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Photo credit: Croy McCoy

COUNTRY: Cayman Islands

PROJECT TITLE: Measuring the Impact of the Red Lionfish (*Pterois volitans* Linnaeus) on local reef fish assemblages-Cayman Islands

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ACKNOWLEDGEMENTS:
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Brac Reef Beach Resort
Little Cayman Beach resort

SURVEY TEAM

Croy McCoy (DoE)
Laura Richardson (Intern)
Monique Grol (Intern)
Paul Chin (DoE)
Natasha Pisani

DATA COMPILATION

Croy McCoy

FUNDING

JNCC funding: £8,500.00
Darwin Initiative: £4,924.22

PROJECT DESCRIPTION:

This project was successful in assessing the current population of 63 target species, which are considered ecologically important to coral reef health and function. Overall, the project established the abundance, size and community structure estimates around all three islands during the set survey period (January-March 2011).

PROBLEMS and RESOLUTION

1. Inclement weather at times delayed surveys. This was anticipated and adjusted for by surveying as the weather allowed, until all surveys were completed. However it would be beneficial to conduct future surveys during the summer months when conditions are more predictable in addition to calmer seas. The deeper sites posed a problem due to depth limiting bottom time to conduct surveys. However in cases where time was anticipated to exceed safe limits, a safety tank was deployed at 5m to be readily available to surveyors to ensure safety.
2. Surveying was carried out during the months of January through to March 2011, between 900 hours and 1600 hours. To assess the population of the 63 target species (Table 1.), 27 sites in Grand Cayman (Figure 1), 16 sites in Little Cayman (Figure 4) and 12 sites around Cayman Brac (Figure 6) were chosen. Half of the studied sites in Little Cayman and Cayman Brac were within their MPAs, which represent 8 sites at Little Cayman and 6 sites at Cayman Brac. However in Grand Cayman, with the Marine Protected Area (MPA) located on the western side, 27 sites were chosen with 9 inside and 18 sites outside of its MPA to achieve a good spread of sample sites around the island (Figure 1). Fish counts were made at two depths; one on the deep terrace reef (16-18 meters) and one on the shallow terrace (10-12 meters), except for the north side of Little Cayman where the deep terrace is missing and the shelf edge rarely exceeds 10 m within the Marine Park, forcing all surveys to be done within the 10-12metre depth contour to be compatible. At each site, three 50m x 5m belt transects were positioned centrally on top of reef spurs on the deep terrace or along constant reef parallel to the shore for the shallow reef terrace sites whereby reducing variance associated with habitat heterogeneity (variable rugosity and/or substrate type).
3. The surveyor swam along transects with a graduated PVC T-bar and recorded the number of individuals, species and total length of fish (in 9 size classes of 5 centimeter increments), within 2.5meters on either side of the transect line and 5 m above it. Target fish crossing the transect belt were identified and counted, with 63 coral reef species, belonging to 16 fish families, constituting the list of targeted fish species (Table 1.)
4. Marine environments, and their associated organisms such as the reef fishes represent vulnerable ecosystems and resources, affected by human activities such as overfishing, habitat physical degradations, pollution and natural perturbations including recurrent hurricanes in particular the Caribbean region.

