Final Report St Eustatius Global Coral Reef Monitoring Network

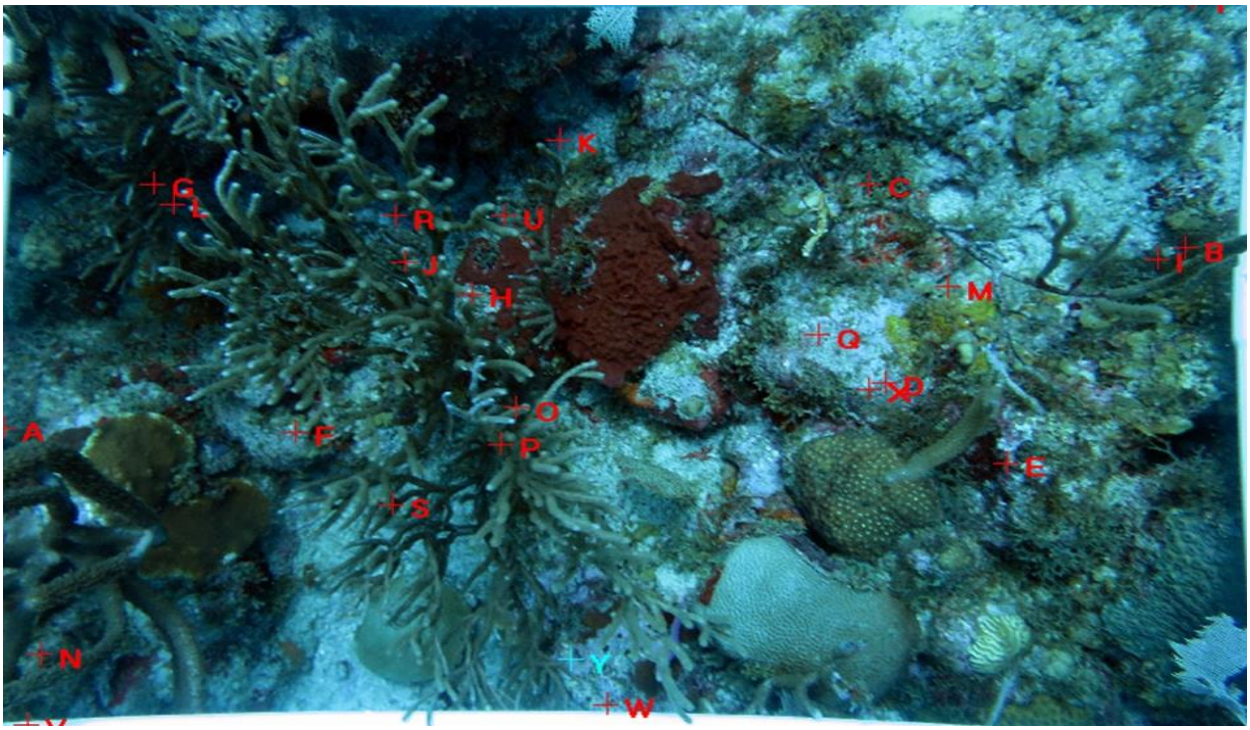


Image: Johan Stapel

This report is presented to:
The Island Government of St Eustatius and
The Ministry of Economische Zaken

Gem City Consulting
Zeelandia 1, St Eustatius, Caribbean Netherlands
599-318-4364
pionteksteve@yahoo.com

Primary Investigator:
Steve Piontek
Gem City Consulting
Zeelandia, St Eustatius
piontekstеve@yahoo.com

Sampling team members: Matt Davies, Captain Nadio Spanner, Johan Stapel, Matt Glue, Heleen Visser, Martin de Graaf, Thomas Smith and Hannah Madden.

Acknowledgements:
Gem City Consulting would like to recognize STENAPA, CNSI and the Island Government of St Eustatius for their direct assistance in performing this survey; additional thanks go to SECAR, for letting us use their camera, Golden Rock Dive Center for tanks and IMARES for slates and waterproof paper. Personal communications with Dr Mark Vermeij and Paul Hoetjes concerning interpretation of the protocol guidelines and species identification and Peter Verweij and Anouk Cormont of Alterra for the statistical analyses of the observations.

Gem City Consulting
Zeelandia 1, St Eustatius, Caribbean Netherlands
599-318-4364
piontekstеve@yahoo.com

Table of Contents:

Gem City Consulting
Zeelandia 1, St Eustatius, Caribbean Netherlands
599-318-4364
pionteksteve@yahoo.com

1. INTRODUCTION:

The goal of the Global Coral Reef Monitoring Network (GCRMN), an operational network of ICRI, the International Coral Reef Initiative, is to improve data collection, archiving and the network internal functioning for a better diffusion of information and to increase the support for regional and sub-regional cooperation. Why is this important?
The report "Status and Trends of Caribbean Coral Reefs: 1970-2012", edited by GCRMN science coordinator Jeremy Jackson, concluded coral reef monitoring in the wider Caribbean is ''scattered, disorganized, and largely ineffective". The weaknesses and inefficiency of the current coral monitoring network, is in part due to the lack of information dissemination and inconsistency in application of monitoring methods and approaches throughout the region.

