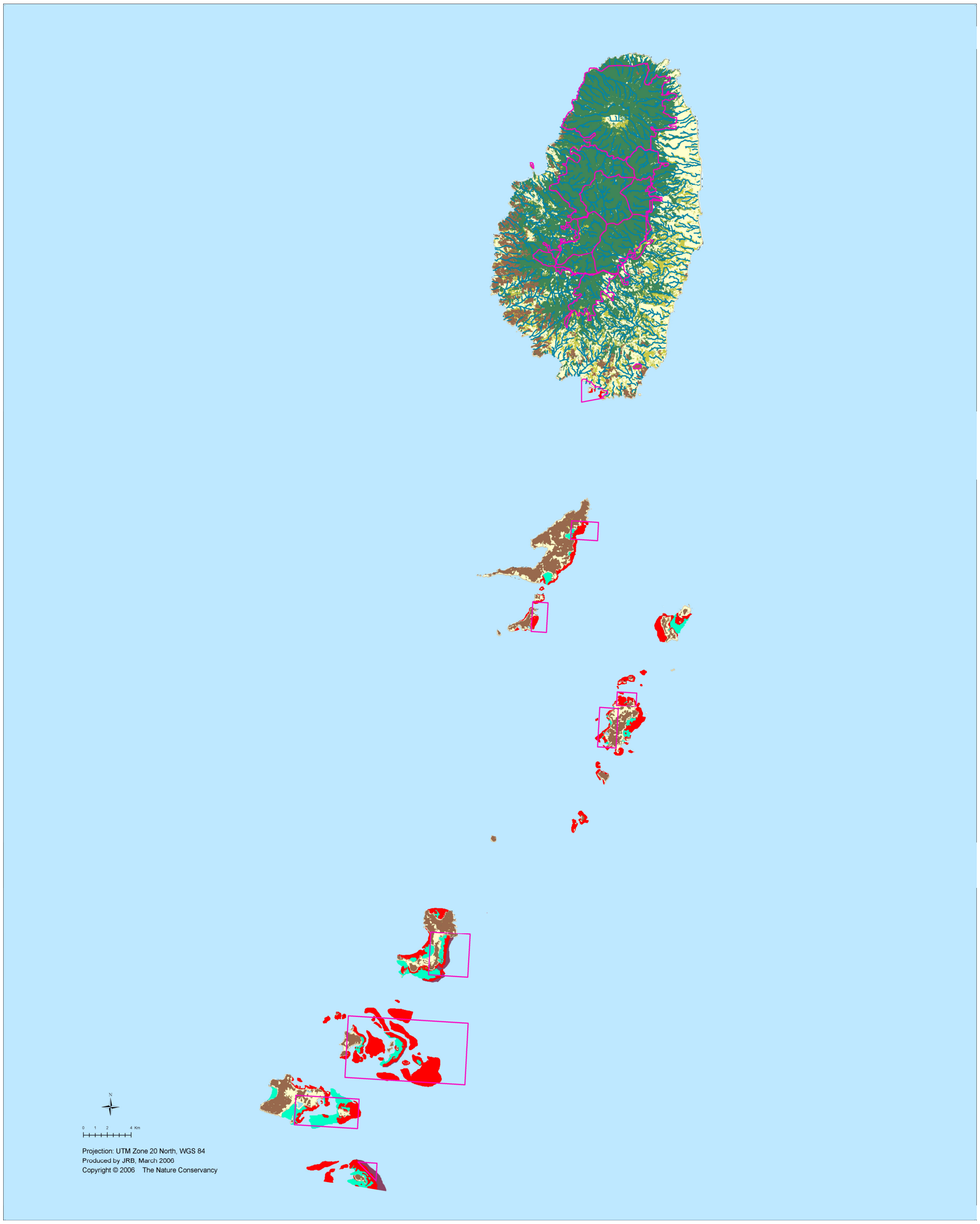
St. Vincent & the Grenadines Protected Areas System Gap Analysis



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Introduction:

At the 7th Conference of the Parties (COP-7) of the Convention on Biological Diversity (CBD) in 2004, governments adopted an ambitious Global *Program of Work on Protected Areas* (PoW). At COP7, a group of 8 international NGOs committed to support government partners in the implementation of this PoW. As a result of this commitment, The Nature Conservancy, CERMES and RARE signed a Memorandum of Understanding (MOU) with the Government of St. Vincent and the Grenadines, in which parties commit to work together in the implementation of this program of work. This MOU is commonly known as the Protected Area National Implementation Support Partnership (NISP).

One of the early actions under the Global Protected Areas Program of Work is the completion of a National Protected Areas Gap Analysis. The National Implementation Support Partnership (NISP) Committee had identified the technical leads from various Governmental, Non-Governmental, and Academic institutions to participate in the St. Vincent & the Grenadines Protected Areas System GAP Assessment Workshops during a meeting in January 2006. The NISP Committee, composed of Ministry of Agriculture, Fisheries and Forestry, Ministry of Health and the Environment, Ministry of Tourism and Culture, The Nature Conservancy, Centre for Resources Management and Environmental Studies (CERMES-UWI) and RARE, lead this initiative. The objective of this analysis is to understand how well the current system of protected areas represents St. Vincent and the Grenadines biodiversity and what actions could be taken to ensure good representation of that biodiversity.

This project will follow the official guide put forward by the Convention on Biological Diversity to conduct gap assessments of protected area systems: Dudley, N., Parrish, J. 2005. Closing the Gap: Creating Ecologically Representative Protected Area Systems. 105 pp.

This guide builds on the best science available for natural resource planning and regional prioritization. It provides a flexible framework for helping government partners complete rigorous gap assessments that eventually lead to more representative and well-designed protected area systems. Once completed, it will be the guiding tool for future actions to be implemented under the CBD Global Program of Work on Protected Areas.