Perhaps the most recent notable negative impact on fish populations has been the introduction of the Pacific red Lionfish *Pterios volitans* into Atlantic waters. With the establishment of this particular species of fish, some ichthyologists are of the opinion that if not controlled or eradicated in the Atlantic basin, they will lead to the collapse of fisheries in the Caribbean and the entire Tropical and Sub-Tropical Atlantic basin as a whole. Developed as a powerful tool for conservation, Marine Parks when managed effectively are accredited for species protection and the promotion of biodiversity, offering refuge to marine life and the protection of fragile marine ecosystems. Actually, Marine Protected Areas (MPAs) preserve the fish community from all kinds of extractions. These no-take zones allow the stock of fish to be restored to their natural population numbers over time in addition to providing fish and larvae to outlying fished area by Spillover effect (Roberts and Hawkins 2000). However with the introduction of *P. volitans*, this primary purpose of MPAs is compromised by the fact that *P. volitans* diet as adults consists mainly of smaller fishes, (Fishelson 1975, Sano et al. 1984), posing a grave danger to the replenishment of juvenile fishes on coral reefs. Most recently, observations in the Bahamas showed that *P. volitans* (mostly small individuals) were capable of herding prey (mostly small fish) into a confined space using their pectoral fins spread widely to trap them (Côté and Maljkovic 2010). *Pterios volitans* is considered an ambush predator, but this observation indicates that this species is capable of systematic hunting. Assuming that the majority of dives are carried out within MPAs (Tratalos and Austin 2001), hence that the extraction of *P. volitans* highest within MPAs, by assessing the fish assemblages of MPAs and non-MPAs sites around each island allows estimations to be made regarding the impact of Lionfish on fish populations and the effectiveness of extraction techniques geared towards control of this chronic invasive species over time. This, coupled with establishment of the biomass of the 63 species of fish assessed, will generate a baseline measurement for the future impact of the Red Lionfish (*P. volitans*) in Cayman waters.

OUTCOMES

1. A total of 55 deep and shallow coral reef terrace sites (16-18 meters and 10-12 meters, respectively) were surveyed around Grand Cayman, Cayman Brac and Little Cayman between January 2011 and March 2011. To standardize survey method and to be consistent with effort, 15 minutes was spent on each transect. In total between >200 hours was spent estimating counts and length of the 53 target fish species during the survey, in addition to >200 scuba dives (combining surveyor and safety diver). At each site, abundance of 63 target species of fish that are considered commercially / ecologically important were assessed along three 50m x 5 m belt transects, covering a total survey area of 41,250 m². Additionally, the red Lionfish (*P. volitans*) survey counts were done at the same sites and transects. (see JNCC report- Lionfish Density, Distribution and Effectiveness of control efforts-Cayman Islands)
2. During the survey, a total of 31, 499 individual fishes of the 63 target species were recorded, 15,221 in Grand Cayman, 8,098 in Little Cayman and 8,190 in Cayman Brac. In total, 21 Red Lionfish (*P. volitans*) were recorded (12 in Little Cayman, 6 in Grand Cayman 3 in Cayman Brac, see JNCC report- Lionfish Density, Distribution and Effectiveness of control efforts-Cayman Islands).