2. BACKGROUND:

The Ministry of Economic Affairs, as part of its efforts for the International Coral Reef Initiative (ICRI), together with GCRMN and the SPAW protocol convened a regional workshop in Curacao August 6th – 8th, 2014 during which coral reef experts from the region came together and discussed how to better coordinate ongoing Caribbean coral reef monitoring and stimulate and support monitoring in areas that lack capacity for sustained monitoring efforts. There was a clear consensus on the importance of revitalizing and formalizing the regional network, with the adoption of a simple and accessible regional data set and associated methods. The group agreed on a minimum core set of data to be collected, with associated recommended protocols and methods, developing a model for simple, accessible, but also scientifically pertinent and sustainable monitoring, both from a regional and local perspective.
The local situation on St Eustatius is in desperate need of scientifically pertinent and sustainable coral reef monitoring. Historically there have been only widely scattered and non-sustainable coral reef monitoring efforts in Statia's waters. Following the protocols established at this and subsequent GCRMN workshops will allow the Island Government of St Eustatius to establish a 2015 baseline of coral reef health indicators, record future changes in coral reef health and manage natural and anthropogenic disasters which may affect the coral reefs.

3. METHODS:

3.1 The survey location is the St. Eustatius National Marine Park (SNMP), which surrounds the island from the high water mark to a depth of 30 meters. To maximize comparability across the region, GCRMN data will be collected solely from forereef habitats at depths ranging from 8 – 15 meters. An effort was made to include sites within the industrialized harbor area along with sites with perceived lower anthropogenic influence on the north and south ends of the island. Within the SNMP 20 sites were selected: Crooks Castle, Humps, Twin Sisters, Ledges, Valley of the Sponges, Five Fingers South, Double Wreck, Northman, The Blocks, The Cave, Aquarium, Anchor Point, Dump, White Wall, Gibraltar, Outer Jenkins Bay, Barracuda Point, Triple Wreck, Mushroom Gardens and Hangover.

Gem City Consulting
Zeelandia 1, St Eustatius, Caribbean Netherlands
599-318-4364
pionteksteve@yahoo.com

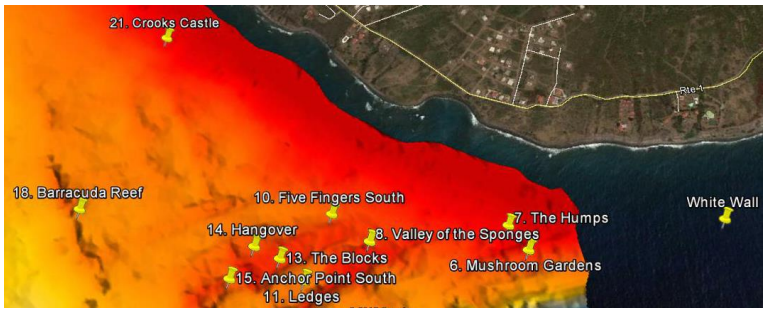


Image 1. Northern survey sites. **Image 2. Southern survey sites. Images from Google Earth**

3.2 The GCRMN methods describe six elements of the coral reef ecosystem to be surveyed:

3.21 Abundance and biomass of reef fish taxa.

To measure fish density, all fish present (of all species) within a belt transect (30m length x 2m width) were counted, with the survey time limited to approximately 6 minutes per transect. To measure size structure and calculate biomass, the length of each fish was estimated and assigned to the following size categories: <5cm, 6-10cm, 11-20cm, 21-30cm, 31-40cm and >41cm. At each site, 5 transects were surveyed and the data pooled to provide an average assessment of the density and size structure of all fishes at the site. Such high resolution estimations of the fish assemblage provide the core information (snappers, groupers, parrotfish and surgeonfish), while also providing fundamental information about other members of the fish assemblage that may serve important roles in fisheries or ecosystem management.

3.22 Relative cover of reef-building organisms (corals) and their dominant competitors.

Percent cover of key benthic taxa was estimated using the photoquadrat method. This approach depends upon taking digital photographs of the reef surface in standardized quadrat areas (0.9m x 0.6m). Photographs were taken along the 5 transect lines set for counting fish, capturing 15 images per transect line (i.e., one image taken at every other meter marker on the transect tape). Data was captured from the images through post – processing using Coral Point Count (CPCe) software. 25 random points on each image were identified and classified into a standardized benthic category, such as Seagrass, Sponge, Zooanthid and Cyanobacteria. Reef building corals were identified to species level; soft corals and macroalgae to genus level.

3.23 Assessment of health of reef-building corals.

Disease prevalence in corals was estimated using the photoquadrats from the benthic cover assessment. Data was recorded as the proportion of images collected that contained a coral with any disease pathology. For example, if there were four colonies in a particular photoquadrat and any of these colonies showed signs of disease, this image would be tagged as “with disease”. The number of images that were “with disease” was divided by the total number of images (15 per transect) to generate a proportional estimate of disease prevalence.

3.24 Recruitment of reef-building corals.

Coral recruits are defined operationally for this assessment as any stony coral that is greater than 1.0 cm^2 and less than 4.0 cm^2. Estimates of coral recruit density were recorded from replicate 25cm x 25xm (625cm2) quadrats. 5 quadrats were surveyed along each of the first three transects used for fish and

benthic surveys. Coral recruit quadrats were placed at 2-m intervals along the transect line, i.e. with the lower corner of the quadrat placed at the following meter marks: 2, 4, 6, 8 and 10m. Each coral within the target size range was recorded to the finest taxonomic level.