The St. Vincent and the Grenadines Protected Areas System GAP Analysis consisted of a series of three workshops to guide and approve the analysis. The first workshop was held in March 2006 for the purpose of determining the goals of the analysis, selecting biodiversity targets, and assessing management effectiveness of the existing protected areas. The second workshop was held in August 2006 to examine the threats and human activity information which was incorporated into the analysis. The final workshop was held in February 2007 and focused on finalizing the results and developing strategies to fill and prioritize the gaps that were identified. The results of this analysis are intended to compliment the recently completed *Master Plan: System of Protected Areas and Heritage Sites for St. Vincent & the Grenadines, August 2004.*

Conservation Targets:

The first action required for the Gap Analysis is to collect and evaluate the spatial data available which represents the biodiversity of the country. Ideally the spatial data would represent all of the biodiversity at all scale levels from species through ecological systems. Spatial data was not available for most of the biodiversity in the country. The data that did exist was either at too coarse of a scale or of questionable origins. The other main issue for spatial data to be included in the analysis is that the data has to be available for the whole country at the same level of accuracy and scale. While there are some excellent data sets available for specific sites these could not included since they did not cover the country uniformly. Spatial data was gathered through partners and existing data collection/creation efforts by The Nature Conservancy. While many of the data sets collected accurately represent specific habitats others had to be modeled or a surrogate data set used. All of the data was incorporated into a hierarchical classification scheme incorporating the global Major Habitat Type, Ecoregion/Ecosystem, and the fine scale habitat class. All the data transformed to a uniform projection allowing for accurate spatial analysis, the projection used was Universal Transverse Mercator (UTM) Zone 20 North with the datum of WGS 1984.

The terrestrial data is the *International Institute of Tropical Forestry, USDA Forest Service (IITF)* land cover data set derived from satellite imagery at a scale of 30 meters. The classification scheme used is the standard classification scheme of IITF. It was determined that this classification was adequate to cover the terrestrial biodiversity. It was also decided that the habitat classification "Mixed Wood Agriculture" should be included as a target and the other forms of agriculture should not be targets. This habitat was also determined to be a subset of the Windward Island Moist Forest Ecoregion.

The freshwater data was derived by modeling the streams and flows from the topographic data of the islands. There were some additional changes to the Freshwater data in that some streams were wrongly classified and these changes were noted. The freshwater data included two classes of streams. Rivers was the larger class and incorporated all the streams that were above class 7 and Streams included all the streams that were class 4, 5 and 6.

The marine data was the most challenging in that there was not complete biological habitat data available for the whole country. Beaches, rocky shores, tidal pools and mangroves were derived from satellite analysis conducted the previous year as part of TNC's Caribbean Ecoregional Assessment utilizing imagery collected by the IKONOS Satellite, a commercial earth observation satellite that collects images at one and four meter high resolution. Turtle nesting beaches was based on information collected during TNC's Caribbean Ecoregional Assessment. The Coral Reef Habitat, Lagoonal Habitat and the Shelf Slope Habitat in the Grenadines were based on *The Millennium Coral Reef Maps* produced by Dr. Serge Andréfouët of the University of South Florida. This data set was selected because it offered a comprehensive coverage of the whole country and its geomorphology classification was a good representation of the benthic structures that provide the habitat for the marine biodiversity. It is very important to understand that the data represents the geomorphology of the shallow water habitats and not biological cover. It was recognized that the data for seagrass was from a regional dataset and that it severely under represented the occurrence of seagrass, and that seagrass would be dropped as a target and considered nested within the Lagoon Terrace and Reef Flat classes. There was also a lack of data for marine habitat around the main island of St. Vincent. It was determined that this is mostly Shelf Slope, and the data for this habitat was modeled by using bathymetry as a proxy for the habitat, as everything from the shore to the 30 meter depth contour, to be consistent with the depth limitations of the other data.

Existing Protected Areas Data

The data used in the analysis representing the existing protected areas included the boundaries for the Forest Reserves, the Marine Conservation Areas, Tobago Cays Marine Park and the Parrot Reserve. The boundaries for Chateaubelair Islands and King's Hill were missing from the original data set, so these were digitized in from topographic maps.

Representation GAP Analysis

The representation GAP Analysis was conducted to determine the amount (percentage) of each conservation target represented within the boundaries of a protected area. This spatial analysis was conducted by overlaying the protected areas data onto the conservation target data and determining the hectares of each target represented within the each protected areas compared to the overall hectares of the target within the country. The following table illustrates the percentage of each target currently represented within the protected area system.

Marine Target Representation (Percentage)

Level 1: Habitat Medium	Level 2: Major Habitat Type	Level 3: Ecosystems	Level 4: Fine Scale Habitats
Marine 47%	Shelf 50%	Reef Habitat: 50%	Deep Terrace: 13%
			Fore Reef: 41%
			Inter-tidal Reef Flat : 79%
			Pinnacle: 56%
			Reef Flat: 53%
			Shallow Terrace: 72%
			Reticulated Shallow Terrace: 76%
			Sub-tidal Reef Flat: 30%
			Channel: 100%
			Pass: 100%
		Shelf Slope: 4%	Outer Slope: 58%
			Shelf Slope: 2%
		Lagoonal Habitat: 45%	Lagoon Terrace: 45%
	Nearshore 23%		Enclosed Lagoon: 100%
		Rocky Shore 15%	Tidal Pool: 0%
			Rocky Shore: 15%
		Beaches:	White Sand Beach: 41%

		21%	Black Sand Beach: 6%
			Leatherback Nesting Sites: 2%
			Loggerhead Nesting Sites:100%
			Green Turtle Nesting Sites: 34%
			Hawksbill Nesting Sites: 16%
		Mangroves 57%	Mangroves: 57%

Terrestrial and Fresh Water Target Representation (Percentage)

Level 1: Habitat Medium	Level 2: Major Habitat Type	Level 3: Ecoregions	Level 4: Fine Scale Habitats
Terrestrial 42%	Tropical Moist Forest 61%	Windward Island Moist Forest 61%	Forest Cloud Elfin :92%
			Cloud Forest:96%
			Forest Cloud Transitional:84%
			Forest Evergreen and Seasonal:47%
			Agriculture Woody :3%
	Tropical Dry Forest 10%	Lesser Antillean Dry Forest: 10%	Forest Dry Deciduous :15%
			Forest Semi Deciduous :4%
Freshwater 38%	Tropical Island Fresh Water Systems 38%	Fresh Water Bodies: 99%	Emergent Wetlands :99%
			Open Water Bodies :100%
		Streams: 37%	Class 4-6 Streams :27%
			Class 7-8 Streams :38%

