



Toward a Sustainable Caribbean FAD Fishery

Introducing Lures to Incentivize Co-Management Efforts





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Florida Sea Grant
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(352) 392.2801
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Introducing Lures to Incentivize Co-Management Efforts

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Project Team and Affiliations

Charles Sidman¹, Kai Lorenzen², Andrew Magloire³, Riviere Sebastien³

Florida Sea Grant¹, University of Florida Fisheries and Aquatic Sciences²,
Dominica Fisheries Division³

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Abstract

Fisheries are an important source of food, income and cultural identity for many Caribbean coastal communities. While reef fisheries resources in the Caribbean are frequently overexploited, pelagic resources (fish of the upper water column including tunas and dolphinfish) are less heavily exploited and indeed use of pelagic resources may be further expanded in order to generate much needed social and economic benefits. Efficient harvesting of thinly-distributed pelagic fish is facilitated by the use of fish aggregation devices (FADs). The use of FADs in pelagic fisheries is being promoted in the Caribbean as a way of maintaining or improving local seafood supply while reducing pressure on reef fishery resources.

During a series of meetings conducted by the project partners in 2013 with more than 100 FAD fishers on Dominica, West Indies, the participants voiced concerns that too many small and juvenile fish were being taken from FADs for subsistence and for use as bait to catch larger fish that also associate with FADs. In addition, several species targeted as bait (yellowfin, skipjack and blackfin tunas) are contributors to the local food supply so there is a desire to minimize their capture for use as bait. These actions were believed by many meeting participants to reduce the effectiveness of FADs to yield economic benefits and pose a threat to the long-term sustainability of the FAD fishery itself.

To address these concerns, this project tested the effectiveness of lures as an addition or replacement to the use of bait in Caribbean artisanal FAD fisheries. The introduction of lures tested in this project addresses two interrelated issues that affect the profitability and sustainability of artisanal pelagic FAD fishing: (1) the capture of pelagic baitfish which requires additional effort from the fishermen and reduces the abundance of smaller fish aggregated around FADs that are believed to play a role in attracting larger species and individuals to the FADs, and (2) access and use arrangements for FADs that often lead to sub-optimal harvest of aggregated fish and to conflict among fishers. This project worked with 25 FAD fishers at seven locations on Dominica, West Indies, to determine if lures can be a practical means to address these fishery management issues.

Information on 157 fishing trips was collected during April through December, 2014. The results show that Dominican artisanal fishers use a variety of bait types to target three main species of fish at FADs: dolphinfish, tunas and marlin. The smaller-type lures were effective as a way of capturing smaller species and juvenile target fish at FADs. This generated overall efficiency gains in harvesting. Larger-type lures were less effective than bait in catching larger pelagic fish at FADs. One large lure however appeared to be comparable with bait in the capture of the most preferred target fish, mature dolphinfish.

Having the lures allowed fishing to also occur while transiting to and from FADs. Lures also provided a back-up that allowed fishing to occur during occasions when baitfish, normally caught at FADs, could not be secured. These results suggest that lures can be effective auxiliary gear in the Caribbean FAD fisheries but are unlikely to replace the use of bait.

Introduction

Fisheries are an important source of food, income and cultural identity for many Caribbean coastal communities. While reef fisheries resources in the Caribbean are frequently overexploited, pelagic resources (fish of the upper water column, including tunas and dolphinfish) are exploited by artisanal fishers within sustainable limits and indeed may be further expanded in order to generate much needed social and economic benefits (Guyader, Bellanger, Reynal, Demaneche and Berthou, 2013). Efficient harvesting of thinly-distributed pelagic fisheries resources is facilitated by the use of fish aggregation devices (FADs). FADs are man-made structures that float on or just below the surface of the ocean and attract pelagic fish that may associate with the structure for days or weeks (Figure 1). By concentrating fish in a known location, FADs increase the efficiency of fishing and are widely employed in artisanal and industrial-scale tropical, pelagic fisheries (Klima and Wickham, 1971; Samples and Sproul, 1985). Use of FADs also provides other benefits such as improved safety at sea due to the known fishing locations. Pelagic FAD fisheries are now being promoted in the Caribbean as a way of maintaining or improving local seafood supply while reducing pressure on reef fisheries resources that are often overfished, reducing fisheries productivity, biodiversity and the tourism potential of reefs (Feigenbaum, Frielander and Bushing, 1989; Frielander, Beets and Tobias, 1994).

Florida Sea Grant is working with Caribbean partners to improve livelihoods by creating economic opportunities for Caribbean fishers and the communities that depend on them for food security. Through our partnerships, we are introducing practical tools to promote the profitability, sustainability and co-management of Caribbean FAD fishery resources as a way of improving local seafood availability while reducing pressure on overexploited reef fisheries.

For this project, Florida Sea Grant partnered with the Royal Caribbean Ocean Fund, lure manufacturers, the Caribbean Regional Fisheries Mechanism (CRFM) and the Dominica Fisheries Division to determine if lures, popular in the US sport-fishing industry, can be a practical tool to enhance the profitability, sustainability and co-management of the Caribbean artisanal FAD fishery (see Appendix A for a letter of support from the Dominica Fisheries Division).

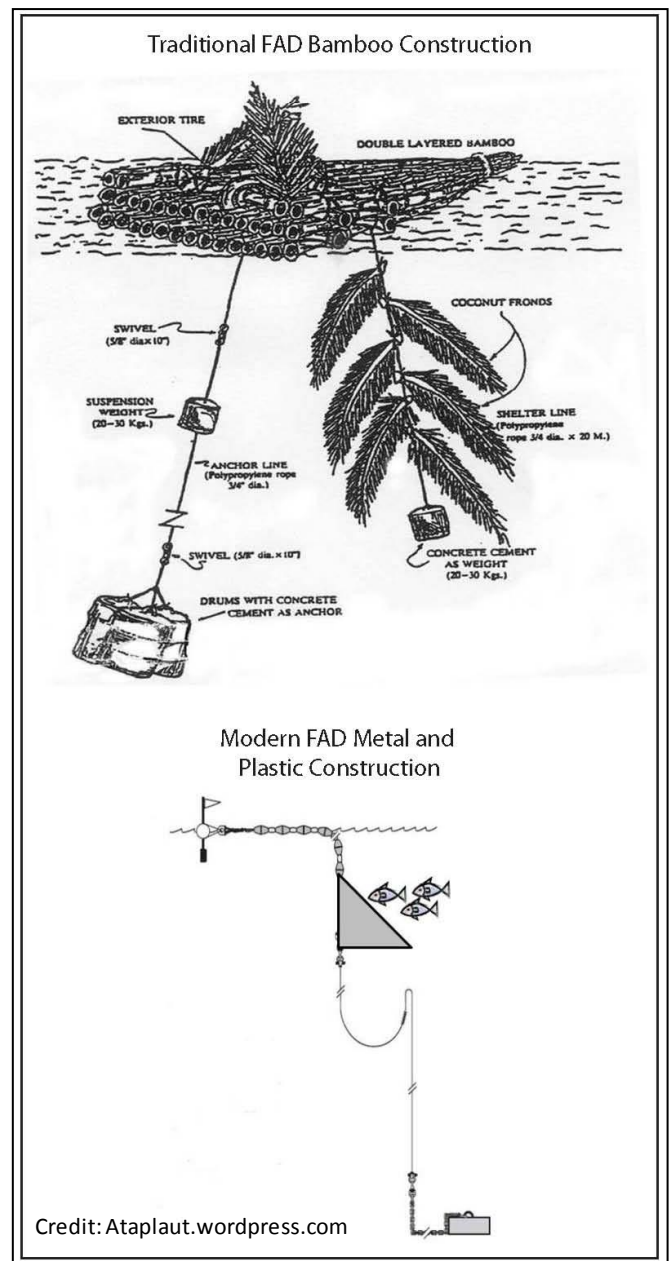


Figure 1. Traditional and Modern FAD Designs.