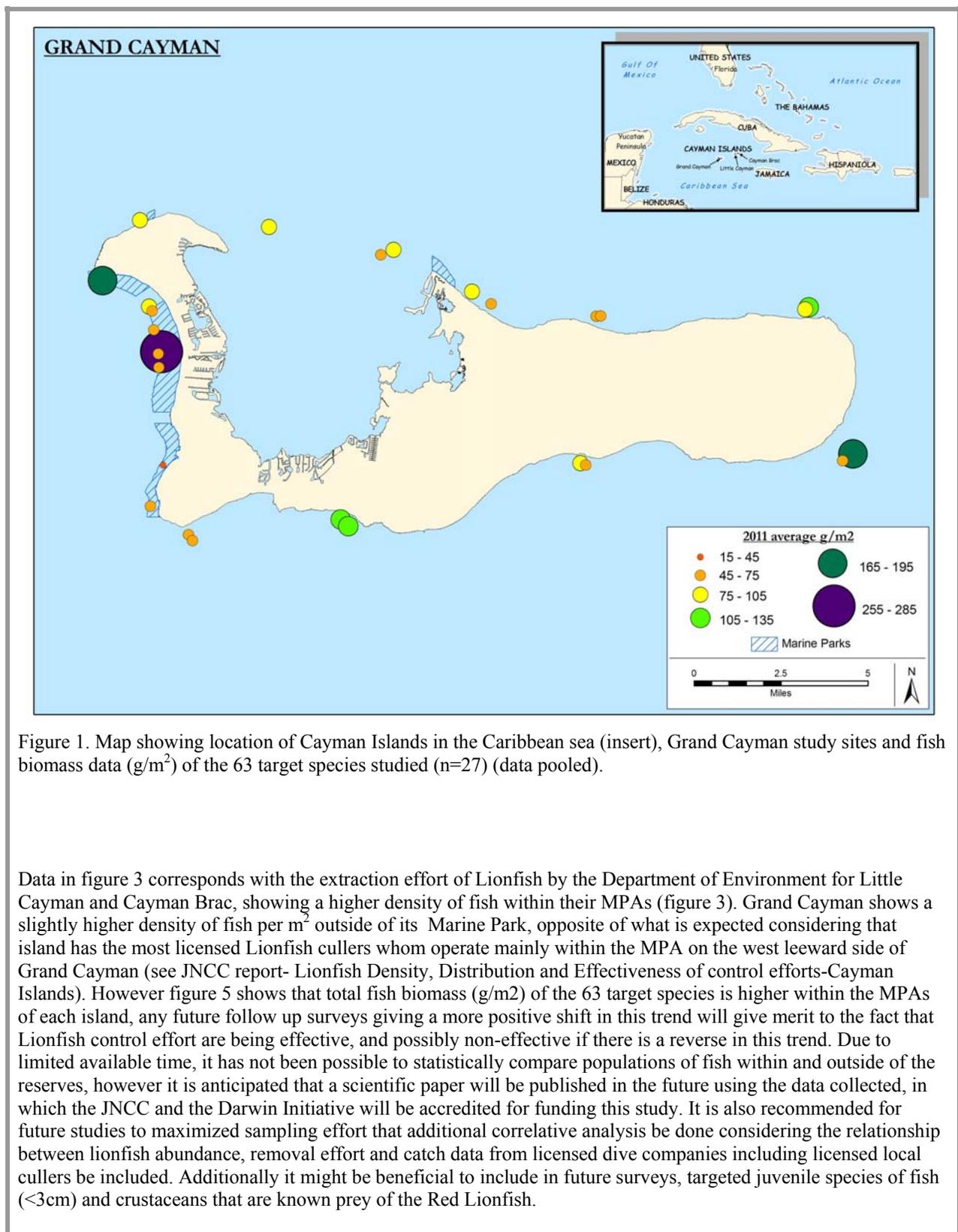


Figure 1. Map showing location of Cayman Islands in the Caribbean sea (insert), Grand Cayman study sites and fish biomass data (g/m^2) of the 63 target species studied ($n=27$) (data pooled).

Data in figure 3 corresponds with the extraction effort of Lionfish by the Department of Environment for Little Cayman and Cayman Brac, showing a higher density of fish within their MPAs (figure 3). Grand Cayman shows a slightly higher density of fish per m^2 outside of its Marine Park, opposite of what is expected considering that island has the most licensed Lionfish cullers whom operate mainly within the MPA on the west leeward side of Grand Cayman (see JNCC report- Lionfish Density, Distribution and Effectiveness of control efforts-Cayman Islands). However figure 5 shows that total fish biomass (g/m^2) of the 63 target species is higher within the MPAs of each island, any future follow up surveys giving a more positive shift in this trend will give merit to the fact that Lionfish control effort are being effective, and possibly non-effective if there is a reverse in this trend. Due to limited available time, it has not been possible to statistically compare populations of fish within and outside of the reserves, however it is anticipated that a scientific paper will be published in the future using the data collected, in which the JNCC and the Darwin Initiative will be accredited for funding this study. It is also recommended for future studies to maximized sampling effort that additional correlative analysis be done considering the relationship between lionfish abundance, removal effort and catch data from licensed dive companies including licensed local cullers be included. Additionally it might be beneficial to include in future surveys, targeted juvenile species of fish ($<3\text{cm}$) and crustaceans that are known prey of the Red Lionfish.



Figure 2. Intern M. Grol conducting fish surveys along the shallow terrace, north coast, Grand Cayman.