Conservation Goals

The results of a preliminary representation GAP analysis were presented during the first workshop. This allowed the group to examine the current status of the targets and to make informed decisions on what would be realistically achievable. The first discussions centered on an overall goal for the country and at what level in the classification scheme should the goals be set. The groups decided to set goals which were a mixture of individual Fine Scale Habitat Goals and Marine Ecosystem/Terrestrial Ecoregion Goals. The goal discussions started off with setting a goal that is considered the best amount ecologically and then was brought down based on what is realistically achievable to the time frame that is selected, by 2020, and considering the limitations on Government resources. The targets ecological significance and environmental services were also considered in the process. The goals were selected to provide greater protection to the upland resources and to marine nursery habitats. Mangroves were considered a valuable resource and it was determined that 75% should be located within a protected area and additional legislation should be crafted to provide additional protection to all mangroves. These decisions were the first effort to include ecological conditions into the analysis. The maps of the current extent of the resources and the protected areas were consulted to determine how realistic the goals were. Since St. Vincent and the Grenadines are a series of small islands, the stakeholders requested that the marine, terrestrial and freshwater analysis be competed as one gap analysis. The consensus was that since all three ecosystems are especially connected on a small island that the best and most accurate gap analysis would be one that analyzed the system as a whole instead of its individual parts. As a result, the inputs and analysis were completed as one system. The final selection of the goals also reflected a natural stratification of the targets. This was important to incorporate the resiliency principles in the overall final design of the system. The following tables illustrate the final goals which were determined during the workshop.

Marine Goals

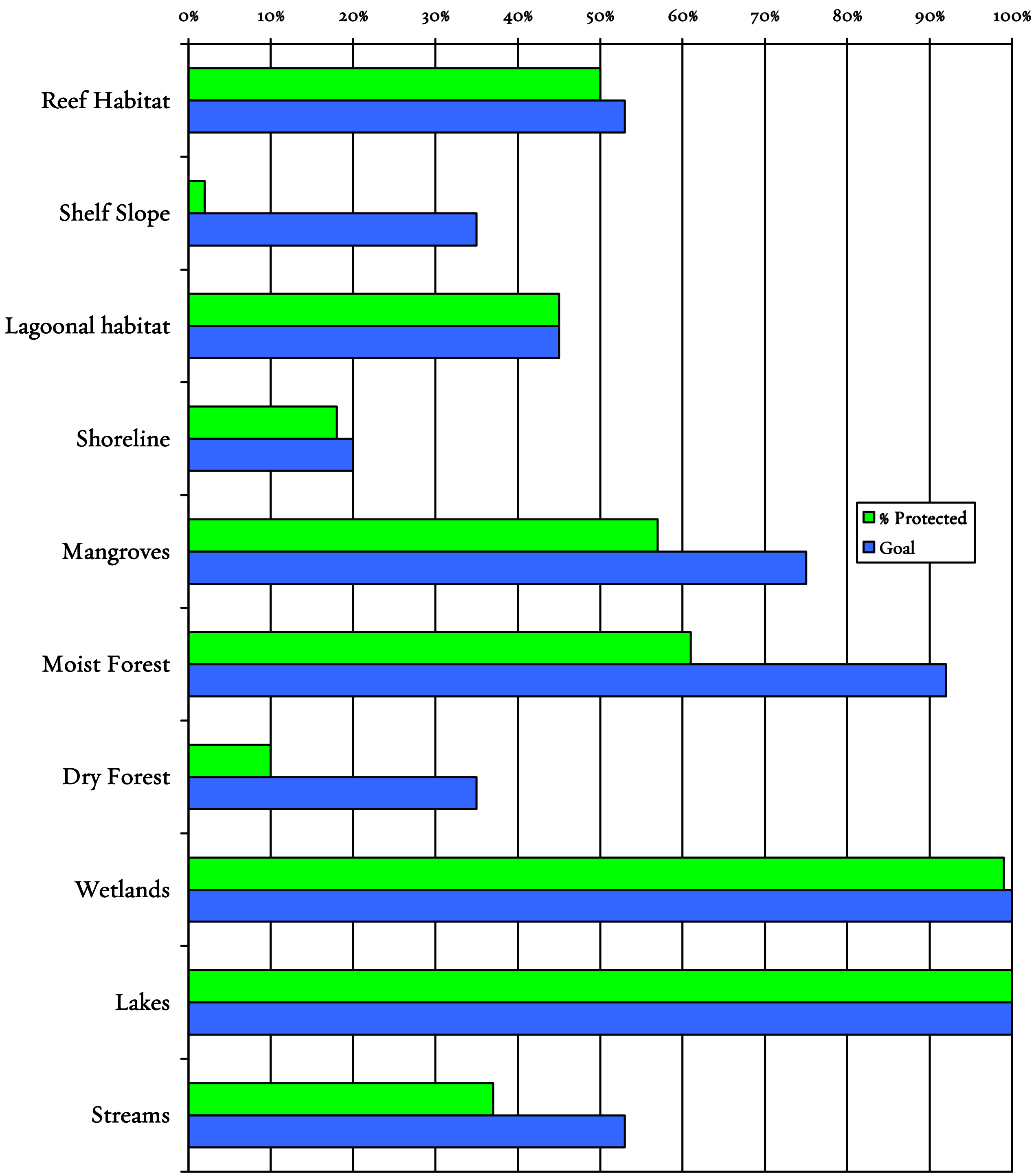
Level 1: Habitat Medium	Level 2: Major Habitat Type	Level 3: Ecosystems GOALS	Level 4: Fine Filter Habitats GOALS
Marine	Shelf	Reef Habitat: 53%	Deep Terrace: **100%**
			Fore Reef
			Inter-tidal Reef Flat
			Pinnacle
			Reef Flat
			Shallow Terrace
			Reticulated Shallow Terrace
			Sub-tidal Reef Flat
			Channel

			Pass
		Shelf Slope: 35%	Outer Slope
			Shelf Slope: 20%
		Lagoonal Habitat: 45%	Lagoon Terrace
	Nearshore		Enclosed Lagoon
		Rocky Shore	Tidal Pool: 100%
			Rocky Shore
		Beaches: 20%	White Sand Beach
			Black Sand Beach: 20%
			Leatherback Nesting Sites: 30%
			Loggerhead Nesting Sites
			Green Turtle Nesting Sites
			Hawksbill Nesting Sites: 30%
		Mangroves	Mangroves: 75 -100%