Through a process of integrated stakeholder engagement (i.e., engagement that is data-driven, where decisions are consensus-based and where outcomes are mutually-beneficial to the stakeholders) lures were introduced as a tool to incentivize co-management efforts by motivating cooperation among fishers and between fishers and fisheries managers (see Appendix B for a diagram of the integrated engagement process).

Project Goal

This project tested the effectiveness of lures as an addition or replacement to the use of bait in Caribbean artisanal FAD fisheries. The introduction of lures addresses two interrelated issues that affect the profitability and sustainability of pelagic FAD fishing: (1) the capture of pelagic baitfish, which requires additional effort from the fishermen and reduces the abundance of smaller fish aggregated around FADs that are believed to play a role in attracting larger species and individuals to the FADs, and (2) access and use arrangements for FADs that often lead to sub-optimal harvest of aggregated fish and to conflict among fishers (Sidman, Lorenzen, Sebastien, Magloire, Chrickshank-Howard, Hazell and Masters,

2014). This project worked with FAD fishers at seven locations on Dominica, West Indies: Fond St. Jean, Dublanc, Marigot, Roseau, Fond Cole', Massacre and Mahaut to test lures as a practical means to address these management issues (Figure 2).

Project Objectives and Activities

Objective 1

Characterize existing bait preferences and artificial lure options for use in Caribbean FAD fishing.

Activities involved interviewing FAD fishers on Dominica to identify baitfish species used. During February-March 2014, Mr. Riviere Sebastien of the Dominica Fisheries Division met with groups of FAD fishers at three landing sites on Dominica in the towns of Fond St. Jean, Dublanc, and Marigot to discuss the types of bait used to target various pelagic fish species at FADs. A questionnaire was developed to collect information from FAD fishers on the types of fish they commonly used as bait to catch various species of pelagic fish at FADs (see Appendix C for the questionnaire).

In addition, consultations with lure manufacturers and fishing experts helped to identify appropriate lure options. During February-March 2014, Aylesworth's Fish & Bait, Inc. organized meetings for the project investigators with lure retailers and manufacturers including L&S Lures and StrikeZone. As a result of these meetings, L&S Lures donated samples of some of its popular MirrOlure offshore sport-fishing lures to the project and StrikeZone provided lure-rigging expertise. MirrOlure samples were augmented by additional lures and tackle purchased from StrikeZone. The equipment was organized into 15 kits, enough to outfit five fishers each from the three phase-one test landing sites (Dublanc, Fond St. Jean and Marigot).

Objective 2

Test the effectiveness of artificial lures relative to bait options with FAD fishers.

Activities involved introducing the lures and a data collection protocol. This involved training small groups of FAD fishers and data collectors on how to use and record use of the lures and implementing field trials with the lures. During April of 2014, a data collection protocol consisting of both trip and monthly logs was developed to (1) quantify the effectiveness of

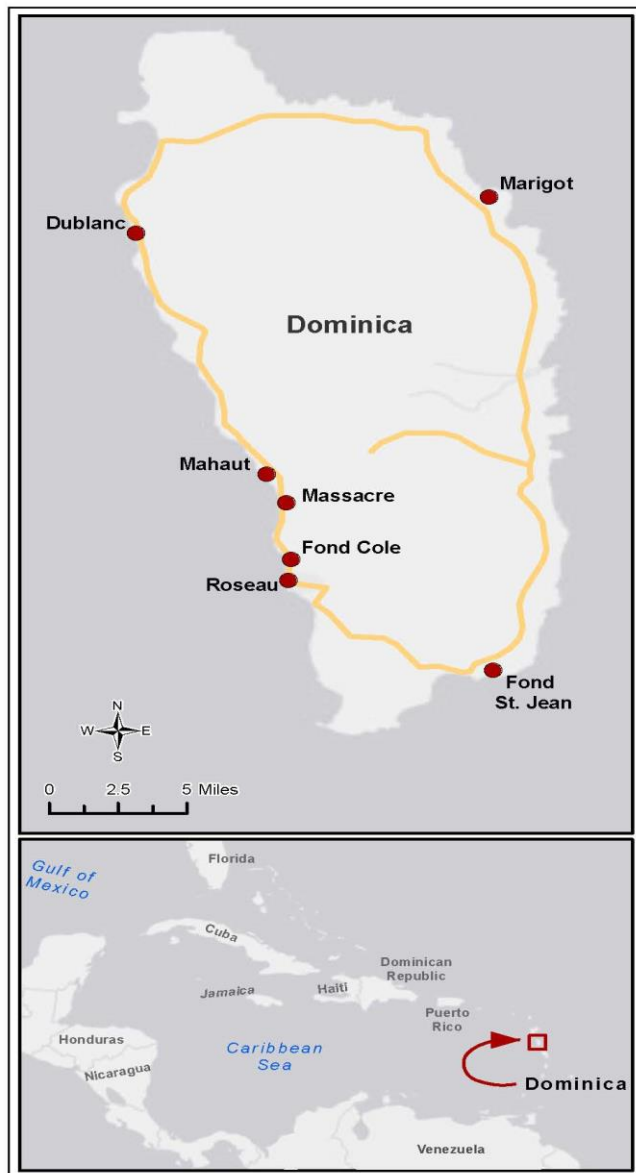


Figure 2. Dominica study locations.



Examples of lures and tackle provided by the L&S Bait Company and StrikeZone.



Introducing the lures and signing pledges – Marigot landing site.

lures relative to bait options during actual fishing trips, and (2) summarize fishing activities on a monthly basis (see Appendix D, E and F for the trip and monthly log forms).

During April of 2014 the project investigators held meetings with participating fishers at the three phase-one test landing sites. The meetings provided a venue to discuss the data collection protocol so that data collectors and fishers were aware of the kinds of information that they would be expected to collect and how to complete the forms. During the meetings the project investigators discussed the use of the fishing lures. A test kit containing examples of each type of lure and tackle provided to the fishers was used to demonstrate the rigging and use (e.g., trolling and jigging) of the lures. Many of the fishers were already familiar with these techniques.

Each fisherman who received lures signed a written pledge stating that they would use the lures

and provide information about their catches (see Appendix G for the pledge form).