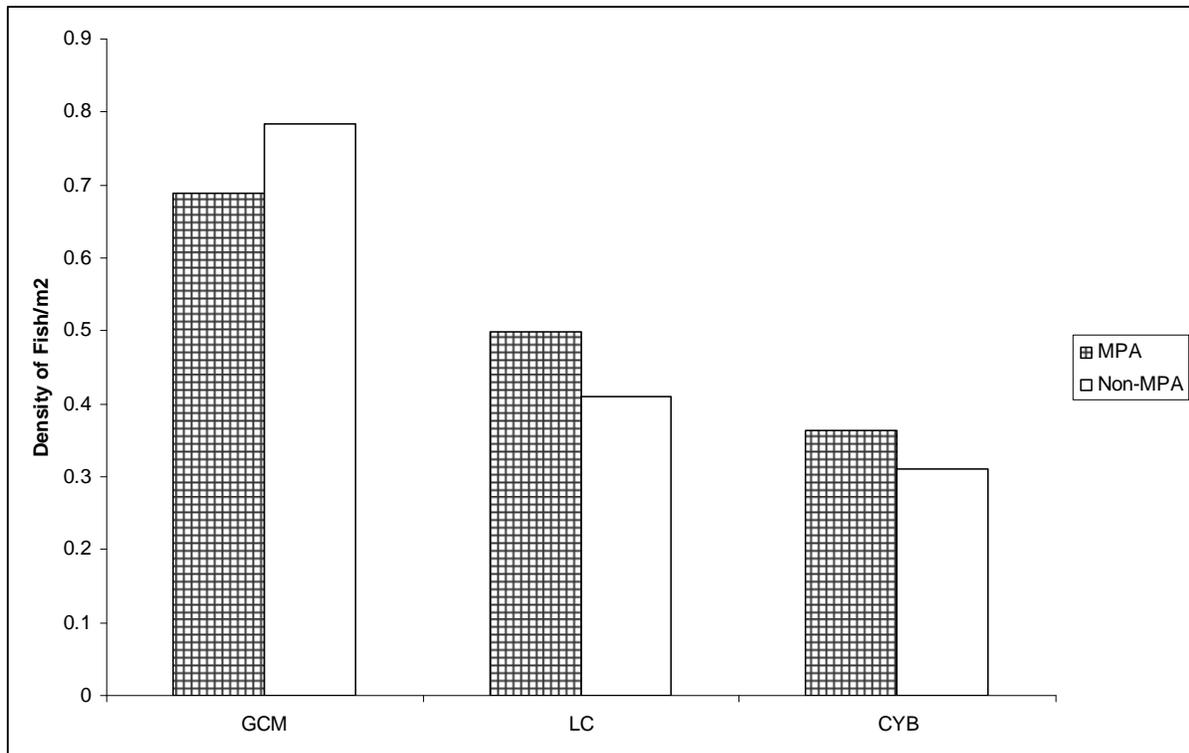


Figure 3. Fish density of the 63 species studied (abundance/m²) at each island showing inside MPA vs. outside MPA. Grand Cayman n=27, Little Cayman n=16, Cayman Brac n=12 (pooled data).

