2014 CORAL REEF ASSESSMENT

PORTLAND BIGHT PROTECTED AREA, JAMAICA

This project was made possible by a **Waitt Foundation Rapid Ocean Conservation Grant** to Dr Suzanne Palmer (The University of the West Indies). ***Scientific expertise:*** Dr Suzanne Palmer (UWI), Dr Judith Lang (AGRRA) and Kenneth Marks (AGRRA)**.**

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THE PORTLAND BIGHT PROTECTED AREA (PBPA)

The Portland Bight Protected Area (PBPA) is the largest protected area in Jamaica comprising unique ecosystems, important areas of biological diversity, and irreplaceable ecosystem services. The marine and wetland areas account for over 75% of the PBPA and include the largest mangrove system in Jamaica, extensive seagrass beds, and coral reefs. These habitats are functionally and ecologically linked and provide essential services including coastal protection from storm surges and flooding, fishing grounds that enhance the local economy, and critical habitats for a number of endangered and critically endangered species. Further, the Goat Islands and 3 Special Fishery Conservation Areas provide major nurseries for numerous species that contribute to Jamaica's fishing industry. Mangroves fix carbon dioxide (carbon sequestration – offsetting CO_2 emissions), and the 55 km^2 of mangroves in the PBPA has an annual estimated value of US$45 million[1]. As the largest environmental conservation area in Jamaica, the PBPA is unquestionably a valuable national resource that must be preserved.

Manatee Bay mangrove lagoon with the Hellshire Hills in the background, Portland Bight Protected Area, Jamaica

In August 2013 the Government of Jamaica released plans for a logistics hub/trans-shipment port in the Portland Bight Protected Area (PBPA). However, to date no evidence has been presented about the marine habitats and ecosystem services that would be impacted by any such development. Specifically, there has not been an assessment of all the coral reefs across the PBPA for ~10 years and to our knowledge there are no published data on the fish stocks within the fishing sanctuaries within the PBPA.

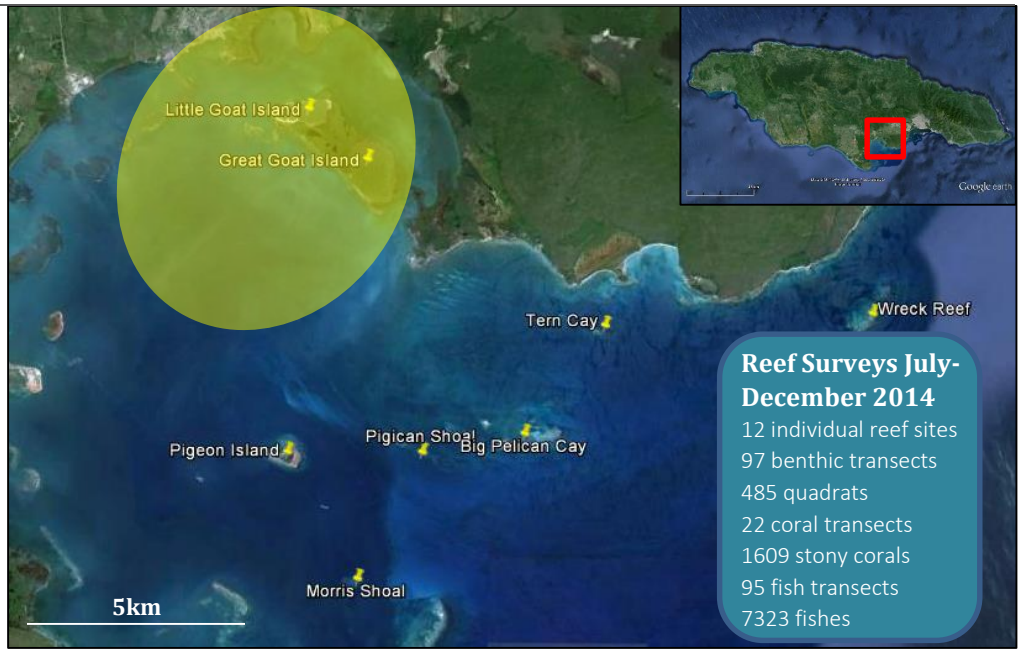
This pamphlet provides the outcomes of a 2014 scientific assessment of the coral reefs within the PBPA in order to: (a) raise public awareness and knowledge about the rarely documented value of the marine ecosystem services of the PBPA; (b) encourage mitigation against any collateral damage associated with the proposed development; and (c) encourage the designation of new protected areas outside any industrial/shipping development as may occur in the PBPA.