Also during April of 2014 the fishing lure kits were distributed to 15 FAD fishers who pledged to participate in the project. Three data collectors who lived in communities near the landing sites were hired to interview the fishers and record information into the trip and monthly logs. Data collection was coordinated by Mr. Sebastien.

1. Implement field trials with smaller-type lures.

During April of 2014 the project investigators participated in sea trials with several of the fishermen who used the lures. This created an opportunity to assess fishing techniques and the data collection protocol.

Fishermen began using the smaller-type lures during May 2014. Unfortunately, fishing was sporadic from May to July. This was due in part to the fact that

several of the FADs had washed away and that fish were scarce. Fishing picked up in August, and additional meetings with the participating fishers were held to remind them of their pledge to use and report on their use of the lures.

2. Introduce larger-type lures for catching adult fish at FADs.

A preliminary analysis of data provided by the fishermen indicated that the initial kits of smaller-type lures were successful in catching smaller fish. A second kit made up of larger-type lures was therefore assembled and given to additional fishers to use.

During October 2014, a FAD fisherman (Mr. Gilbertson Peter) and Mr. Sebastien from Dominica travelled with project staff to C & H Lures in Jacksonville, Florida, where they selected a set of larger-type lures, which were custom made for the project. These lures were assembled into kits and distributed during November 2014 in a second project

phase to 10 additional FAD fishers in the towns of Dublanc, Marigot, Roseau, Mahaut, Fond Cole' and Massacre (Figure 2).

Objective 3

Support co-management arrangements for resolving access and use conflicts.

Activities involved implementing an integrated stakeholder engagement strategy that incentivized cooperation and information sharing among FAD fishers and between FAD fishers and fisheries managers. The idea of using lures to increase the efficiency and sustainability of FAD fishing originated from prior meetings with FAD fishers held by the project investigators and the Dominica Fisheries Division. The fishers embraced the idea and were eager to try the lures.

Fishers were engaged in the design and purchase of custom lures for the project. One of the participating FAD fishers was invited to visit the lure



Distributing the lures and tackle to Dublanc and Marigot FAD fishers.



Fond St. Jean FAD fishers receiving lures and tackle.

manufacturers with project staff. He helped to select the lures and upon returning to Dominica he helped to teach the other fishers how to use the lures. The fishing lures and tackle incentivized collaboration among fishers, who normally act independently, to share information and work cooperatively.

Fishers routinely are asked to provide information about their catches to Fisheries Officers but are frustrated that they don't benefit in return for this effort. Introduction of the lures offered a tangible benefit to fishers to participate in the project and provided a positive interaction with government, motivating cooperation and information sharing.

Project Communications and Visibility

The Florida Sea Grant communications director discussed methods of showcasing the partnership and the project with Royal Caribbean corporate

communications. An initial project notice was posted as a feature story on the Florida Sea Grant website. This story summarized the project goals and included some pictures of FAD fishing.

In addition, the project has been presented at three regional meetings hosted by the French-sponsored MAGDELESA (Moored Fish Aggregating Device in the Lesser Antilles) project, the CRFM and the Japan International Cooperation Agency – (JICA) (April 2014, September 2014 and December 2014). Those meetings, which focused on FAD co-management issues, were attended by international donor organizations, NGOs, the CRFM and Chief Fisheries Officers representing 17 Caribbean island nations.



Introducing large lures to Roseau fishers.



Fisheries officer discussing use of the large lures.



Lure Types Tested by FAD Fishers

Smaller-type Lures Tested

During the first project phase (April to October 2014) 15 FAD fishers from the towns of Dublanc, Marigot and Fond St. Jean received kits containing a variety of smaller-type MirrOlure lures from L&S Bait, Inc., St. Petersburg, Florida.

The kits included a variety of “cup” and “bullet” head lures from the manufacturers Ilander line. The cup-shaped lures are designed to wiggle up and down as they are pulled through the water. The bullet-shaped lures are designed to produce bubbles as they are pulled through the water. Kits contained several examples each of the smaller-type lures (Table 1).

In addition to smaller-type lures, fishers received several flyingfish lures and a package of five squid-like lures (Table 1). All of the lures tested came pre-rigged with stainless steel hooks, monofilament leader, non-chafing sleeves and clasps. Some lures

also came pre-rigged with spikes to attach ballyhoo and other baitfish.

Larger-type Lures Tested

During the second phase of the pilot project (November to December 2014) 10 FAD fishers from the towns of Roseau, Fond Cole’, Massacre, Dublanc, Marigot and Mahaut were introduced to a variety of larger-type lures, sourced from C&H Lures, Inc., Jacksonville, Florida. The larger lures were customized and rigged by the manufacturer based on consultation with an experienced FAD fisher and a Dominica Fisheries Officer. Additional materials were sourced from StrikeZone, Inc., Jacksonville, Florida. The lures were assembled as kits inside a custom-made tote for storage. Mr. Gilbertson Peter, the FAD fisher who accompanied the project team to the lure manufacturers, explained tips for using the lures to the other fishers. An illustration and description of the larger-type lures tested is provided in the Table 2.



Field trials.



Selecting larger-types of lures.

Smaller-sized Lures Tested	Size	Description	Target Species
	8.5 inches long	Rapala magnum lure – dives up to 30 feet deep.	King mackerel and wahoo
	4.0 inches long	Ilander “Tracker” lure - bullet and cup head versions.	Skipjack tuna, yellowfin tuna, blackfin tuna
	6.5 inches long	Ilander “Junior” lure – bullet and cup head versions.	Yellowfin tuna and blackfin tuna
	6.5 inches long	Ilander “Mistress” lure – bullet and cup head versions.	Dolphinfish
	8.5 inches long	Ilander “Ilander” lure – bullet head version.	Wahoo, dolphinfish, yellowfin tuna
	10 inches long	Ilander “Express” – cup head version.	Dolphinfish and marlin
	6.5 inches long	Flyingfish-type lure.	Dolphinfish, tuna, king mackerel, wahoo, marlin
	Five 6 inch long squid rigged in tandem	Squid-type lure.	Used as “teasers” in combination with other lures to increase fishing success

Table 1. Smaller-type lures tested.





Larger-type Lures Tested	Size	Description	Target Species
 <p>VANATU 50 (DOLPHIN FISH) (large slant head; double hook) - pink & white - blue, silver, pink & white</p>	12 inches long – one in kit	Vanatu 50. Wedge-shaped head produces movements in the water while trolling.	Dolphinfish
 <p>ALIEN (DOLPHIN FISH) (round head; single hook; ballyhoo tie) - pink, white & blue - pink, purple & silver</p>	12 inches long – set of two in kit	Alien. Hexagonal head generates irregular movements in the water while trolling. Two color combinations were tested.	Dolphinfish and tuna
 <p>JET HEAD (TUNA) (cone head; single hook; ballyhoo tie) - pink, purple & silver - pink, blue & yellow</p>	12 inches long — one in kit	Jet-Head. Bullet- shaped head with holes produces bubbles while trolling. Two color combinations were tested.	Tuna
 <p>BILLY BAIT (TUNA) (medium slant head; single hook) - pink & silver</p>	14 inches long – set of two in kit	Billy-Bait. Wedge shaped head with holes produces irregular movements and bubbles in the water while trolling.	Tuna

Table 2. Large-type lures tested.