Image 3. Coral recruits in situ. (Photograph by S Piontek)

3.25 Abundance of key macro-invertebrate species (sea urchins and sea cucumbers).

The 15 benthic photoquadrats from each of the 5 transect lines (75 photographs per site) were used to estimate the density of sea urchins and sea cucumbers. The number and species identity of each sea urchin and sea cucumber were recorded for each image. The density was calculated by dividing the total number of sea urchins and sea cucumbers recorded by the product of the number of images (75) and the size of each photoquadrat (0.54 m2 [i.e., 0.6 m x 0.9m]).

3.26 Water quality (i.e. water transparency)

The Secchi disk (a black-and-white disk 20 cm in diameter) was used to estimate the concentration of particulates in the water column. The Secchi disc was placed on the seafloor and the diver swam away along the transect line until the Secchi disc could no longer be seen. The diver then swam back until the Secchi disc could be seen. Recording this distance gave a measurement of water clarity.

3.27 Macroalgae height (added after site #12).

The macroalgae height was estimated to calculate macroalgae biomass. Algal impacts scale with biomass and canopy heights are the best (nondestructive) way to get at that. The canopy height of algae in the recruit quadrat was measured at a sufficient number of points relative to algal biomass.

4. RESULTS:

4.1 20 sites within the SNMP were surveyed following the GCRMN protocol between January 26 and May 29, 2015. There were 3 sites on the Atlantic side of the park, 3 sites from the Northern Reserve, 3 sites from the Harbor area of the park and 11 sites in the Southern Reserve.

4.21 All 20 sites were surveyed for abundance and biomass of reef fish taxa by Marine Park Ranger Matt Davies, with the assistance of interns Matt Glue and Thomas Smith. A total of 99 transects were sampled. Using conversion values from the Fishbase website the abundance/length data was converted

to grams/m² for the two main groups of herbivorous reef fish (parrotfish and surgeonfish) and the two main groups of carnivorous reef fish (groupers and snappers).

Figure 4.1 Fish biomass of the two groups of herbivores and carnivores for each site.

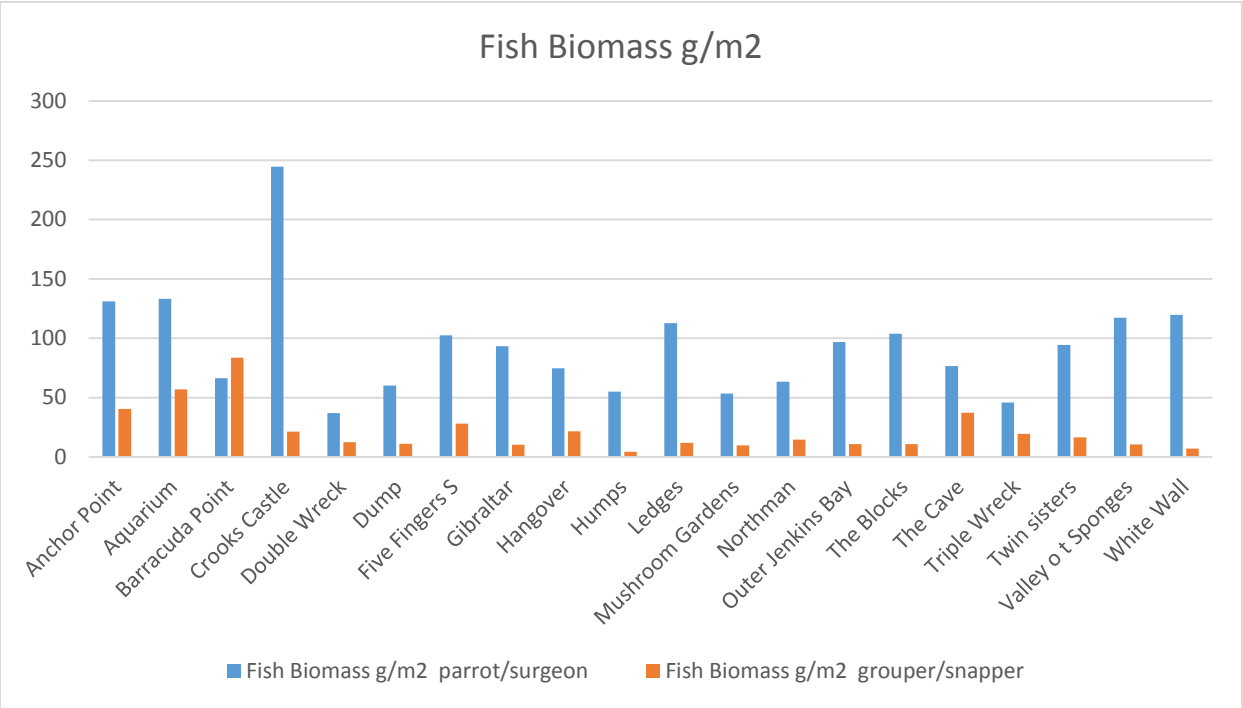
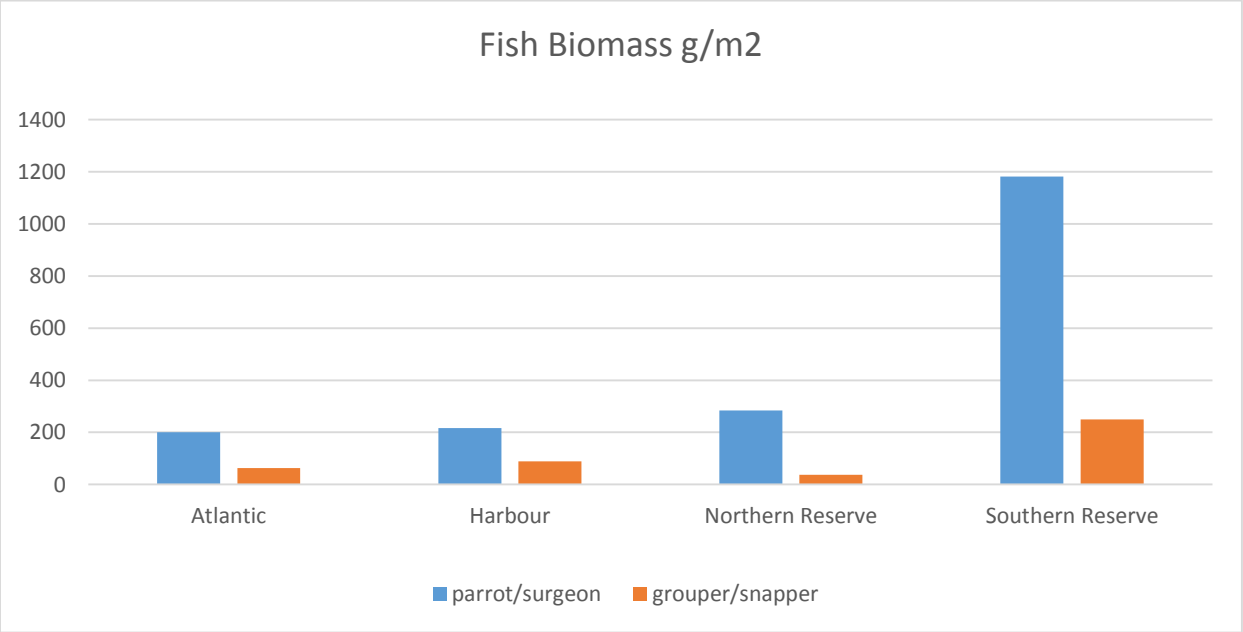