EVIDENCE-BASED APPROACH

The Atlantic Gulf Rapid Reef Assessment (www.agrra.org) program, a regional initiative that uses non-fixed, transect-based visual surveys to characterize the condition of corals, benthos, and fishes was used to assess coral reefs in the Portland Bight Protected Area (PBPA), Jamaica.

The platform reefs are predominantly shallow fore or patch reefs. The survey sites included 6 each in windward and leeward orientations and exhibited diverse zonation patterns (spur and groove, coral field, rubble field).

Data from the Portland Bight (PB) are compared to an extensive (2011-2014) AGRRA database[2] on Caribbean coral reef condition.



Google Earth map showing the location of coral reefs survey sites in the Portland Bight Protected Area, Jamaica. Note the location of the proposed development and likely dredging area around the Goat Islands (after Smith Warner International: http://savegoatislands.org/wp-content/uploads/2014/02/Smith_Warner_Site_Options_Logistics_Hub_Jamaica.pdf).

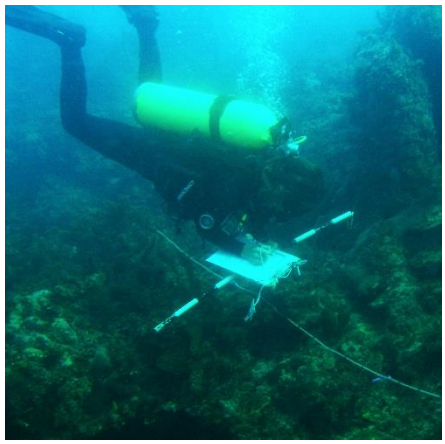
[1]Cesar, H. & Chong, C.K. (2004) Economic Valuation and Socioeconomics of Coral Reefs: Methodological Issues and Three Case Studies. *Economic valuation and policy priorities for sustainable management of coral reefs*. Ahmed et al (Ed). WorldFish. pp14-40.

IMPORTANCE OF CORAL REEFS

Coral reefs are complex 3D structures providing habitat, food, and shelter for marine species.

Coral reefs sustain biodiversity and boost local economy through fishing and tourism.

Coral reefs buffer the impact of high seas and severe storms therefore naturally protecting the shoreline and coastal inhabitants.