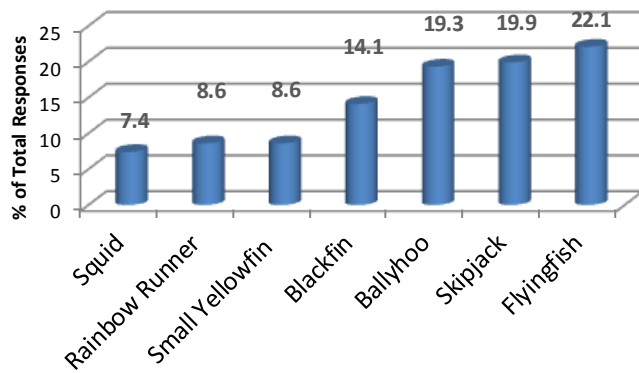


Figure 3. Preferred types of baitfish used by Dominica FAD fishers

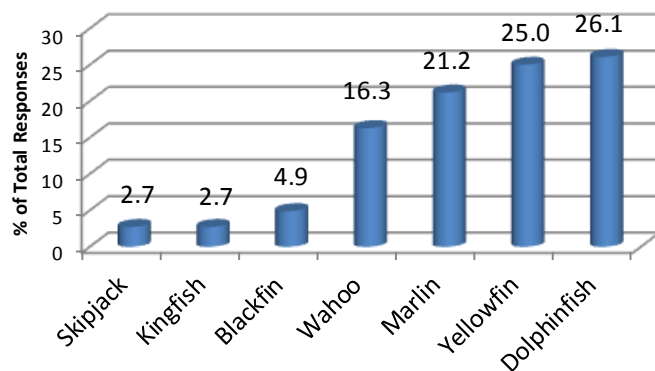


Figure 4. Popular types of fish targeted by Dominica FAD fishers

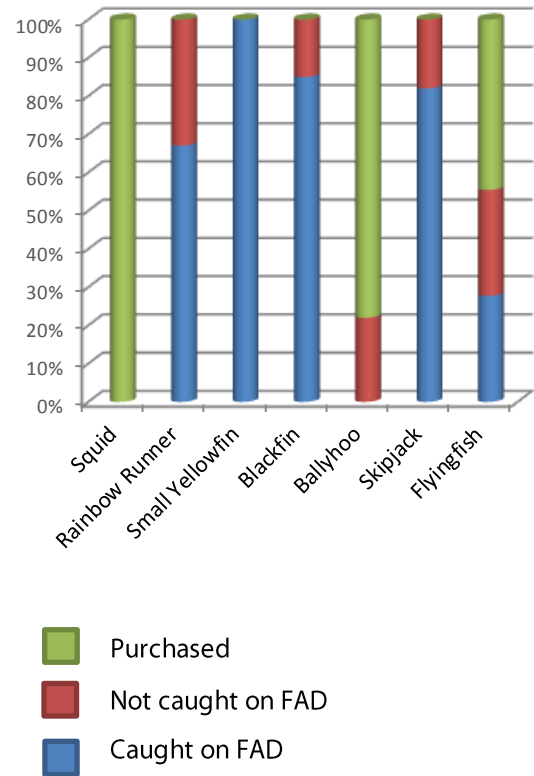


Figure 5. How baitfish are obtained

Results and Discussion

Bait and Target Species Characterization

The results, which helped to determine the most appropriate lures to test, indicate that some differences exist between the three study locations in the kinds of fish used for bait and targeted for subsistence. For example, Marigot fishers targeted small yellowfin tuna as bait. Dublanc and Fond St. Jean fishers targeted skipjack and small blackfin tunas for bait. This points to differences in availability of bait species at the study locations. Despite these differences, most fishers use similar types of bait (e.g., ballyhoo, skipjack tuna, and flyingfish— Figure 3) to target their favorite types of fish (e.g., marlin, yellowfin tuna and dolphinfin— Figure 4). Figures 3 and 4 graph the percentage of the 20 FAD fishers surveyed who reported a preference for specific types of baitfish and target species. Most small tunas used for bait (skipjack, blackfin and juvenile yellowfin) are caught on the FADs (Figure 5). These small tunas are then typically used to catch the larger fish.

Conversely, squid (which is not used often) and ballyhoo are typically purchased. Flyingfish can be caught on a FAD, not on a FAD (i.e., in the open water), but are mostly purchased.

Smaller-type Lure Test Results

The smaller-type lures were used by fishermen primarily to catch small skipjack, blackfin and juvenile yellowfin tunas for use as bait for larger dolphinfin, tunas and marlin. This meant that on most trips the smaller lures were used only for brief periods of about an hour or less. In contrast, bait was used for periods of between 3-8 hours to target larger pelagic fish.

Use of smaller-type lures resulted in catches of baitfish (e.g., skipjack and blackfin tuna) similar to those obtained using bait, but much lower catches of marlin, yellowfin tuna and dolphinfin (Figure 6). This suggests that smaller-type lures were more selective for skipjack and blackfin tuna and less so for the other species than bait. It is noteworthy that

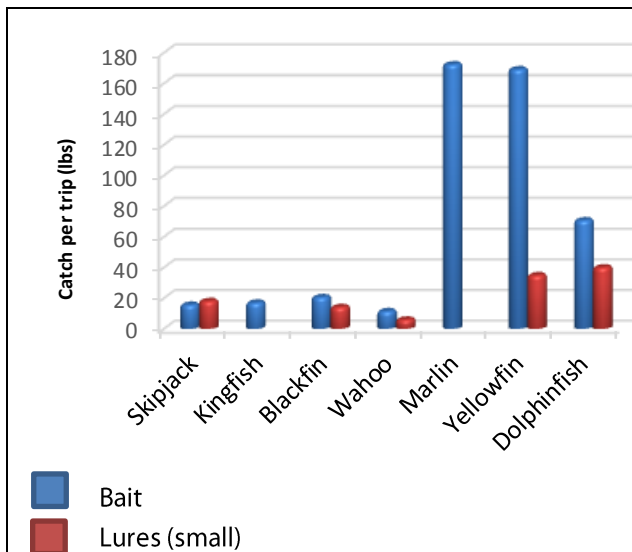


Figure 6. Catches on smaller-sized lures and bait

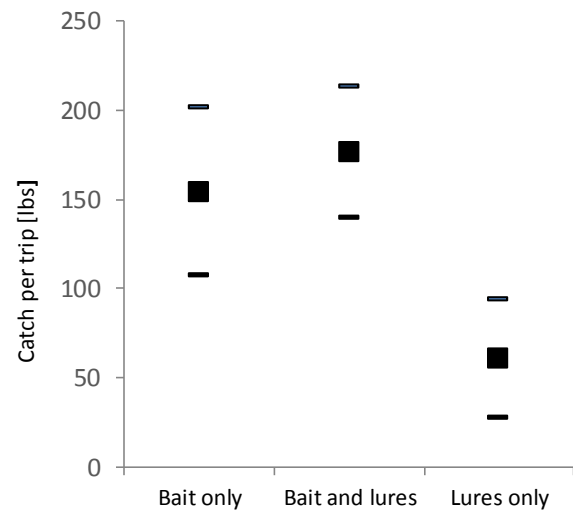


Figure 7. Catch per trip

baitfish harvest accounted for only a small proportion (7%) of the total harvest by weight during the study period. Importantly, addressing the issue of resource sustainability, the results show that availability of smaller-type lures does not affect the amount of baitfish harvested in the fishing operations.