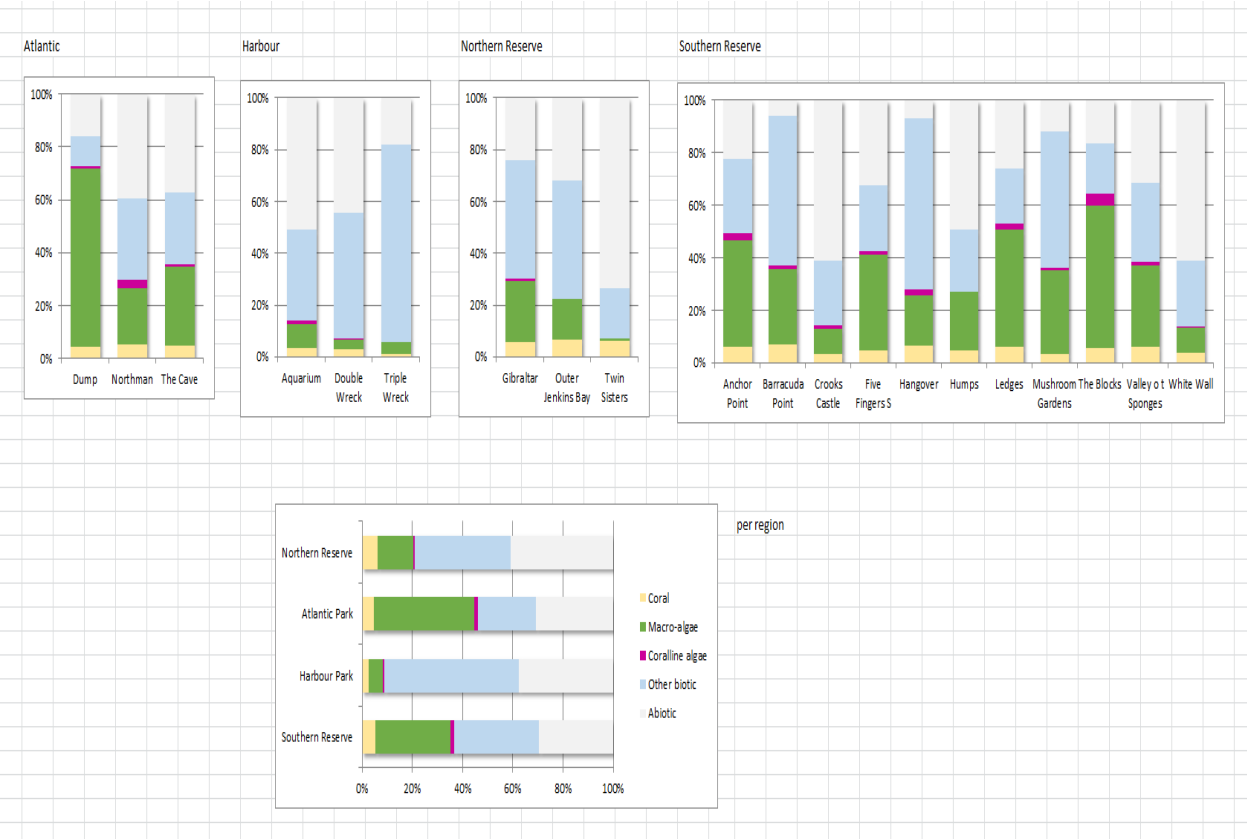
Figure 4.2 Fish biomass of the two groups of herbivores and carnivores by region.