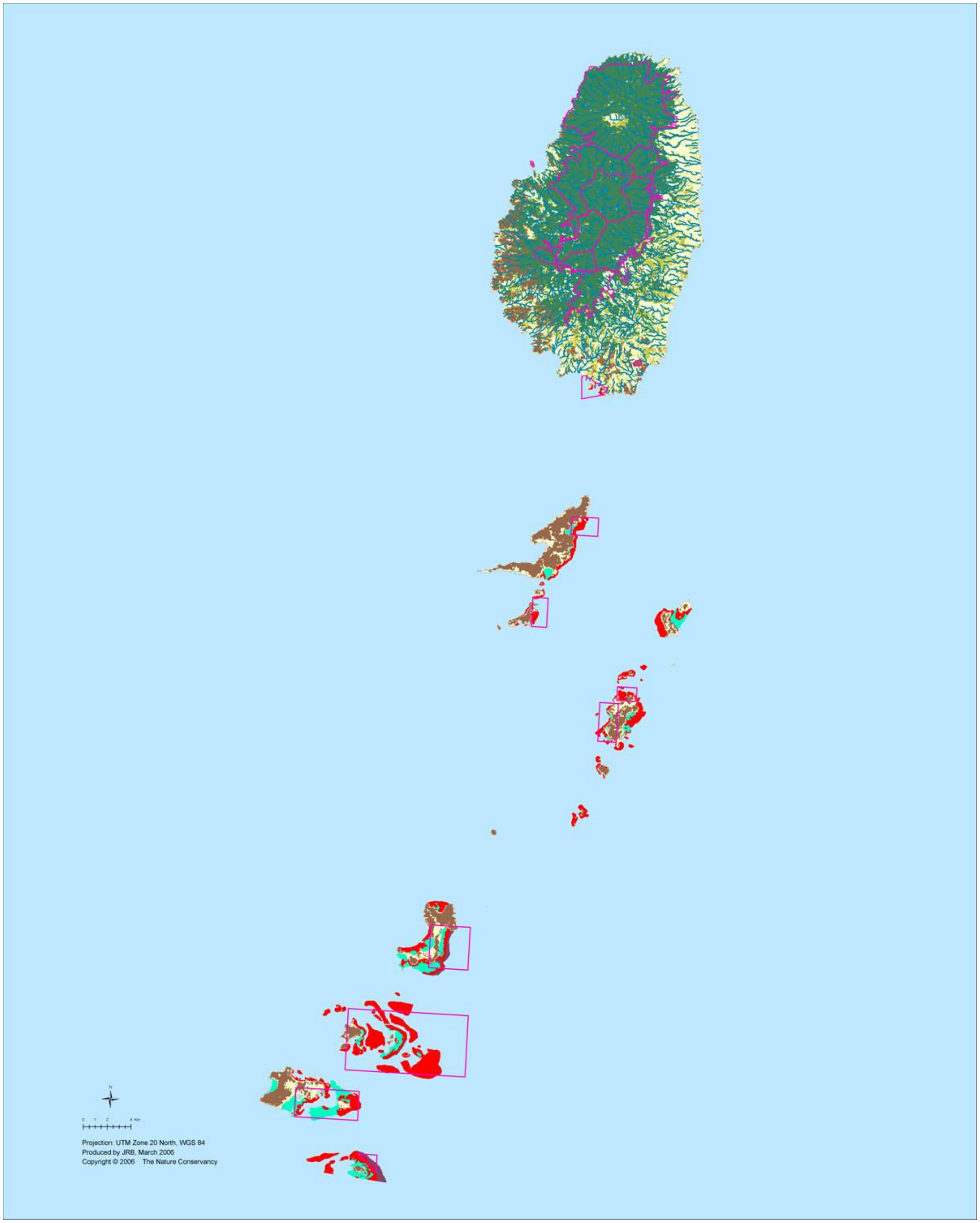
Terrestrial and Fresh Water Goals

Level 1: Habitat Medium	**Level 2: Major Habitat Type**	**Level 3: Ecoregions Goals**	**Level 4: Habitat Classification Individual Goals**
Terrestrial	Tropical Moist Forest	Windward Island Moist Forest 92%	Forest Cloud Elfin **:100%**
			Cloud Forest**:100%**
			Forest Cloud Transitional**:100%**
			Forest Evergreen and Seasonal**:100%**
			Agriculture Woody **:35%**
	Tropical Dry Forest	Lesser Antillean Dry Forest: **35%**	Forest Dry Deciduous **:35%**
			Forest Semi Deciduous **:35%**
Freshwater	Tropical Island Fresh Water Systems	Fresh Water Bodies: **100%**	Emergent Wetlands **:100%**
			Open Water Bodies **:100%**
		Streams: **53%**	Class 4-6 Streams **:50%**
			Class 7-8 Streams **:100%**

The next analysis completed compared the goals to the amount within existing protected areas. This information formed the gap that needs be addressed in the incorporation of new protected areas in order to reach the goals:


0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Reef Habitat
Shelf Slope
Lagoonal habitat
Shoreline
Mangroves
Moist Forest
Dry Forest
Wetlands
Lakes
Streams
% Protected
Goal

Conservation Target Representation within Protected Areas Map:



Environmental Risk and Human Activities

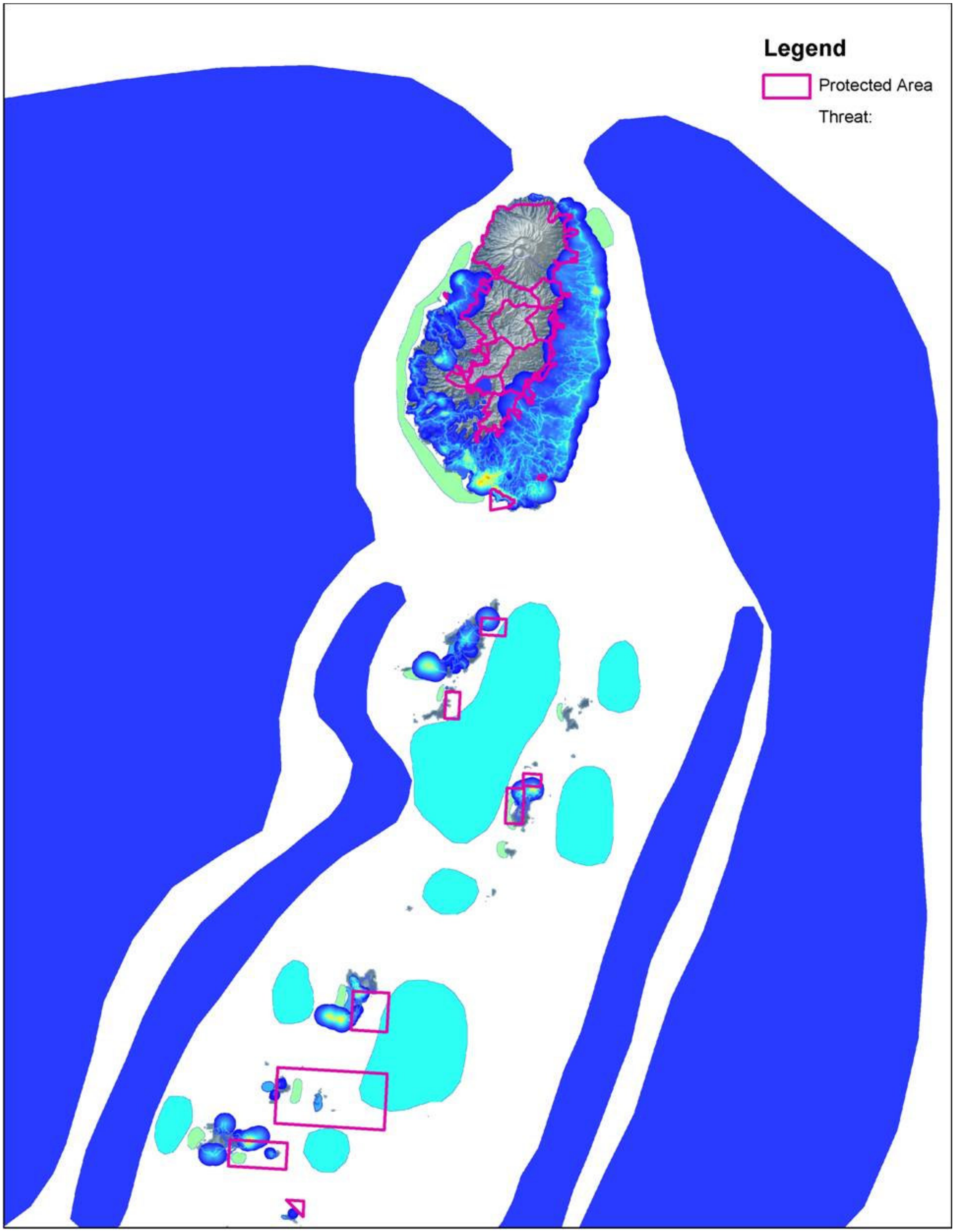
The next stage of the analysis involved the creation of the Environmental Risk data. This data was created to allow for an analysis of the level threats that are currently impacting the biodiversity. Threats to the conservation occurrences were evaluated by the development of a "human footprint" derived from mapped human activities such as roads, development, agriculture, hotels, marinas, ports, population density, fishing intensity, and other extractive industries. The threats were mapped out based on their range of impact and intensity level. The range of impact was expressed by the distance from the activity that the particular activity would still have an impact on biodiversity. The intensity level was based on a relative scale from 0 -100 with 100 being total destruction of all biodiversity. The workgroup evaluated the available spatial data available and determined the distance and intensity values for each activity and adjusted them accordingly for marine, terrestrial and fresh water impacts and within the context of the local conditions. The values were then used to create a Environmental Risk Surface which maps out each occurrence of the human activity and assigns the maximum value for that activity to the actual spatial occurrence and the decreases the intensity value out to the maximum distance of influence. Each resulting dataset was then combined into a cumulative impact map which represented the overall environmental risk to all the biodiversity in the country. The following is the table of human activities with the corresponding distance and intensity values:

Human Activity	Type or value range	T Distance	FW Distance	M Distance	T Intensity	FW Intensity	M Intensity
roads	Major	100	100	200	50	50	50
roads	Minor	60	60	200	50	50	50
roads	Secondary	60	60	200	50	50	50
Foot trails		20	20	20	20	20	20
Population Density	1-9	500	500	500	5	5	5
Population Density	10-49	500	500	500	11	11	11
Population Density	50-99	1000	1000	1000	25	25	25
Population Density	100-199	1000	1000	1000	50	50	50
Population Density	200-499	1000	1000	1000	75	75	75
Population Density	500-999	1500	1500	1500	87	87	87
Population Density	>1000	1500	1500	1500	95	95	95
agriculture	cultivated	500	500	500	25	25	25
agriculture	Rootcrops	500	500	500	25	25	25
agriculture	coconut plantation	500	500	500	17	17	17

Human Activity	Type or value range	T Distance	FW Distance	M Distance	T Intensity	FW Intensity	M Intensity
agriculture	coconut & banana	1000	1000	1000	25	25	25
agriculture	pasture (grazing)	500	500	500	20	20	20
agriculture	banana	1000	1000	1000	30	30	30
agriculture	ganja	0	0	0	20	20	20
tourism	# Hotel rooms 4-14	500	500	500	11	11	11
tourism	15-24	500	500	500	17	17	17
tourism	25-49	500	500	500	25	25	25
tourism	50+	500	500	500	50	50	50
Tourism	Attractions - check doc						
quarries	aggregate and sand	500	500	1000	95	95	95
quarries	Inactive	500	500	1000	85	85	85
golf courses	All	300	300	300	87	87	87
airports	Active and proposed	1000	1000	1000	90	90	90
dumps	All	1000	1000	1000	90	90	90
ports	cruise ship			500			80
marinas	<5 boats	200	200	200	50	50	50
marinas	>5 boats	200	200	200	80	80	80
jettys	All			30			40
dive sites	all			50			20
anchorage	150+ yachts, 50 ft+ length			100			40
anchorage	30m+ ships			100			40
anchorage	yachts on seagrass			100			30
anchorage	cruise ships			100			40
anchorage	mooring and achor, yachts			100			20
anchorage	yachts			100			30
anchorage	no value			100			40
Conch/Lobster	All			0			90

Human Activity	Type or value range	T Distance	FW Distance	M Distance	T Intensity	FW Intensity	M Intensity
Fishing	Beach Seining			50			80
Fishing	Hand Line			0			60
Fishing	Long Lining			0			10
Fishing	Trolling			0			10
Fishing	Spearfishing			0			40
Sewage outfall				200			80
Industrial Waste				100			80