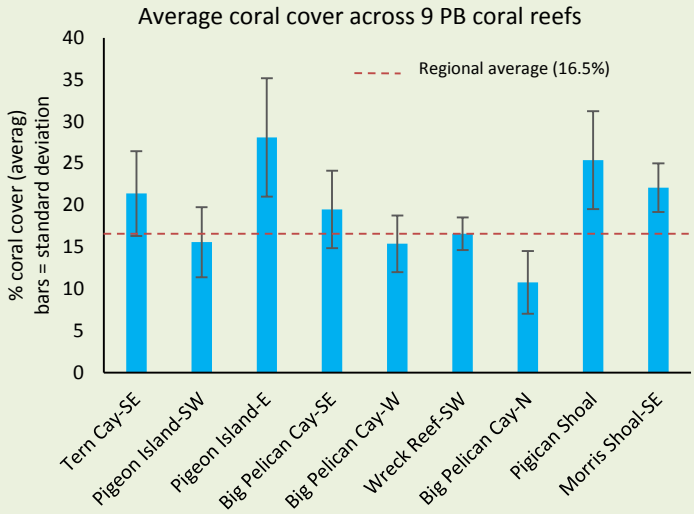


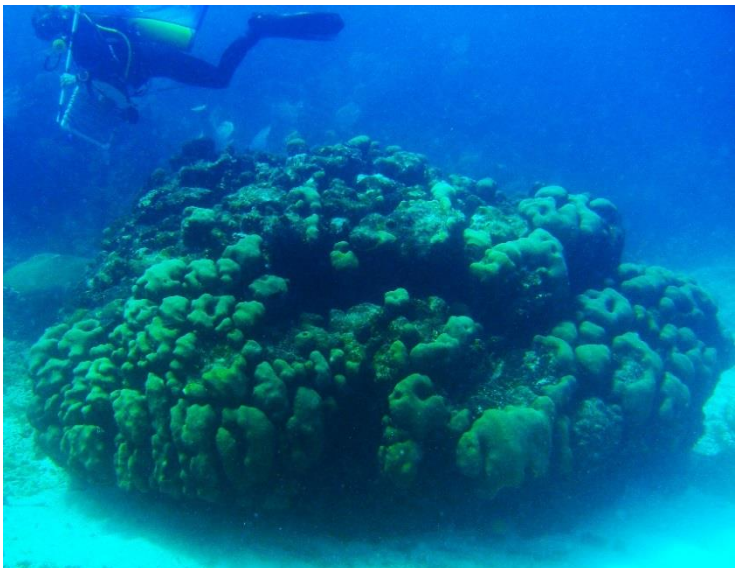
'Healthy' reefs are typically coral-dominated, whereas degraded reefs are often dominated by seaweeds and other soft-bodied organisms. We can assess the condition of coral reefs and fish populations by quantifying a number of structurally and functionally important benthic and fish indicators. Coral reef assessments are typically carried out as part of a monitoring programme to inform management. Data from repeat surveys are used to detect changes in reef condition.

Diver carrying out AGRRA benthic reef surveys across Pigican Shoal

PBPA CORAL HEALTH

- ***Live coral cover*** across all 12 fore and patch reef sites ranges from 11-28%. The average coral cover across the Portland Bight area (19.4%, standard deviation 5.4%) is slightly above the latest regional AGRRA mean of 16.5% (standard deviation 8.0%).
- ***High coral cover hotspots:*** small, isolated areas of high live coral cover that were recorded at 3 reef sites averaged 35% live coral cover.
- ***Opportunistic coral species:*** Locally high coral cover is due to the high abundance of mustard hill *(Porites astreoides)* and lettuce *(Undaria agaricites)* corals which form relatively small colonies and are known as opportunistic or 'weedy' species.





Large lobed star coral (*Orbicella annularis*), Pigeon Island

17 coral species were found across the PB reefs. Coral cover was dominated by the mustard hill (29.3%), massive starlet *(Siderastrea siderea* 15.7%), lobed star *(Orbicella annularis* 10.9%), lettuce (8.9%) and mountainous star *(Orbicella faveolata* 7.8%) corals.

Coral mortality: Across fore reef sites all forms of mortality were at the lower end of regional ranges.

- ***Low old mortality***: Old mortality at 7.8% (standard deviation 1.2%) was lower than the regional mean of 13.8% (standard deviation 3.9%).
- ***Recent mortality*** of 1.1% (standard deviation 1.2%) is not considered stressful or a sign of a degrading conditions for Caribbean corals (after Lirman et al., 2014)[3].

PBPA corals are presently in reasonable condition

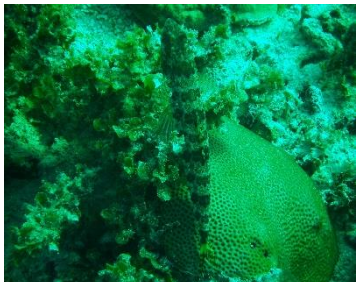
[2]AGRRA regional database 2011-2014: Jamaica (Pedro Bank), The Bahamas, Belize, Colombia, Honduras, Guatemala, Navassa, Mexico and St. Kitts/Nevis.
[3]Lirman, D. et al. (2014) Percent recent mortality (PRM) of stony corals as an ecological indicator of coral reef condition. *Ecological Indicators*. 44, 120-127.

PBPA Coral Reef Health

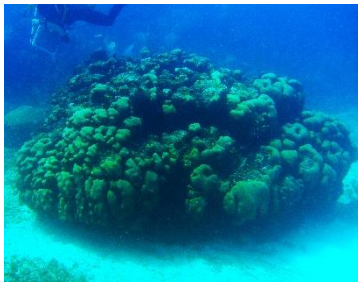
Good news: The PB coral reefs are reasonably healthy when compared nationally and regionally.