Gem City Consulting
Zeelandia 1, St Eustatius, Caribbean Netherlands
599-318-4364
pionteksteve@yahoo.com

4.22 All 20 sites were photographed by Johan Stapel, assisted by Heleen Visser and Hannah Madden, for relative cover of reef-building organisms (corals) and their dominant competitors and the 1484 photographs were analyzed by Steve Piontek. Analysis using CPCe software gave the following results:

Figure 4.3 Relative benthic cover of 20 sites, then combined into four regions.



The "Other biotic" category, when averaged over all 20 sites, consisted of: 32% Cyanobacteria, 3.1% Seagrass, 32.3% Gorgonians/Soft corals, 30.4% Sponges and 2.2% Zooanthids.

4.23 All 20 sites were surveyed for health of reef-building corals using the 1484 photoquadrats analyzed by Steve Piontek. 32 of the 1484 (2.2%) photoquadrats contained one or more diseased reef building corals.

Table 4.1 Diseased quadrats by region.

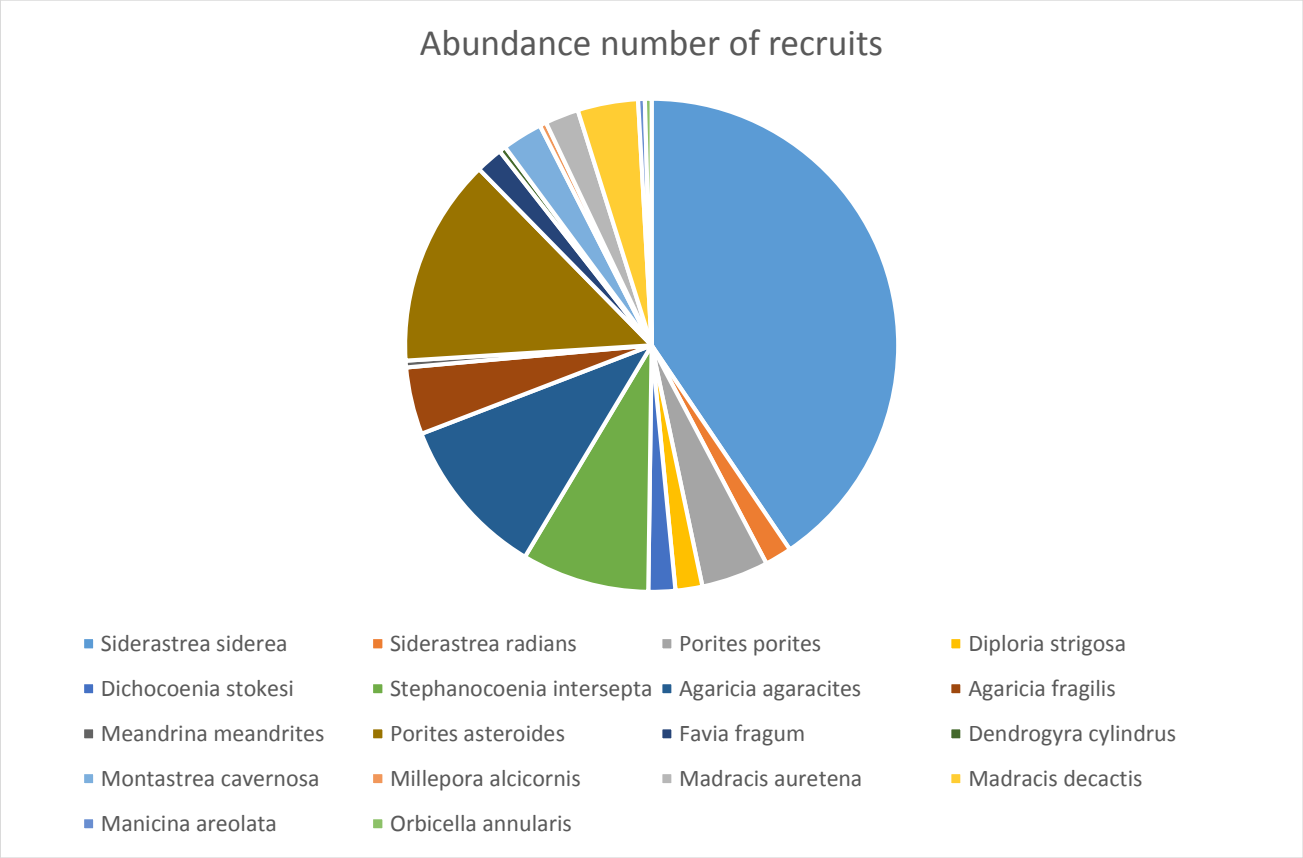
Region	Sites with Diseased Quadrats	Number of Diseased Quadrats
Northern Reserve	1 out of 3	2
Atlantic Park	2 out of 3	3
Harbor Park	1 out of 3	2
Southern Reserve	7 out of 11	25

Table 4.2 Disease type and host reef building coral species.

Disease	# of Quadrats	Host
Dark Spot Disease	13	Siderastrea siderea
Yellow Blotch Disease	10	Montastrea cavernosa, Orbicella faveolata, Orbicella annularis, Diploria strigosa
White Band Disease	5	Acropora cervicornis
Red Band Disease	3	Siderastrea siderea

4.24 All 20 sites were surveyed in situ for recruitment of reef-building corals by intern Matt Glue (1 site) and Steve Piontek (19 sites), who recorded 230 reef building coral recruits in 300 (.0625m²) quadrats; a density of 12.27 recruits / meter².