Catches per trip were significantly lower on trips that involved fishing with lures only, compared to trips that involved fishing with bait only or with bait and lures. Catches on trips involving fishing with bait and lures were the highest on average, but not significantly higher than those obtained during bait-only trips (Figure 7).

Larger-type Lure Test Results

Catch rates achieved using larger-type lures were significantly lower than those achieved using bait (Figure 8). However, catch rates for dolphinfish, the most preferred target were comparable between bait and the Alien lure (Figure 9).

The species composition of catches obtained using larger-type lures and bait differed substantially, with larger-type lures being more selective for dolphinfish and less so for yellowfin tuna and marlin (Figure 8). Catch rates obtained using larger-type lures increased slightly over the first 5-10 days following their introduction (Figure 10). This suggests that fishermen may need time to become familiar with the use of the larger-type lures.

Most fishers had prior experience using smaller-type lures to catch baitfish. Conversely, the fishers

had less experience using the larger-type lures to target the adult fish.

The data show that fishers used bait for periods three times longer, on average, than they used the smaller-type and larger-type lures. Moreover, fishers tended to deploy lures with only one or at most two lines at a time. This is compared with the use of four to six lines typically deployed with bait to catch the larger fish.

1. It is recommended that fishers use the larger-type lures for longer periods of time in order to more effectively compare lure catch rates with bait options.
2. It is recommended that fishers deploy lures using more lines to approximate fishing effort using bait.
3. It is recommended that more lures be provided to the fishers so that they can deploy more lines while trolling.

Fish caught with bait averaged 83 lbs while fish caught with smaller-type and larger-type lures averaged 25 lbs. The lower numbers for lures is related to the fact that of the 82 trips recorded using large lures only 30 resulted in catches - several fishers commented that they hooked but lost large fish while using the larger lures. This result is compared to the use of bait, which yielded catches on 77 of the 82 trips. The number of trips on which fish were caught with smaller-type lures was comparable to that when bait was used (~75 trips).

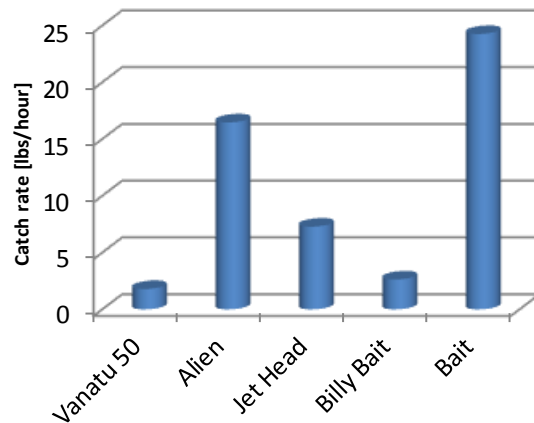
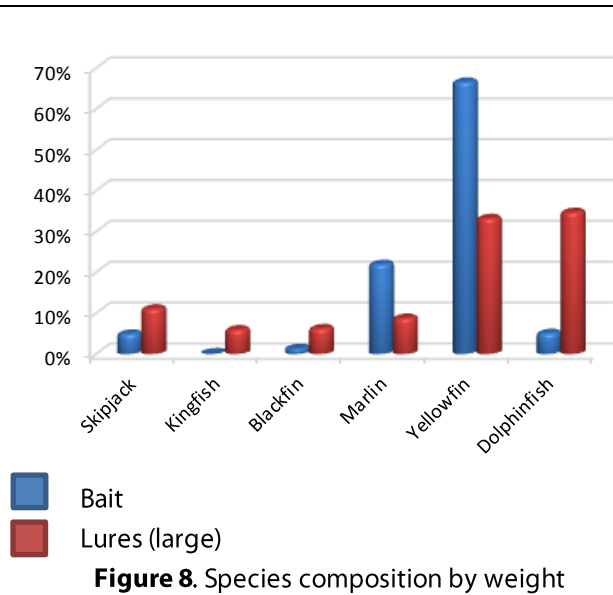
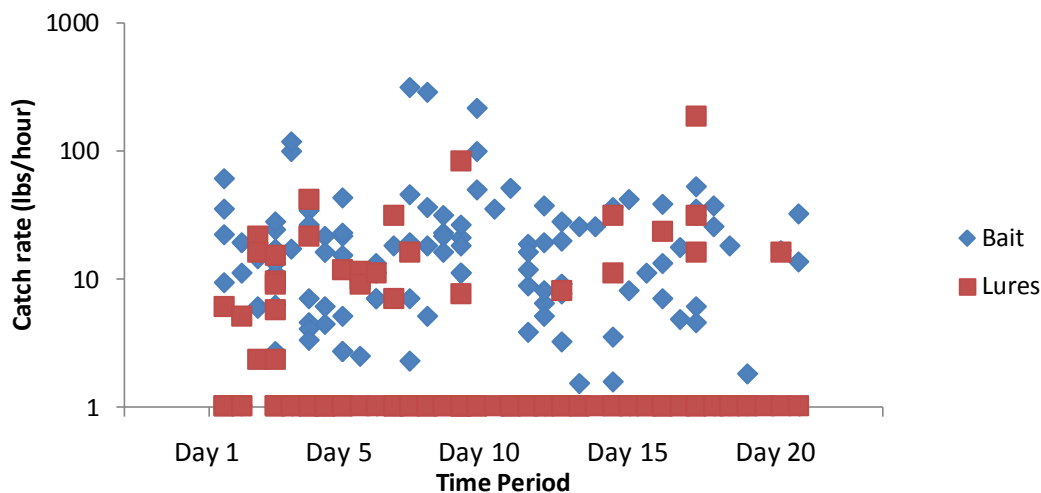


Figure 9. Catch rates achieved by fishermen with large lures and with bait



These results show that fishing with bait is much more reliable than fishing with the large-type lures. Moreover, even when the number of days that fish were caught - using a combination of smaller-type lures and bait - are equal, bait yielded much larger catches (in average pounds of fish caught). This result is explained by the fact that the smaller-type lures were mainly used to catch smaller fish for bait, while bait was then used to catch larger fish.

1. It is recommended that additional training be given to fishers on rigging and trolling techniques for the use of the larger-type lures, particularly when targeting tuna.