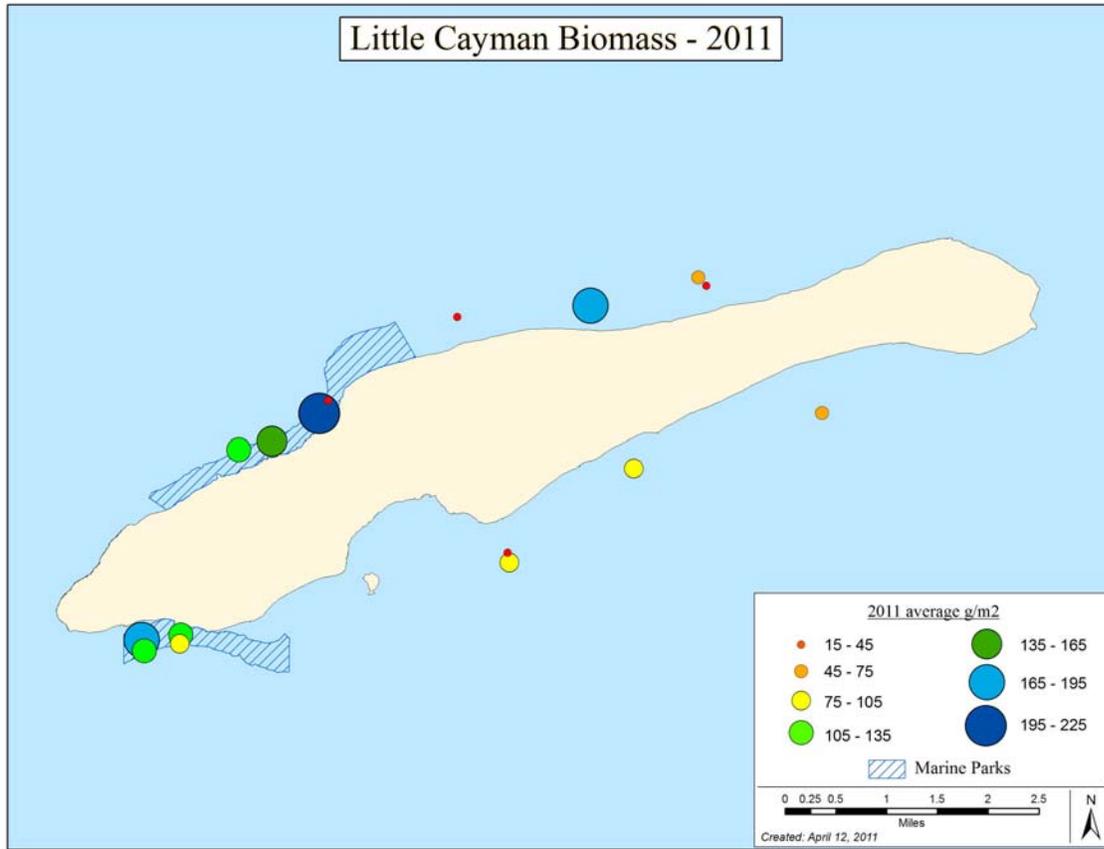


Figure 4. Map of Little Cayman showing location of study sites and fish biomass data (g/m^2) of the 63 target species studied ($n=16$) (data pooled).

Table 1. List of the 63 target fish species studied and their common names

Goliath Grouper	Hogfish	Sea Chubs	Banded Butterflyfish
Nassau Grouper	Spanish Hogfish	Barracuda	Foureye Butterflyfish
Yellowfin Grouper	Puddingwife	Bar Jack	Spotfin Butterflyfish
Yellowmouth Grouper	Bluehead	Horse-eye Jack	Longsnout Butterflyfish
Graysby	Yellohead Wrasse	French Grunt	Queen Angelfish
Red Hind	Stoplight Parrotfish	Bluestriped Grunt	Rock Beauty
Rock Hind	Queen Parrotfish	White Grunt	French Angelfish
Coney	Princess Parrotfish	Cesar grunt	Gray Angelfish
Black Grouper	Striped Parrotfish	Spanish Grunt	Queen Triggerfish
Tiger Grouper	Redband Parrotfish	Black Margate	Black Durgon
Mutton snapper	Redtail Parrotfish	White Margate	Whitespotted Filefish
Dog Snapper	Yellow tail Parrotfish	Tomtate	Scrawled Filefish
Mahogany Snapper	Midnight Parrotfish	Sailor Choice	Trumpetfish
Yellowtail Snapper	Rainbow Parrotfish	Porgies / sparidae	Moray eel
Blackfin Snapper	Ocean Surgeonfish	Goatfish / mullidae	
Lane Snapper	Blue Tang		
Schoolmaster	Doctorfish		