Figure 4.4 Coral recruit abundance



Gem City Consulting
Zeelandia 1, St Eustatius, Caribbean Netherlands
599-318-4364
pionteksteve@yahoo.com

Figure 4.5 Recruit distribution

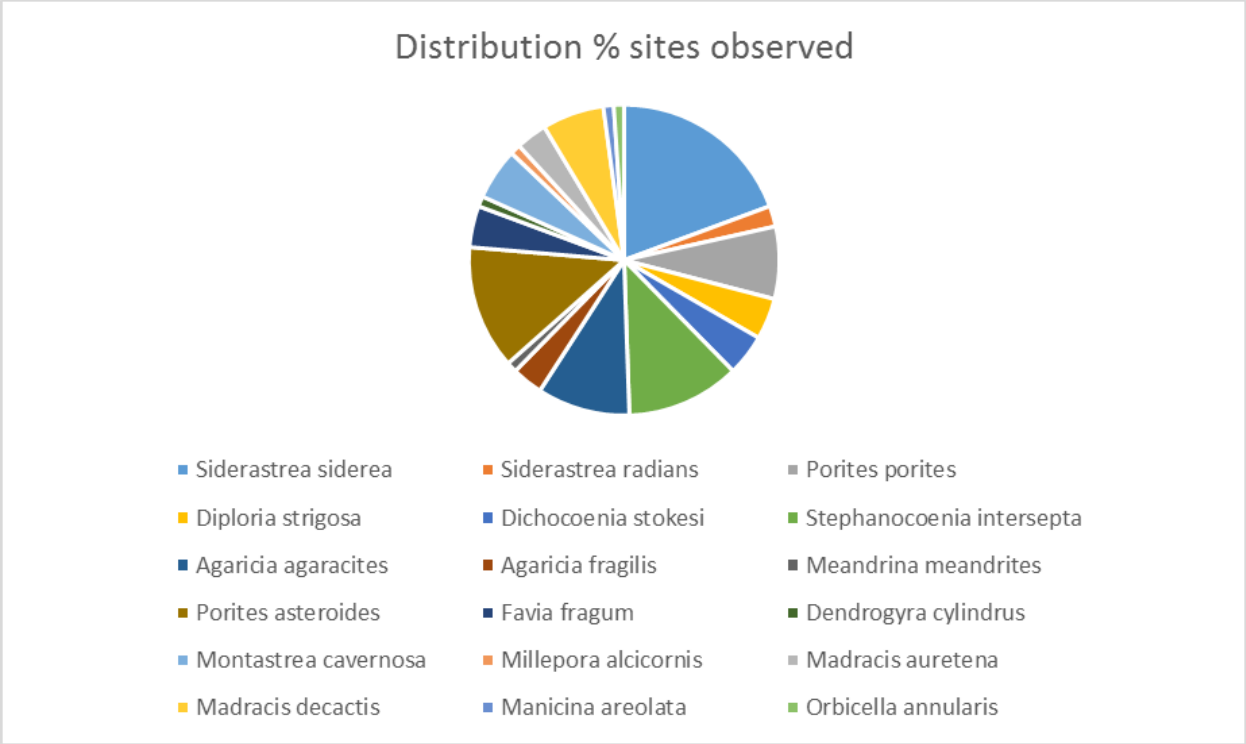
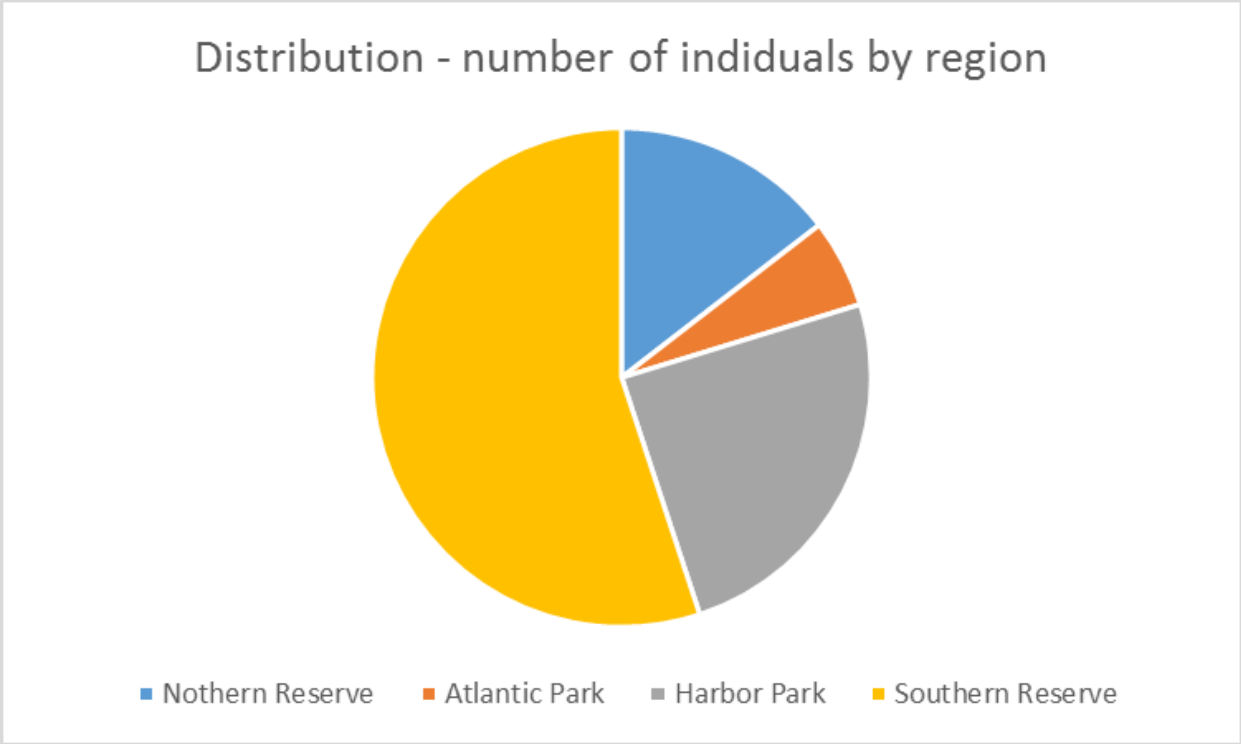


