 3814
Montserrat	Alwyn Ponteen	Alwyn Ponteen	Fisheries Unit, Department of Agriculture, Ministry of Agriculture, Trade, Lands, Housing and the Environment	<a href="mailto:up669929@myport.ac.uk">up669929@myport.ac.uk</a> ; <a href="mailto:ponteena@gov.ms">ponteena@gov.ms</a> 1 664 491 3529; 1 664 496 1996
Saint Lucia	Sarita Williams-Peter	Allena Joseph	Ministry of Agriculture, Food Production, Fisheries, Cooperatives and Rural Development	<a href="mailto:allena.joseph@govt.lc">allena.joseph@govt.lc</a> 1 758 468 4140/4143
St Vincent and the Grenadines	Jennifer Cruickshank	Kris Isaac	Fisheries Division,	<a href="mailto:kris.isaacs@yahoo.com">kris.isaacs@yahoo.com</a> <a href="mailto:fishdiv@vincysurf.com">fishdiv@vincysurf.com</a> 1 874 456 2738
Trinidad and Tobago	Christine Chan A Shing (Trinidad)  Garth Ottley (Tobago)	Jahson Alemu	The Institute of Marine Affairs	<a href="mailto:jalemu@ima.gov.tt">jalemu@ima.gov.tt</a> 1 868 634 4292 ext 1316 1 868 299 0406 ext 1316

**APPENDIX 5: RESEARCH PAPERS LISTED ON THE GCFI'S WEB PORTAL FOR CRFM MEMBER STATES (BASED ON A SEARCH OF COUNTRY NAMES ONLY AS AT 4 DECEMBER 2015)**

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Green, S.J., I.M. Côté. 2008. Abundance of Invasive Lionfish (*Pterois volitans*) on Bahamian Coral Reefs. 10-14

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Higgs, N.D. 2013. The feeding habits of the Indo-Pacific lionfish *Pterois volitans* at artificial lobster habitats in the Bahamas. 1-5

Indo-Pacific lionfish are larger and more abundant on invaded reefs: a comparison of Kenyan and Bahamian lionfish populations. 2011. . Indo-Pacific lionfish are larger and more abundant on invaded reefs: a comparison of Kenyan and Bahamian lionfish populations. . Biological Invasions 13 (9):2045-2051.

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Johnston, M.W., S. Purkis, R. Dodge 2015. Measuring Bahamian lionfish impacts to marine ecological services using habitat equivalency analysis. Marine Biology 1-12

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- Stevens, J. L., J.B. Olson 2013. Invasive lionfish harbor a different external bacterial community than native Bahamian fishes. . Coral reefs 32 (4): 1113-1121.

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. 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.

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