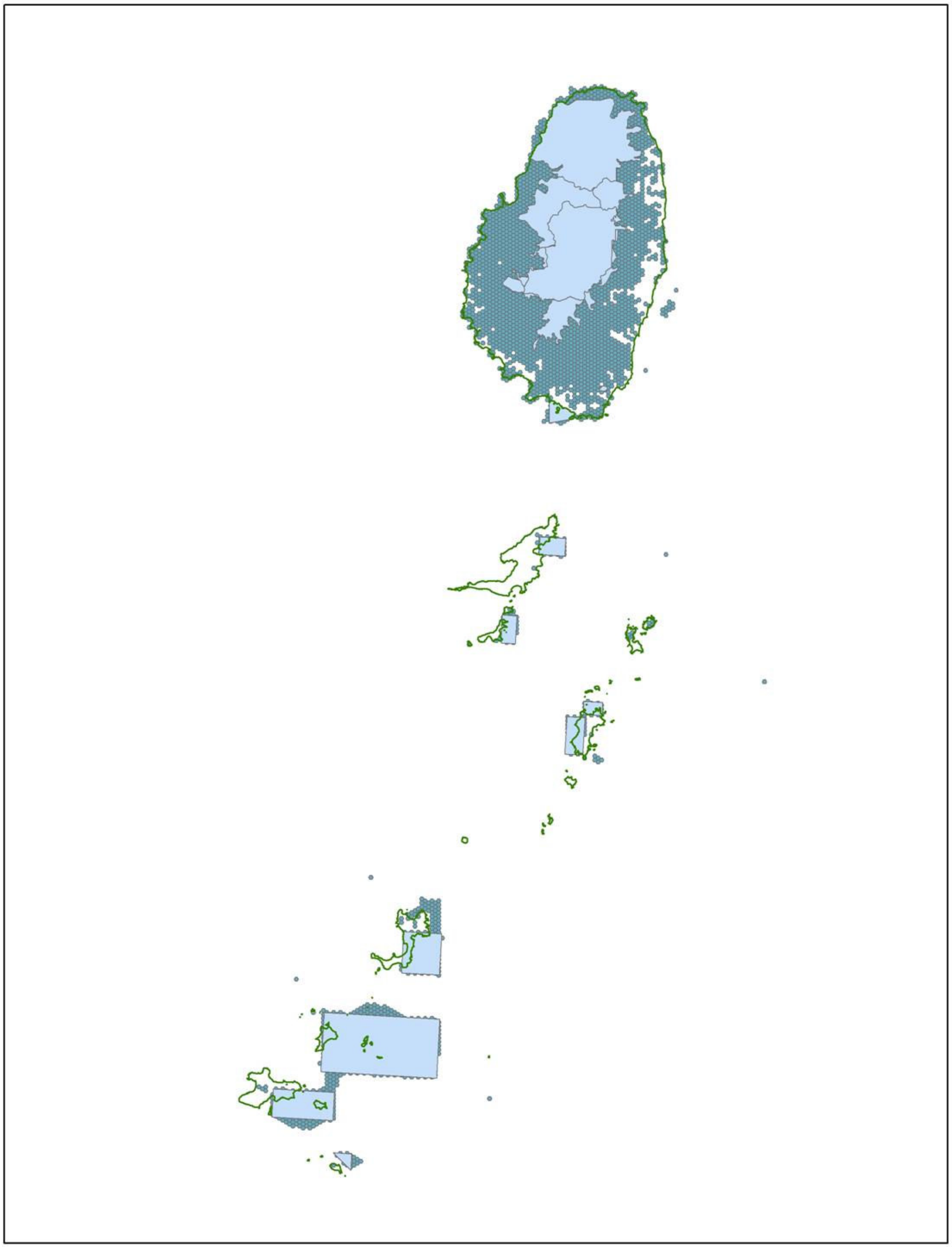
Environmental Risk Map:



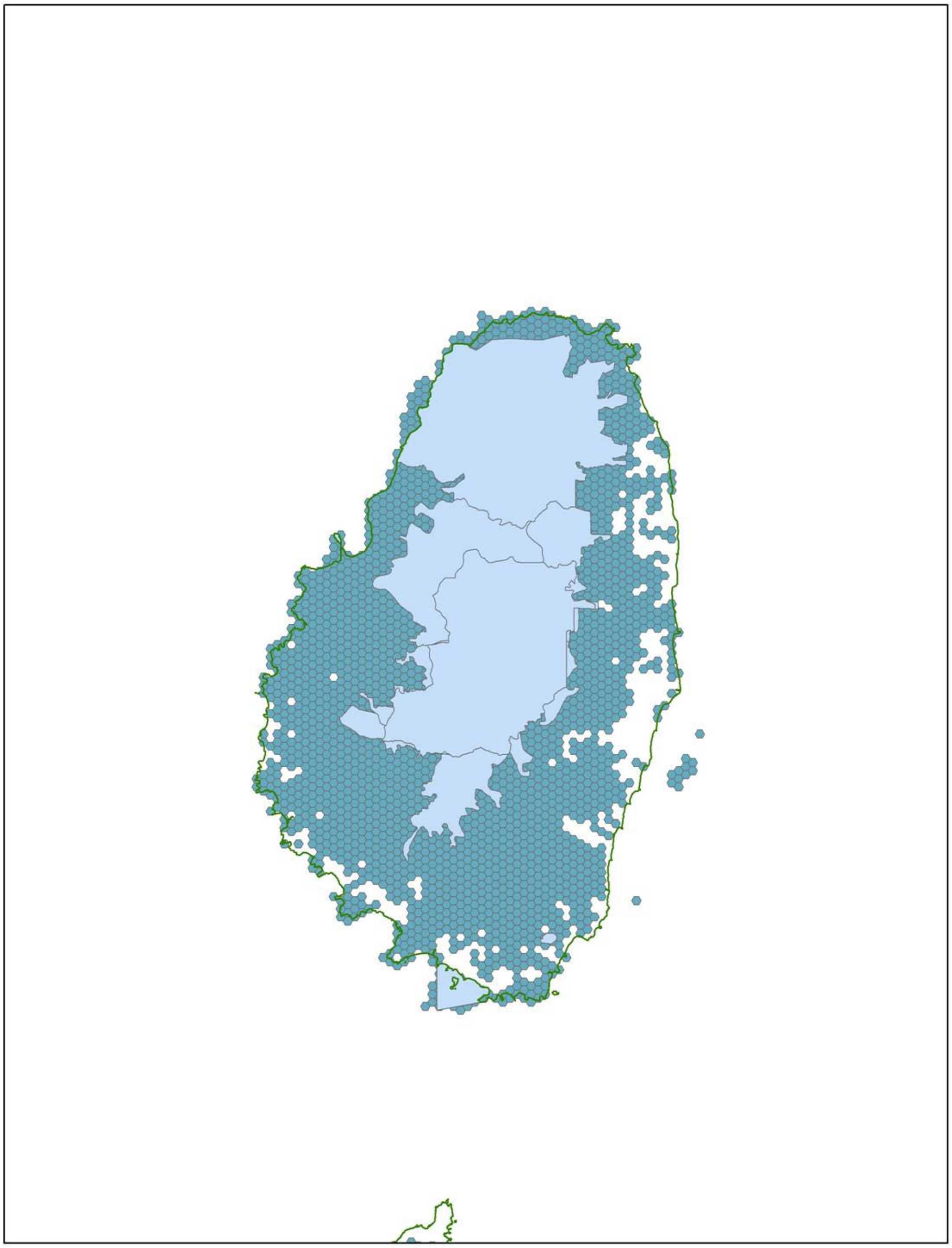
Filling the GAPS

The next stage of the analysis consisted of the utilization of the Caribbean Decision Support System developed by TNC and the spatial planning tool MARXAN to select possible a possible portfolio of sites in order to reach the selected goals. The analytical process of the tools uses the spatial data of the conservation targets and overlays a planning unit data set onto the data. The planning unit is a hexagon of 10 hectares in size the shape and size of the planning unit was selected based on the overall data scale used and the types of biodiversity covered. The size and shape allowed for the best approximation of natural contours and for spatial coverage suitable to the overall extent of the analysis. The tool determined the amount of each conservation target represented within each planning unit, and by overlaying the protected areas data the planning units which are already protected were identified. The environmental risk data was then incorporated into the analysis and the value from this data set was selected for each planning unit. The analysis then utilized the MARXAN software to determine the optimal sites to be included in the final system. MARXAN uses simulated annealing to build planning units into an efficient network or portfolio of priority sites. The algorithm runs through one million iterations to build an efficient portfolio using a cost function to evaluate the portfolio during each iteration. The cost of the network is a combination of the environmental risk value of each planning unit, penalties set for not meeting representation goals and the length of the boundary of the network. The algorithm works by iterative improvement, but also has stochastic acceptance of bad choices. This allows the algorithm to choose less than optimal planning units early in the process that may allow for better choices and overall portfolios later. As the program progresses, the criteria for good selection gets progressively more strict until the portfolio is finally built. This process is automatically repeated for a user defined number of runs, often in the order of 200. The resulting data represented the planning units that were selected to reach the conservation goals while minimizing these costs. The first analysis conducted for St. Vincent resulted in results that the group determined was neither attainable nor realistic. The main reason for this was the ambitious goals of protection for Rivers, Streams and Moist Forests. The team decided to change the goals for these targets to the existing levels of protection and the analysis was conducted a second time. The results of the modified analysis were then utilized in a discussion to determine the final selection of sites for the system of protected areas. The team used the outputs of the analysis along with their local expertise to select the final sites.

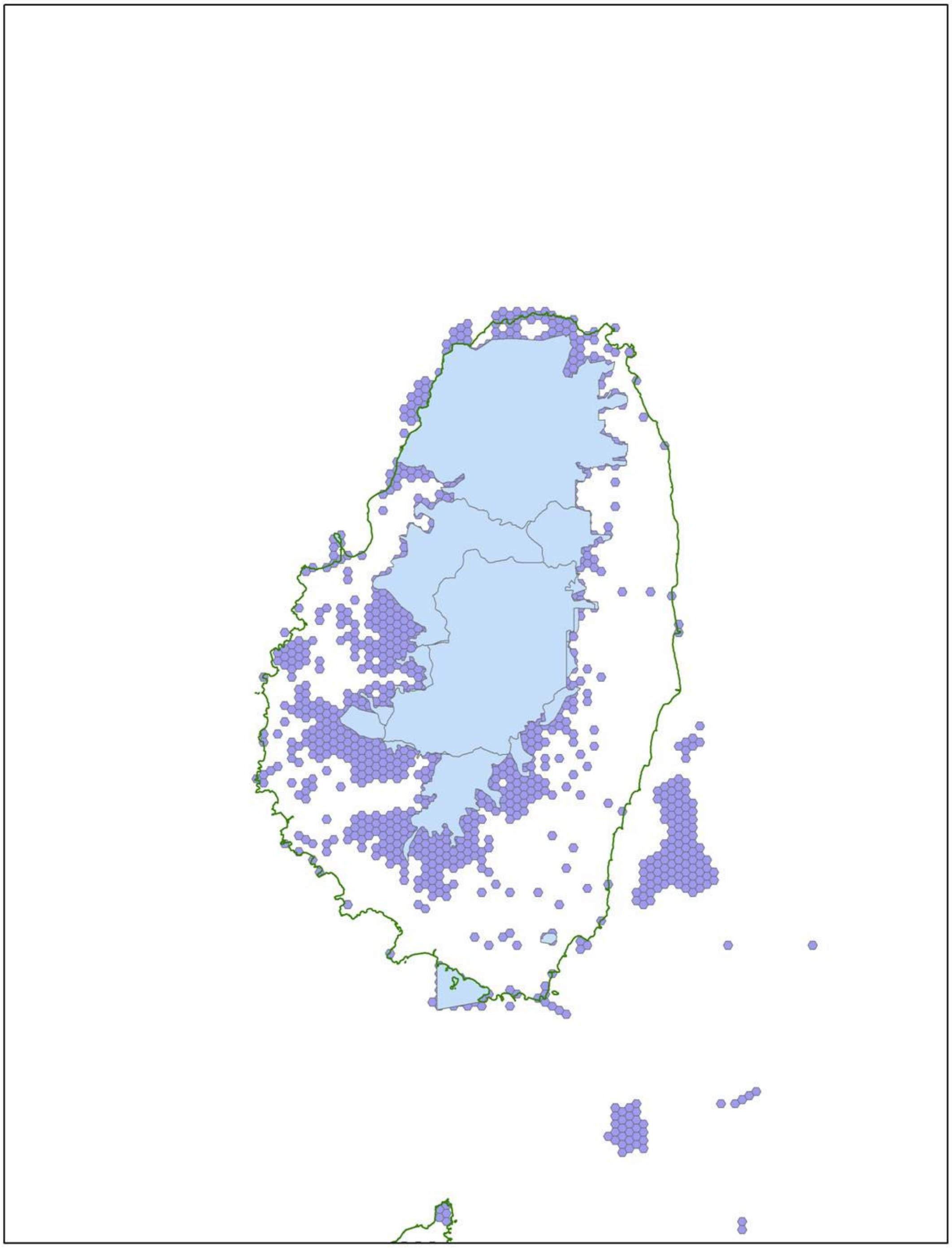
Map of the initial analysis results:



Close up view of St. Vincent's initial results:



Modified Goals Results for St. Vincent:



Final System and Prioritization

The final portfolio of sites selected by the working group included the existing protected areas, the creation of two protected areas management units for the Grenadines (Northern

Grenadines and Southern Grenadines), extension of existing reserves in Fenton, Beaumont, Cumberland Watershed and Owia & Fancy. There was also the decision to include the Leeward Coast Management Area which was included in the Master Plan: System of Protected Areas and Heritage Sites.