Figure 4.6 Recruit distribution by region.



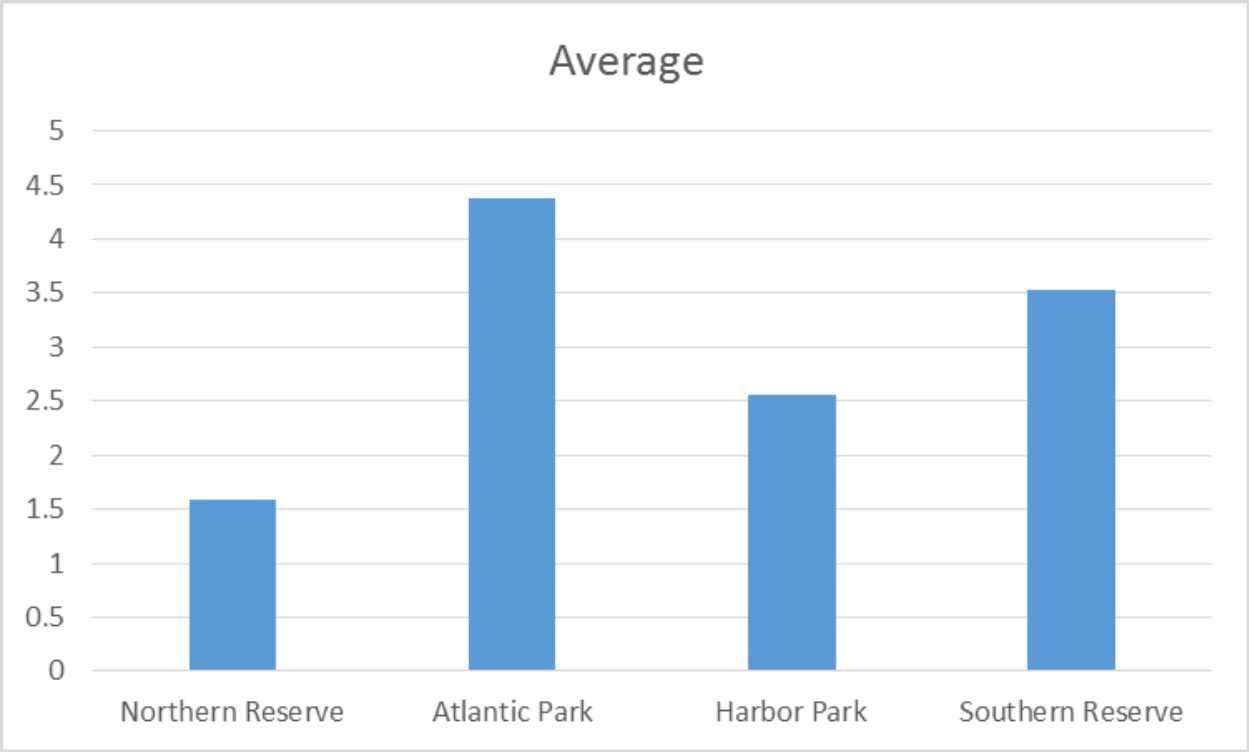
Gem City Consulting
Zeelandia 1, St Eustatius, Caribbean Netherlands
599-318-4364
pionteksteve@yahoo.com

4.25 All 20 sites were surveyed for abundance of key macro-invertebrate species (sea urchins and sea cucumbers) using the 1484 photoquadrats analyzed by Steve Piontek.
Sea urchins were observed in .13% of the 1484 photoquadrats, which gives a sea urchin density of .0025 individuals / m².
Sea cucumbers were observed in .13% of the 1484 photoquadrats, which gives a sea cucumber density of .0025 individuals / m².

4.26 All 20 sites were surveyed in situ for Water quality (i.e. water transparency) by Matt Glue (1 site) and Steve Piontek (19 sites). Minimum horizontal visibility using the Secchi disc was 10 m and the maximum was 43m. The average of the results is 25.7m.

4.27 Measurements used to estimate algal height were conducted in situ by Steve Piontek for eight sites: two sites in the Northern Reserve, one in the Atlantic Park, one in the Harbor Park and four in the Southern Reserve.

Figure 4.7 Average Macroalgae Height by region.



Gem City Consulting
Zeelandia 1, St Eustatius, Caribbean Netherlands
599-318-4364
pionteksteve@yahoo.com

5. DISCUSSION:

5.1 The 20 sites are representative of the forereef habitat in the SNMP. Suitable locations are limited in the SNMP, due to the number of moorings and the difficult dive conditions found on the North Coast and the Atlantic side of the park.