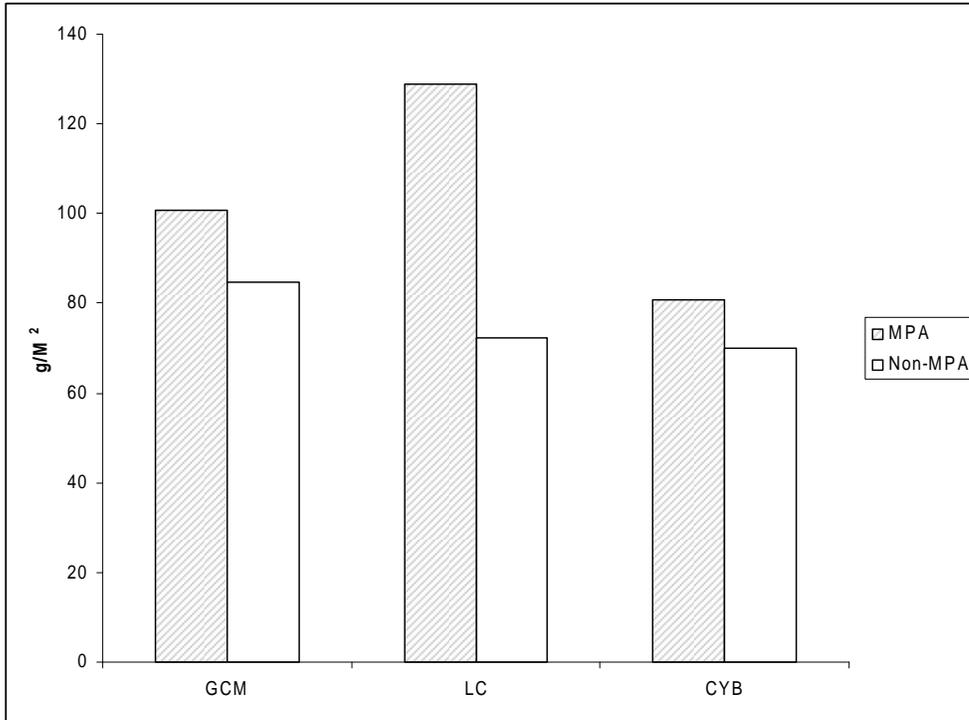


Figure 5 Fish Biomass (g/m^2) for the 63 target species at each island showing inside MPA vs. outside MPA (pooled data). Grand Cayman $n=27$, Little Cayman $n=16$, Cayman Brac $n=12$