Bad news: There is high variability across individual reefs and in places fleshy macroalgae are out-competing corals.

Coral cover



Fleshy macroalgae & coral



Relief – the 3D reef structure

Grazing: long-spined sea urchin

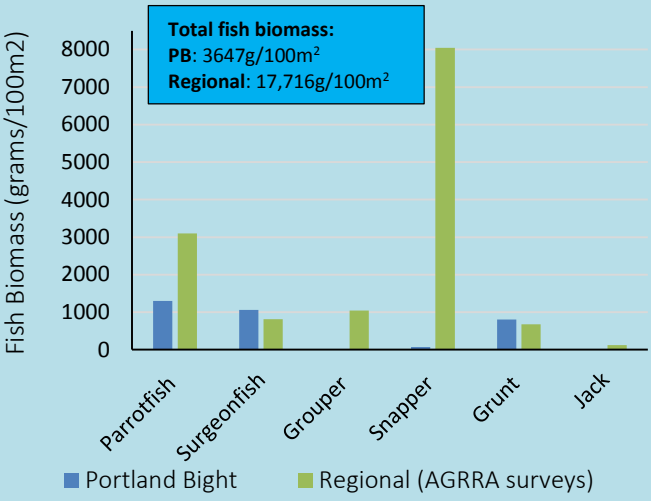
	ROLE IN CORAL REEF HEALTH	PORTLAND BIGHT 2014	REGIONAL[2]	HOW DOES THE PB FARE?
CORAL COVER	*The primary building blocks of the reef, providing its 3D structure i.e., habitat for all other reef organisms.*	19.4% (5.4)	16.5% (8.0)	Similar/ slightly greater live coral cover
DESIRABLE COVER	*Important reef-building corals and crustose coralline algae (CCA), and indicators of space where coral larvae can settle (CCA and sparse turf algae).*	31.7% (14.1)	39% (14)	Similar/ slightly lower desirable cover elements largely due to lower CCA and turf algae. Significant variation among individual PB reefs.
UNDESIRABLE COVER	*Organisms with the potential to displace the reef-building corals and CCA which, if unchecked can lead to reef decline – macroalgal sediment mats (TAS), macroalgae, coralline macroalgae, fleshy macroalgae, cyanobacteria, aggressive invertebrates.*	47.3% (14.3)	44 (11)	Similar undesirable cover elements with fleshy and coralline macroalgae being the most common.
MAXIMUM RELIEF	*Related to the size of coral colonies and the 3D structure of the reef above the seafloor. All else being equal, structurally complex reefs have higher fish diversity and dissipate more wave energy, providing greater coastal protection from storms.*	30.4cm (15.2) Maximum measured at each site 70-400cm	65cm (29.5) Maximum measured at each site 130-1000cm	Much lower relief; high variability due to dominance of small low-lying corals plus some large coral outcrops
GRAZER DENSITY	*The density of long-spined sea urchin (Diadema antillarum) - a generalist algal grazer that eats both macroalgae and turf algae preventing algae from overgrowing coral.*	0.56/m^2 (0.62) Average (standard deviation)	0.49/m^2 (Pomory et al., 2014)[4]	Reasonable - only in comparison to regional standards but too low to control the macroalgae and/or TAS. Significant variation among individual PB reefs.

[4]Pomory, C.M. et al. (2014) Density of *Diadema antillarum* (Echinodermata: Echinoidea) on live coral patch reefs and dead *Acropora cervicornis* rubble patches near Loggerhead Key, Dry Tortugas National Park, Florida, USA. *Caribbean Journal of Science*, 48 (1) 1-8.