5.21 The density of reef fish in the surveyed areas appears to be reasonable when compared to similar areas in the Caribbean. As more locations are sampled it will be possible to compare the findings. There is cause to be concerned with the size structure of the reef fish. No snappers and only one grouper greater than 41 cm were recorded in the fish surveys. So even though the overall snapper / grouper biomass is reasonable, the low frequency of large snappers and groupers is troubling.

5.22 The recorded percent cover of reef building corals is low at 5%. The actual cover of reef building corals is even lower, since CPCe includes the Milleporids (fire coral) as reef building coral. There are sites within the SNMP having higher coral cover, however they are found deeper than the 8 – 15 meter depth range of the GCRMN protocol.
The high amount of macroalgae is troubling, as it can prevent recruit settlement, outcompete reef building corals and has been linked to coral disease. The actual macroalgae biomass is higher than recorded, since much of the recorded cyanobacteria are growing over the macroalgae. Even more troubling may be the high cyanobacteria cover. Cyanobacteria are thought to be a sign of anthropogenic impacts, particularly nutrient loading, and is linked to coral disease.
Although not represented statistically, there is a low occurrence of large reef building coral colonies. This may be a result of natural impacts such as frequent hurricanes and anthropogenic impacts, most noticeably siltation caused by erosion. The negative impact of erosion is increased by overgrazing of free roaming livestock and poor building practices. The coral colonies may be expending too much energy removing this eroded sediment, which leaves too little energy available for growth.

5.23 Although coral cover is low, so is the prevalence of diseased coral colonies. The disease component requiring management attention is white band affecting the already distressed *Acropora cervicornis* population.

5.24 The high density of coral recruits is encouraging, with the potential for higher coral cover in the future. 40% of the observed recruits were one species: *Siderastrea siderea.*

5.25 The low frequency of sea urchins reflect the Caribbean wide decline in these populations. Discovering these organisms in a photoquadrat is difficult, if sufficient field support is available it would be better in future surveys to sample the macro invertebrates in situ.

5.26 The Secchi measurements accurately reflect the water quality during the sampling, it is only a minimum indicator however. In the future, if sufficient field support is available it would be better to also sample additional parameters related to water quality: sedimentation, dissolved oxygen, nutrients, temperature, pH, salinity and others. Or at least to do the Secchi measurements frequently throughout the year at each site/area to get an average value.

Gem City Consulting
Zeelandia 1, St Eustatius, Caribbean Netherlands
599-318-4364
pionteksteve@yahoo.com

5.27 The macroalgae and turf algae canopy height is an important component to sample and in the future should be measured for all 20 sites.

6. RECOMMENDATIONS:

Continuing scientifically pertinent monitoring annually in the Statia National Marine Park will provide insight into temporal trends in the reef condition. The use of the regionally accepted GCRMN-Caribbean methods allows for comparison across the region and will help to reflect good management practices. Annual monitoring will not only describe the status of coral reef health in the SNMP but will also assess the effectiveness of local and regional management efforts. Annual monitoring of 20 sites in the SNMP provides a 50% chance of documenting a change of 5% in coral cover as a general guideline

7. REFERENCES:

Biodiversity Monitoring on the BES-islands. 2010. Ministry EL&I.
DE GRAAF M, PIONTEK SE, MILLER D, BRUNEL T. 2015. Status and Trends of St Eustatius Coral Reef Ecosystem. IMARES. (in review)
DILROSUN F (2004) Inventory of the Fishery sector of St. Eustatius. Environmental department, pp. 14.
Fishbase.org
JACKSON JBC, DONOVAN MK, CRAMER KL, LAM VV (editors). 2014. Status and Trends of Caribbean Coral Reefs: 1970-2012. Global Coral Reef Monitoring Network, IUCN, Gland, Switzerland.
KOHLER KE, GILL SM. 2006. Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. Computers and Geosciences (32) pgs 1259-1269.
KLOMP KD, KOOISTRA DJ. 2003. A post-hurricane, rapid assessment of reefs in the Windward Netherlands Antilles. In: LANG JC, editor. Status of coral reefs in the western Atlantic: results of initial surveys, Atlantic and Gulf Rapid Reef Assessment (AGRRA) Program. pp. 404-437.
MCCLELLAN K. 2009. Evaluating the Effectiveness of Marine No-Take Reserves in St. Eustatius, Netherlands Antilles. MSc thesis, Duke University, pp. 71.
SYBESMA J, VAN'T HOF T, PORS LPJJ. 1993. Marine Area Survey – an inventory of the natural and cultural marine resources of Sint Eustatius, Netherlands Antilles. Report, CARMABI Foundation, Curaçao, Netherlands Antilles. Pp 73.
SCHUTJES, A.H.M, 2011. Assessment of opportunities for sustainable agriculture and fisheries on St Eustatius. Min EL&I
WHITE, J., ESTEBAN, N., WHITE, M. P. J., & POLINO, M. (2006). Fisheries Baseline Assessment of Statia Marine Park, St Eustatius, Netherlands Antilles. pp. 31.
Workshop of GCRMN for the Wider Caribbean. 2014. Annex D – Proposed Data Methods.

Gem City Consulting
Zeelandia 1, St Eustatius, Caribbean Netherlands
599-318-4364
pionteksteve@yahoo.com