Due to the short duration of the project, smaller-type lures were only evaluated during a six-month

period from late April through early October, 2014. Larger-type lures were introduced and tested during a two-month period from November to December, 2014. Almost all of the 25 fishers who received the lures reported that they needed more time to experiment with the lures to more accurately assess their effectiveness. Many of the fishers reported that they intended to continue to use the lures and were optimistic that with time (e.g., during peak dolphin and tuna seasons) the lures would prove to be effective in catching the larger fish.

2. It is recommended that the lures be evaluated for a longer period of time to account for probable differences in use tactics, use periods, catch rates and success over several fishing seasons.

According to the lure manufacturers tunas are more selective in attacking the lures than dolphinfish and marlin, which are more aggressive. Tunas also have better vision and can potentially see thicker line and rigging. They also are more wary of the presence of boats and may avoid feeding in close proximity to them.

3. According to consultations with StrikeZone it is recommended that fishers downsize the rigging of lures (i.e., rig with longer leader line and select lighter monofilament line) especially when targeting tunas.

Wider Benefits

The results suggest that lures can increase fishing efficiencies but are not a replacement for the use of bait. Specifically, the results show that availability of smaller-type lures does not seem to affect the amount of fish harvested at FADs for bait in the fishing operations. Additionally, the use of larger lures was not as immediately effective as bait used during the short trial period. However, with extended use, the larger lures may eventually boost FAD fishing efficiency and sustainability by directing fishing effort toward the larger adult fish. In keeping with this, the following project benefits are summarized:

1. Engagement of stakeholders in research on the use of fishing lures was impressive. The concept of using lures resulted from earlier discussion with FAD fishers. As a result, the fishers eagerly participated in the project.
2. Results suggest that lures (both smaller and larger) can augment, but not fully replace the use of bait. Smaller-type lures are shown to be as effective as bait in catching smaller fish, increasing fishing efficiencies by reducing the costs and time spent trolling for bait.
3. The availability of the smaller lures did not seem to increase the take of small fish normally harvested in FAD fishing operations for bait. This indicates that use of lures does not adversely affect the sustainability of the FAD fishery by increasing the harvest of small and juvenile fish over and above the number taken by other means. As fishers continue to gain experience with using the lures to target larger adult fish, lures may prove to be an effective tool for improving the sustainability of FAD fishing.

4. One of the larger lures (Alien) holds potential to be as effective as bait in the capture of dolphinfish, the most preferred target species. Lures also increase the opportunity for catching fish by allowing fishers to troll on the way out to and back from FADs.
5. Mutually beneficial outcomes were achieved for government and fishermen by introducing lures as a tool that stakeholders could use to improve the efficiency of fishing and create a platform for information-sharing, collaboration, and commitment to a shared-governance process.

Acknowledgments

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Appendix A. Dominica Fisheries Division letter of support.



COMMONWEALTH OF DOMINICA

MINISTRY OF AGRICULTURE AND FISHERIES
FISHERIES DIVISION

Tel: (767) 266 5291 / 448 0140
Fax: (767) 448 0140
E-mail: fisheriesdivision@dominica.gov.dm
Website: www.dominica.gov.dm

Roseau Fisheries Complex Bldg.
Dame Mary Eugenia Charles
Blvd.
Roseau
Commonwealth of Dominica

January 29, 2015

Mr. Miguel Pena
Senior Analyst, Sustainability Programs
Royal Caribbean Cruises Ltd.
1080 Caribbean Way
Miami, FL 33132

Dear Mr. Pena,

On behalf of the Fisheries Division of Dominica and the fisherfolk of Dominica I write to express gratitude for The Ocean Fund support to enhance the productivity and sustainability of our offshore fishery.

Dominica fishers were among the first in the Caribbean region to use fish aggregation devices (FADs) to attract offshore fish, including tunas and mahi mahi. The use of FADs has greatly improved our fishing, and allows our fishers to provide food for their communities that more and more depend on their success.

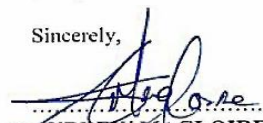
The benefits are great, but we recognize that their success has led to concerns among fisheries scientists and public sector agencies that protect Caribbean coastal and ocean resources. We know that unmanaged use of FADs may lead to conflicts among greater numbers of fishers who compete for fish that are attracted by these systems, and lead to a condition in which fish stocks may become overexploited.

Support from Florida Sea Grant and The Ocean Fund allowed us to commence research activities that seek to develop mechanisms that can contribute to strengthen shared-governance of the fishery. Support from the Ocean Fund allowed our Fisheries Officers to work collaboratively with the FAD fishing community to test the potential of using lures in the fishery. The fishers eagerly embraced the idea of using lures to test the potential to reduce the take of small and juvenile fish at FADs for use as bait and subsistence, thereby, reducing the ability of the FAD structure to attract the larger fish.

The results of the pilot project are generally positive. The introduction of the lures provided a mutually beneficial opportunity for our Fisheries Officers to collaborate with the fishing community. During the trials some lures worked well allowing fishers to effectively catch small fish, typically used for bait. On the other hand, the larger lures were not as effective as using bait to catch larger fish. Nevertheless, having the lures generally extended fishing opportunities by allowing fishing to occur during times when bait could not be caught and during the long journey to and from FADs. The general consensus among the fishers is that the lures will eventually be effective in targeting the larger fish, given that they devote more time to fishing with the lures and to experimenting with various rigging and trolling techniques.

We look forward to continuing as a partner in this collaboration to pilot practical tools that can benefit fishers from other Caribbean island nations who would like to transition to offshore fishing.