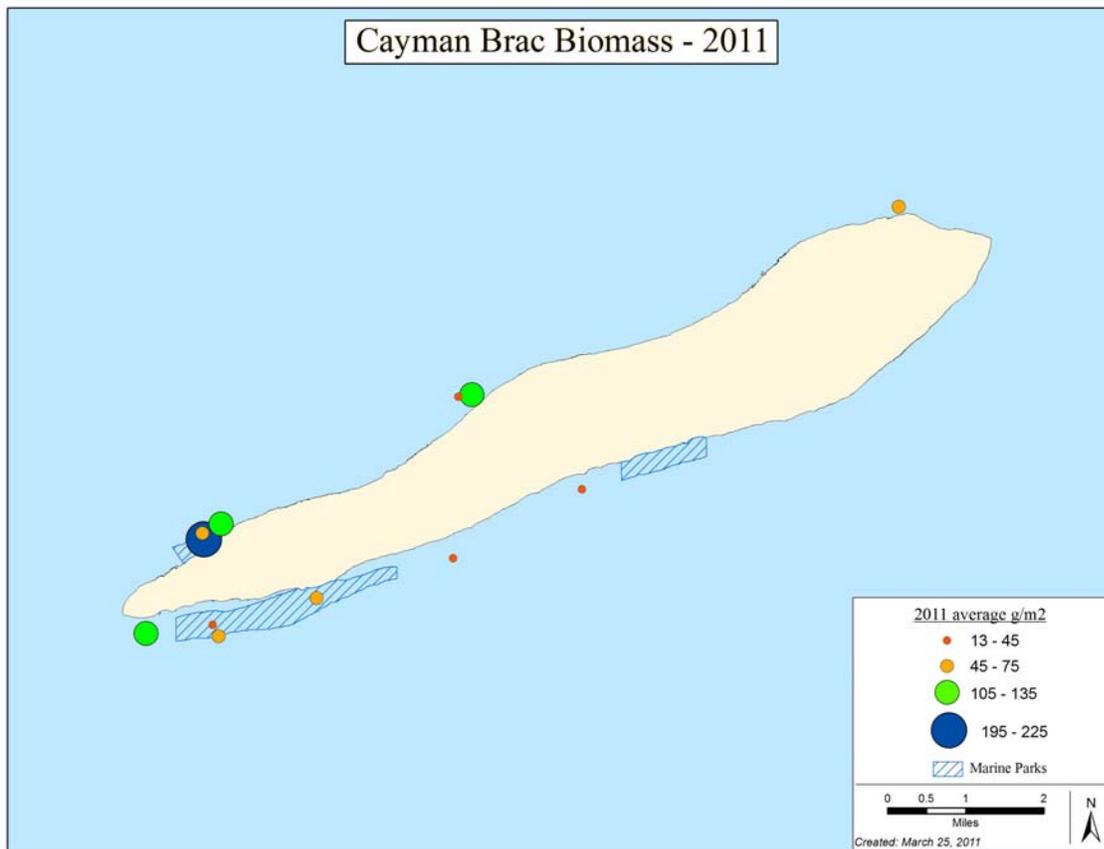


Figure 6 Map of Cayman Brac showing location of study sites fish biomass data (g/m^2) of the 63 target species

studied (n=12). (pooled data)

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OUTPUTS:

ACTIVITY	ACTUAL OUTCOME	COMMENTS
1	Use grant funds to cover inter-island travel and subsistence of volunteers during this project.	Completed
2	In-water surveys of 63 target fish species around all three Cayman Islands (recording abundance and size).	Completed
3	Additional progress made towards developing the <i>National Lionfish Action Plan for the Cayman Islands</i> .	Completed
4	Develop and implement monitoring programme for 63 target fish species populations in and around the Cayman Islands to use as a measure to quantify the impact that the invasive Red Lionfish, <i>Pterois volitans</i> , will have on the local fisheries, which also aids in determining the effectiveness of current control efforts.	Completed

INFORMATION: This final section is, in some ways, the most important part of this form. Provision of this information will enable us to pursue further funding and support for conservation projects in the Overseas Territories.

I ATTACH the following, by way of INFORMATION:
(Please ✓ tick appropriate boxes, and attached necessary information as necessary)

- ✓ **Brief QUOTATIONS from the Project Manager / individuals involved with this project, which may be used freely to promote and publicized the conservation achievements of this project through suitable media:**
“The Cayman Islands Department of Environment wishes to extend its sincere thanks to the JNCC and the Darwin Initiative for their financial support of this important project.”
Croy McCoy, Senior Research Officer.
- ✓ **PHOTOGRAPHS or VIDEO CLIPS and full details of associated photo-credits, which may be used freely by JNCC and other OTs, to promote and publicized the conservation achievements of this project through suitable media.**
Attached.
- A scanned copy and / or web-address of any NEWS ITEMS, PUBLISHED ARTICLES arising from this project.**
- A copy of any EDUCATIONAL MATERIALS, books, brochures, pamphlets or posters, arising from this project.**
- ✓ **Details of any WEBSITE or WEBLINKS arising from this project.**
<http://www.doe.ky/marine/invasive-lionfish-in-cayman/>
- ✓ **Details of any COLLABORATION or PARTNERSHIP, local or international, which contributed to the success of this project.**
JNCC
Cayman Islands Department of Environment

Volunteer field workers
Darwin Initiative

√

Details of any other unexpected benefits arising from this project, such as CONSERVATION AWARDS, PUBLIC SUPPORT, VOLUNTEER PARTICIPATION or SPONSORSHIP.

All fieldworkers involved received a subsistence stipend only during the course of the survey. The Department of Environment donated accommodation for volunteers during Grand Cayman (and part of Little Cayman) survey periods.