CORAL REEF FISHES

Fish biomass

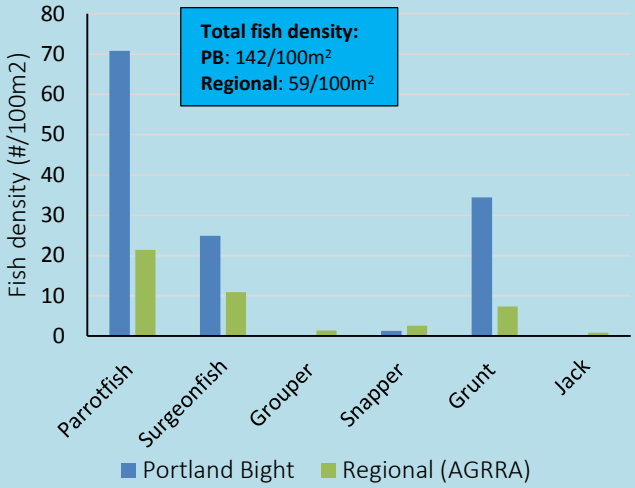
By counting the number of fish in a given area, and measuring their sizes, (i.e. along a transect there may well be individuals of different sizes within one fish species) we can calculate fish biomass (grams of fish per 100m^2).



Results: At the regional level, except for surgeonfishes, fish biomass on the Portland Bight coral reefs is low to extremely low in all surveyed fish groups.

Fish density

Fish density is the number of individual reef fishes within a given area, here calculated, by fish families, as the number of fishes within 100m^2.



Results: The densities of (small) parrotfish, surgeonfish and grunt on the Portland Bight reefs are substantially higher than regional averages, but densities of snapper and jack were below average and grouper were absent.

Fish size

Vallès & Oxenford (2014)[5] suggested that average parrotfish length might be a useful indicator of fishing effect over shallow Caribbean reefs. Here we look at the average length of both parrotfish and snapper compared to regional data.

Results: Large-sized fishes, both parrotfishes and snappers, were rare or absent across the PB reefs.

Fish size (centimetres)			
centimetres (cm)	Portland Bight	Regional (AGRRA)	PB in comparison to regionally
Parrotfish length (cm)	7.9 (0.7)	14 (3.5)	Low
% Parrotfish >20cm	2	22 (9)	Extremely low
Snapper length (cm)	14.5 (1.6)	26.5 (8)	Low
% Snapper >40 cm	0	12 (18.5)	Absent at PB

Herbivores: Large-sized parrotfish are important herbivores on coral reefs that help control algal growth and enhance coral recruitment and/or survivorship. *The Portland Bight coral reefs have low abundances of large-sized parrotfishes.*

Carnivores: Large-sized predatory fishes help keep populations of smaller fish and invertebrates that feed on corals in balance. Healthy populations of diverse reef fishes are needed to sustain the health and productivity of coral reefs. *Most of the reef fishes in the Portland Bight are small in size and many are juveniles. The lack of large fishes is likely a reflection of fishing pressures*.

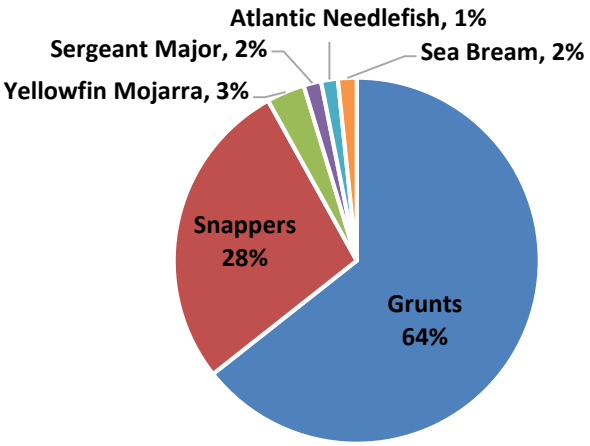
[5]Vallès, H. & Oxenford, H.A. (2014) Parrotfish size: A simple yet useful alternative indicator of fishing effects on Caribbean Reefs. *PLoS One* 9 (1) 1-15.

PBPA Fish Nurseries

Mangroves enhance the biomass of coral reef fish communities in the Caribbean by serving as important nursery habitats that increase the survivorship of many young fishes. The biomass of several commercially important reef species more than doubles when adult reef habitat is located near mangroves (Mumby et al., 2004)[6]. 32 fish transects were carried out along 2000m^2 of mangrove prop roots in Galleon Harbour, a Special Fisheries Conservation Area, to learn the extent to which the extensive mangroves surrounding the Goat Islands act as nurseries for coral reef fishes.