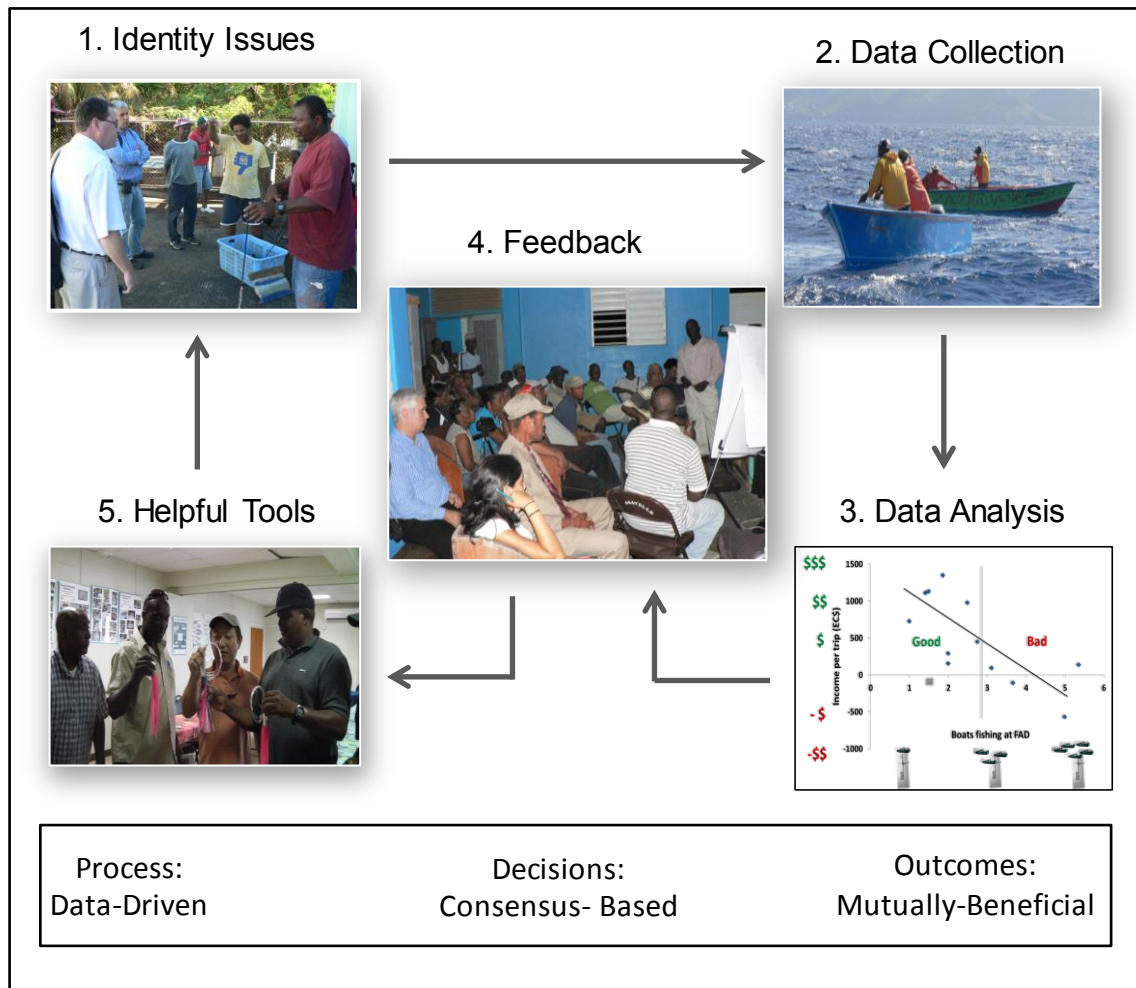
Sincerely,


ANDREW MCGLOIRE
CHIEF FISHERIES OFFICER








"An Efficient Service, A Sustainable Future"

Appendix B. Integrated stakeholder engagement process.



Appendix C. Baitfish use questionnaire.

    Types of Bait Used in Pelagic FAD Fishing 								
Landing Site (check appropriate box) <input type="checkbox"/> Fond St. Jean <input type="checkbox"/> Dublanc <input type="checkbox"/> Marigot <input type="checkbox"/> Other landing site (write name)								
Fisher's Name								
FORM 1 Characterization of Fishing Timing and Location								
Target Fish	Types of Baitfish Used to Catch Target Fish						Other Baitfish Used	
	Rainbow Runner	Ballyhoo	Flying fish	Squid	Small Blackfin Tuna	Skipjack Tuna	1. Other	2. Other
Yellowfin Tuna	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased
Blackfin Tuna	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased
Skipjack tuna	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased
Bonito	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased
King Fish	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased
Wahoo	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased
Marlin	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased
Dolphin fish	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased
Other	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased
Other	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased	<u>Bait Caught</u> <input type="checkbox"/> On FAD <input type="checkbox"/> Not on FAD <input type="checkbox"/> Purchased

Question 1. Have you ever used an artificial lure to catch baitfish (☐ yes ☐ no)?

Question 2. Have you ever used an artificial lure to catch offshore pelagic fish (☐ yes ☐ no)?

Question 3. How much time do you typically spend fishing for bait on fishing trips? Hours _____ minutes _____

Question 4. About how many of the following types of baitfish do you typically purchase and/or catch while on fishing trips?

Baitfish Type	Estimated <u>NUMBER</u> of baitfish used per fishing trip		
	Number of Baitfish Purchased	If NOT purchased: Number of baitfish caught on or near a FAD	If NOT purchased: Number of baitfish not caught on or near a FAD
Rainbow Runner			
Ballyhoo			
Flying Fish			
Squid			
Small Blackfin tuna			
Skipjack tuna			
Other Baitfish Used (from table above)	Number of Baitfish Purchased	If NOT purchased: Number of baitfish caught on or near a FAD	If NOT purchased: Number of baitfish not caught on or near a FAD
1.			
2.			

Appendix D. Small and medium lure fishing trip log form.

Evaluating Lures Used for FAD Fishing							
Date:							
Landing Site (check box): <input type="checkbox"/> Fond St. Jean <input type="checkbox"/> Dublanc <input type="checkbox"/> Marigot <input type="checkbox"/> Other (specify)							
Fisher's Name (Print):							
Lure Type Used: <input type="checkbox"/> Small <input type="checkbox"/> Medium <input type="checkbox"/> Large <input type="checkbox"/> Diving <input type="checkbox"/> Flying Fish				Sea State: : <input type="checkbox"/> Calm <input type="checkbox"/> 1-2 <input type="checkbox"/> 2-3 <input type="checkbox"/> 3-5 <input type="checkbox"/> 6 foot + Wind Direction:			
Lures Used				Baitfish Used			
Start Time:				Start Time:			
End time:				End Time:			
Number of Lines Used:				Number of Lines Used:			
Target Fish	Number of Fish Caught	Pounds of Fish Caught	On FAD	Target Fish	Number of Fish Caught	Pounds of Fish Caught	On FAD
Yellowfin Tuna			<input type="checkbox"/> Yes <input type="checkbox"/> No	Yellowfin Tuna			<input type="checkbox"/> Yes <input type="checkbox"/> No
Blackfin Tuna			<input type="checkbox"/> Yes <input type="checkbox"/> No	Blackfin Tuna			<input type="checkbox"/> Yes <input type="checkbox"/> No
Skipjack Tuna			<input type="checkbox"/> Yes <input type="checkbox"/> No	Skipjack Tuna			<input type="checkbox"/> Yes <input type="checkbox"/> No
Bonito			<input type="checkbox"/> Yes <input type="checkbox"/> No	Bonito			<input type="checkbox"/> Yes <input type="checkbox"/> No
King fish			<input type="checkbox"/> Yes <input type="checkbox"/> No	King fish			<input type="checkbox"/> Yes <input type="checkbox"/> No
Wahoo			<input type="checkbox"/> Yes <input type="checkbox"/> No	Wahoo			<input type="checkbox"/> Yes <input type="checkbox"/> No
Marlin			<input type="checkbox"/> Yes <input type="checkbox"/> No	Marlin			<input type="checkbox"/> Yes <input type="checkbox"/> No
Dolphin fish			<input type="checkbox"/> Yes <input type="checkbox"/> No	Dolphin fish			<input type="checkbox"/> Yes <input type="checkbox"/> No
Other			<input type="checkbox"/> Yes <input type="checkbox"/> No	Other			<input type="checkbox"/> Yes <input type="checkbox"/> No

Appendix E. Larger lure fishing trip log form.

Evaluating Lures Used for FAD Fishing: <i>Phase 2 - Large Lure Field Test 2014</i>												
Date:												
Landing Site (check box): <input type="checkbox"/> Roseau <input type="checkbox"/> Dublanc <input type="checkbox"/> Massacre <input type="checkbox"/> Mahaut <input type="checkbox"/> Fond Cole <input type="checkbox"/> Other												
Fisher's Name (Print):												
Lure Type Reference: (1) Vanatu 50 (2) Alien (3) Jet Head (4) Billy Bait (5) Micro-Mini (6) Tube (7) Rapala												
Lures							Bait					
Time spent fishing with lures:							Time spend fishing with bait:					
Hours <input type="text"/> Minutes <input type="text"/>							Hours <input type="text"/> Minutes <input type="text"/>					
Type of Fish Caught	Lure Types Used	Pounds of Fish Caught					On FAD	Type of Fish Caught	Pounds of Fish Caught	On FAD		
Yellowfin Tuna	1 2 3 4 5 6 7	1 <input type="text"/>	2 <input type="text"/>	3 <input type="text"/>	4 <input type="text"/>	5 <input type="text"/>	<input type="checkbox"/> Yes <input type="checkbox"/> No	Yellowfin Tuna		<input type="checkbox"/> Yes <input type="checkbox"/> No		
Blackfin Tuna	1 2 3 4 5 6 7	1 <input type="text"/>	2 <input type="text"/>	3 <input type="text"/>	4 <input type="text"/>	5 <input type="text"/>	<input type="checkbox"/> Yes <input type="checkbox"/> No	Blackfin Tuna		<input type="checkbox"/> Yes <input type="checkbox"/> No		
Skipjack Tuna	1 2 3 4 5 6 7	1 <input type="text"/>	2 <input type="text"/>	3 <input type="text"/>	4 <input type="text"/>	5 <input type="text"/>	<input type="checkbox"/> Yes <input type="checkbox"/> No	Skipjack Tuna		<input type="checkbox"/> Yes <input type="checkbox"/> No		
Dolphin fish	1 2 3 4 5 6 7	1 <input type="text"/>	2 <input type="text"/>	3 <input type="text"/>	4 <input type="text"/>	5 <input type="text"/>	<input type="checkbox"/> Yes <input type="checkbox"/> No	Dolphin fish		<input type="checkbox"/> Yes <input type="checkbox"/> No		
King fish	1 2 3 4 5 6 7	1 <input type="text"/>	2 <input type="text"/>	3 <input type="text"/>	4 <input type="text"/>	5 <input type="text"/>	<input type="checkbox"/> Yes <input type="checkbox"/> No	King fish		<input type="checkbox"/> Yes <input type="checkbox"/> No		
Marlin	1 2 3 4 5 6 7	1 <input type="text"/>	2 <input type="text"/>	3 <input type="text"/>	4 <input type="text"/>	5 <input type="text"/>	<input type="checkbox"/> Yes <input type="checkbox"/> No	Marlin		<input type="checkbox"/> Yes <input type="checkbox"/> No		
Other	1 2 3 4 5 6 7	1 <input type="text"/>	2 <input type="text"/>	3 <input type="text"/>	4 <input type="text"/>	5 <input type="text"/>	<input type="checkbox"/> Yes <input type="checkbox"/> No	Other		<input type="checkbox"/> Yes <input type="checkbox"/> No		
No Fish Caught	1 2 3 4 5 6 7	1 <input type="text"/>	2 <input type="text"/>	3 <input type="text"/>	4 <input type="text"/>	5 <input type="text"/>	<input type="checkbox"/> Yes <input type="checkbox"/> No	No Fish Caught		<input type="checkbox"/> Yes <input type="checkbox"/> No		

Appendix F. Monthly fishing log form.

Monthly Lure Use Status Survey

During April we introduced a variety of lures to FAD fishers who agreed to use the lures and report on the effectiveness of the lures. We provided data collectors with forms to collect information from a small sample of fishers on the use and effectiveness of the lures.

We would like data collectors to discuss the following questions with **EACH** of the five participating fisherman at your site and complete this project status questionnaire with the information that they provide. For example, at the end of every month interview and complete this form for **EACH** of the five fishermen who received lures.


Landing Site: ☐ Fond St. Jean ☐ Dublanc ☐ Marigot

Fisher's Name: _____.

During the month of **June** ☐ **July** ☐ **August** ☐ **September** ☐ **October** ☐ **November** ☐ (check month)

1. How many days did you go fishing? _____.
2. How many days did you use the lures? _____.
3. On fishing trips how much time did you spend using lures? hours _____ minutes _____
4. On fishing trips how much time did you spend using bait? hours _____ minutes _____
5. On fishing trips did you typically use the lures and bait at the same time? ☐ Yes ☐ No
6. Which lure or lures were the **most effective** in catching fish? Check top two options.
☐ Diving Lure ☐ Small lure ☐ Medium lure ☐ Large lure ☐ Flying fish ☐ Squid
7. Which lure or lures were the **least effective** in catching fish? Check top two options.
☐ Diving Lure ☐ Small lure ☐ Medium lure ☐ Large lure ☐ Flying fish ☐ Squid
8. What types of fish did you mainly catch with the lures? Check all options that apply.
☐ Yellowfin ☐ Blackfin ☐ Skipjack ☐ Bonito
☐ King fish ☐ Marlin ☐ Dolphin ☐ I did not catch any fish with the lures
9. Did you mainly catch adult or juvenile fish with the lures? ☐ Adult ☐ Juvenile
10. Were the lures as effective as bait in catching fish?
☐ Not as effective ☐ As effective ☐ More effective
11. Will you continue to use the lures in June and July? ☐ Yes ☐ No
12. What would you like us to know about the usefulness of using lures for fishing?

Appendix G. Project participation pledge form.

					
<h3 style="margin: 0;">Pledge</h3> <p style="margin: 10px 0;">I _____ acknowledge receipt of lures and tackle provided the Royal Caribbean Ocean Fund, in partnership with L&S Lures, the Dominica Fisheries Division, Florida Sea Grant, and the Caribbean Regional Fisheries Mechanism. I agree to provide data to the project each time I use the equipment for the duration of the project.</p> <table style="width: 100%; margin-top: 40px;"><tr><td style="width: 50%; vertical-align: bottom; padding-bottom: 10px;">_____ Participant's Signature</td><td style="width: 50%; vertical-align: bottom; padding-bottom: 10px;">_____ Date</td></tr><tr><td style="width: 50%; vertical-align: bottom; padding-bottom: 10px;">_____ Witness Signature</td><td style="width: 50%; vertical-align: bottom; padding-bottom: 10px;">_____ Date</td></tr></table>		_____ Participant's Signature	_____ Date	_____ Witness Signature	_____ Date
_____ Participant's Signature	_____ Date				
_____ Witness Signature	_____ Date				



Science Serving Florida's Coast



Florida Sea Grant College Program
University of Florida
PO Box 110409
Gainesville, FL, 32611
(352) 392-5870
www.flseagrant.org