Mangrove prop roots act as a breeding area for the spiny Lobster (*Panulirus argus*), Little Goat Island

Survey summary November 2014
32 fish transects along ~2000m^2 mangrove prop roots
16,061 fish, nurse sharks, lobsters



Dominant fish within the mangrove prop roots (all species >1% of total assemblage, minus blue fry)

Dense mangrove forests encompass Galleon Harbour, Little Goat Island, and Great Goat Island. Many of the creeks are rarely visited and only known to a few fishers.

Highest density of fishes and largest grunts and snappers recorded throughout all surveys were found within the extensive mangrove prop root zones. Spanish Grunt (*Haemulon macrostomum*) and Schoolmaster Snapper (*Lutjanus apodus*) were the most common of the reef fishes.

Numerous large shoals (2000+) of blue fry *(Jenkinsia lamprotaenia)* and larvae were recorded at every survey site along the Goat Islands. Blue fry (locally known as scad) are typically important forage fish for high trophic level predators and often used as fishing bait.

Endangered and Critically Endangered Species in the PBPA

Elkhorn and staghorn corals, formerly the most dominant reef-building species in the Caribbean are currently are listed as critically endangered on the IUCN Red List of Threatened Species. Small to moderate-sized colonies can be found at most of the Portland Bight reefs sites and were assessed during surveys. These data are vital for informing future restoration efforts in the area.

The mounding lobed star coral, currently listed as endangered on the IUCN Red List, can be found across PB reefs as large, reasonably healthy colonies and should be protected to prevent the loss and damage of this important reef framework-building species.

A colony of staghorn coral *(Acropora cervicornis)*, Little Goat Island

Green turtle (*Chelonia mydas*), Big Pelican Cay.

IUCN Red List of Threatened Species PB 2014 surveys

Critically Endangered species

- *Acropora cervicornis* (staghorn coral)
- *Acropora palmata* (elkhorn coral)
- *Eretmochelys imbricate* (Hawksbill turtle)

Endangered species

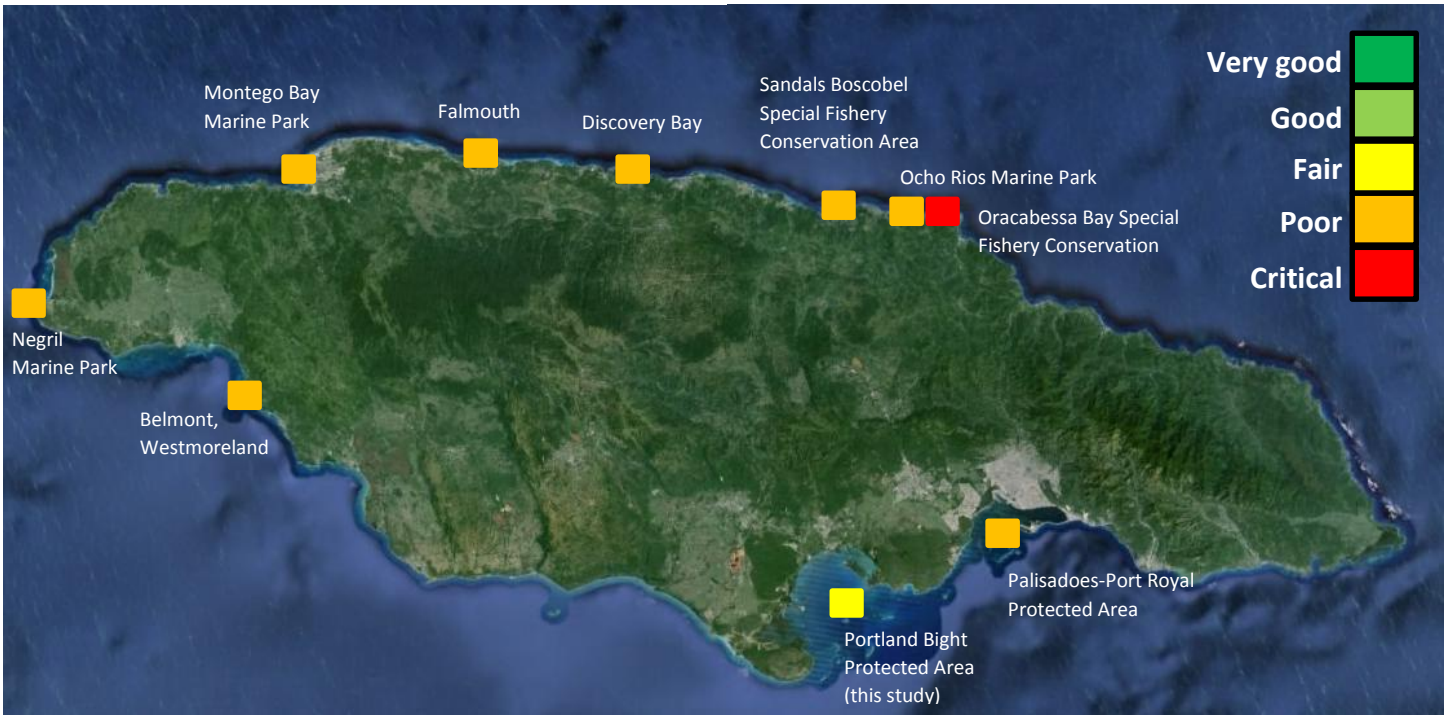
- *Orbicella annularis* (lobed star coral)
- *Chelonia mydas* (green turtle)

[6]Mumby, P.J. et al. (2004) Mangroves enhance the biomass of coral reef fish communities in the Caribbean. *Nature*. 427, 533-536.

THE NATIONAL CONTEXT

In 2014 The National Environment & Planning Agency (NEPA) presented coral and reef biota indices based on a report card[7] developed by the Healthy Reefs Initiative (www.healthyreefs.org). Threshold values were used to determine the index rank for each indicator and an overall average was used to calculate the Coral Reef Health Index value. Reefs were then ranked from very good to critical based on their overall ranking. Here we use the coral and reef biota index that is presented in the NEPA report card[7] on the PBPA data to allow comparison at the national level.

Indicator	PB reefs	Index	Ranking
Coral cover	19.40%	3	Fair
Coral recruitment	5/m^2	4	Good
Coral Index (average)		**3.5**	Good
Macroalgal (fleshy & calcareous) cover	32.2%	3	Fair
Herbivorous fish biomass	2488g/100m^2	3	Fair
Commercial fish biomass	877g/100m^2	2	Poor
Diadema sp. abundance	0.56/m^2	3	Fair
Reef Biota Index (average)		**3**	Fair
Coral Reef Health Index for PB Reefs		**3.1**	**Fair**



Map of Jamaica with the Coral Reef Health Index ranking for each location surveyed by NEPA in their most recent national assessment[7]. Note the added ranking of the Portland Bight Protected Area (this study, ranking scheme following method in NEPA report[7]).

Recommendations

Coral reefs, seagrass beds and mangroves (in addition to adjacent hardgrounds) are functionally and ecologically linked. It is therefore crucial that the preservation and management of these marine habitats should be performed in an holistic manner. The Portland Bight coral reefs are above the average regional condition and there are critically important nursery areas surrounding the Goat Islands. Therefore, there needs to be a focus on: (a) maintaining and restoring coral reef habitats, and (b) restoring fish populations to ensure a sustainable fisheries. Based on this assessment the following recommendations are provided:

1. Reducing the fishing of key herbivores (parrotfishes and surgeonfishes) will promote overall reef health.
2. Protecting key nursery habitats near the Goat Islands will produce more lobster and fish in surrounding fishing grounds.
3. Allowing fish to reach breeding maturity size will allow fish stocks to replenish and become more sustainable.
4. Prohibiting the catch of snapper while they are gathered in spawning aggregations to avoid population collapse.
5. Regular monitoring of the coral reefs, mangroves and seagrass beds in the Portland Bight will allow changes to be detected and therefore inform effective management.

[7]NEPA (2014) Coral Reefs of Jamaica, *An Evaluation of Ecosystem Health: 2013*. NEPA, 15pp.

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