The team then prioritized each of the new sites based on the ecological importance, the overall threat level to the biodiversity in the site and the feasibility of establishing effective management of the site. The following table is the summary of the prioritization.

Site Prioritization Worksheet

Site	Ecological Importance	Threat Level	Feasibility	Final Ranking
Southern Grenadines Management Unit	Very High	Very High	Medium	High
Northern Grenadines Management Unit	Medium	High	Medium	Medium
Buccament/Vermont Corridors	High	High	Medium	High
Leeward Coast MPA	High	High	Medium	High
Cumberland Corridors	High	Medium	Medium	Medium
Owia & Fancy	High	Medium	Medium	Medium
Fenton Corridors	High	High	Medium	High
Soufriere	Very High	High	Very High	Very High

The workgroup then decided on the mechanism for implementation, the lead agency and the timeframe for implementation for each site. The following table illustrates these results.

3rd PROTECTED AREAS SYSTEM GAP ASSESSMENT

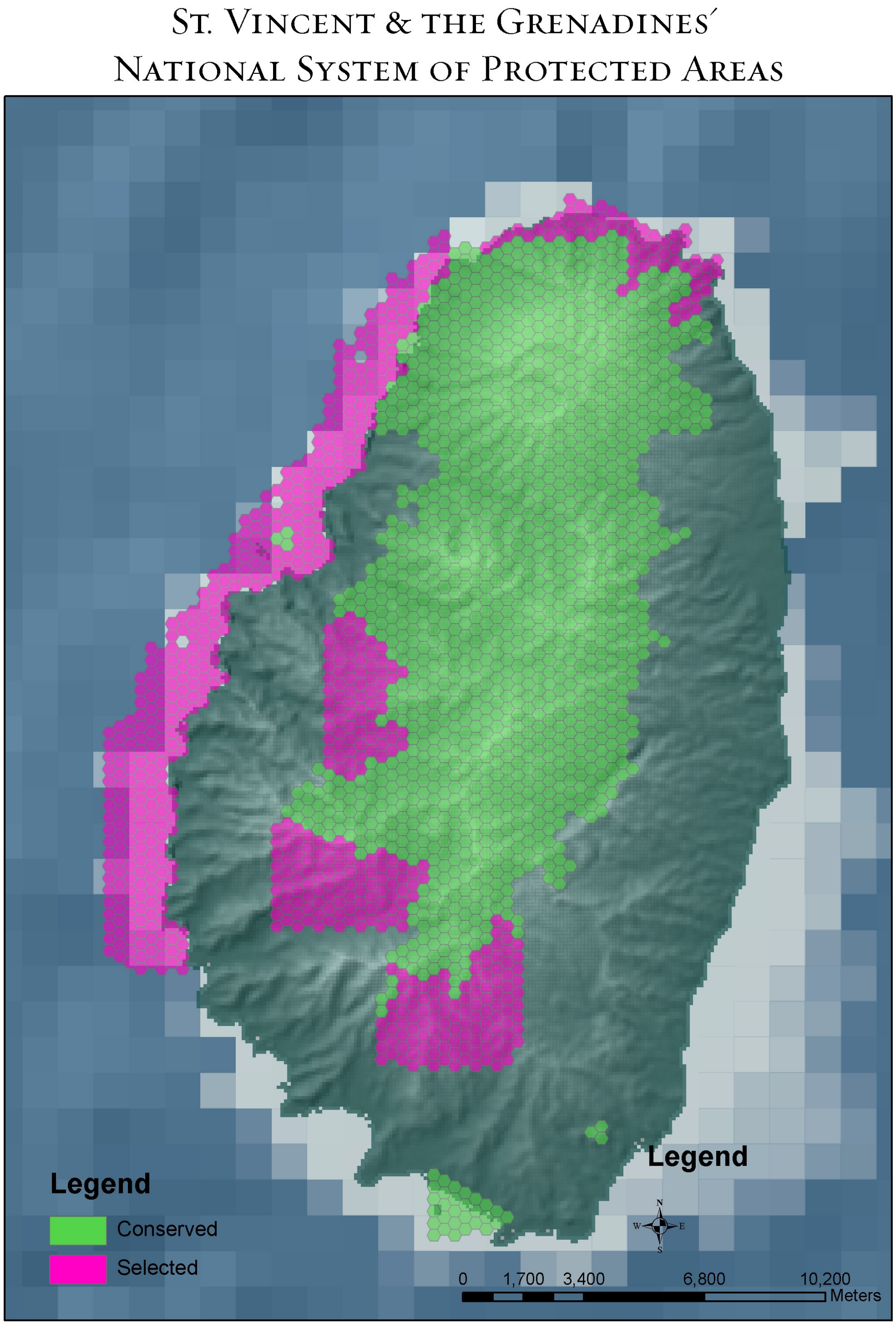
&

PROTECTED AREAS MANAGEMENT STRATEGIES WORKSHOP

Site Strategies Worksheet

Site	Priority	Mechanism	Lead	Timeframe
Southern Grenadines Management Unit	**High**	National/Marine (?) Parks Acts	National Parks/Fisheries	2010-12
Northern Grenadines Management Unit	**Medium**	National/Marine (?) Parks Acts	National Parks/Fisheries	2015
Buccament/Vermont Corridors	**High**	Forestry/National Parks Acts	Forestry/National Parks/	2010-2012
Leeward Coast MPA	**High**	National/Marine (?) Parks Acts	National Parks/Fisheries	2010-designed and Planned, 2012 implemented
Cumberland Corridors	**Medium**	Forestry/National Parks Acts	Forestry/National Parks/	2010-2012
Owia & Fancy	**Medium**	Forestry/National Parks Acts	National Parks/Forestry	2010
Fenton Corridors	**High**	Forestry	Forestry/Physical Planning	2009
Soufriere	**Very High**	Forestry/National Parks Acts	National Parks/Forestry	2010

Final Proposed System for St. Vincent:



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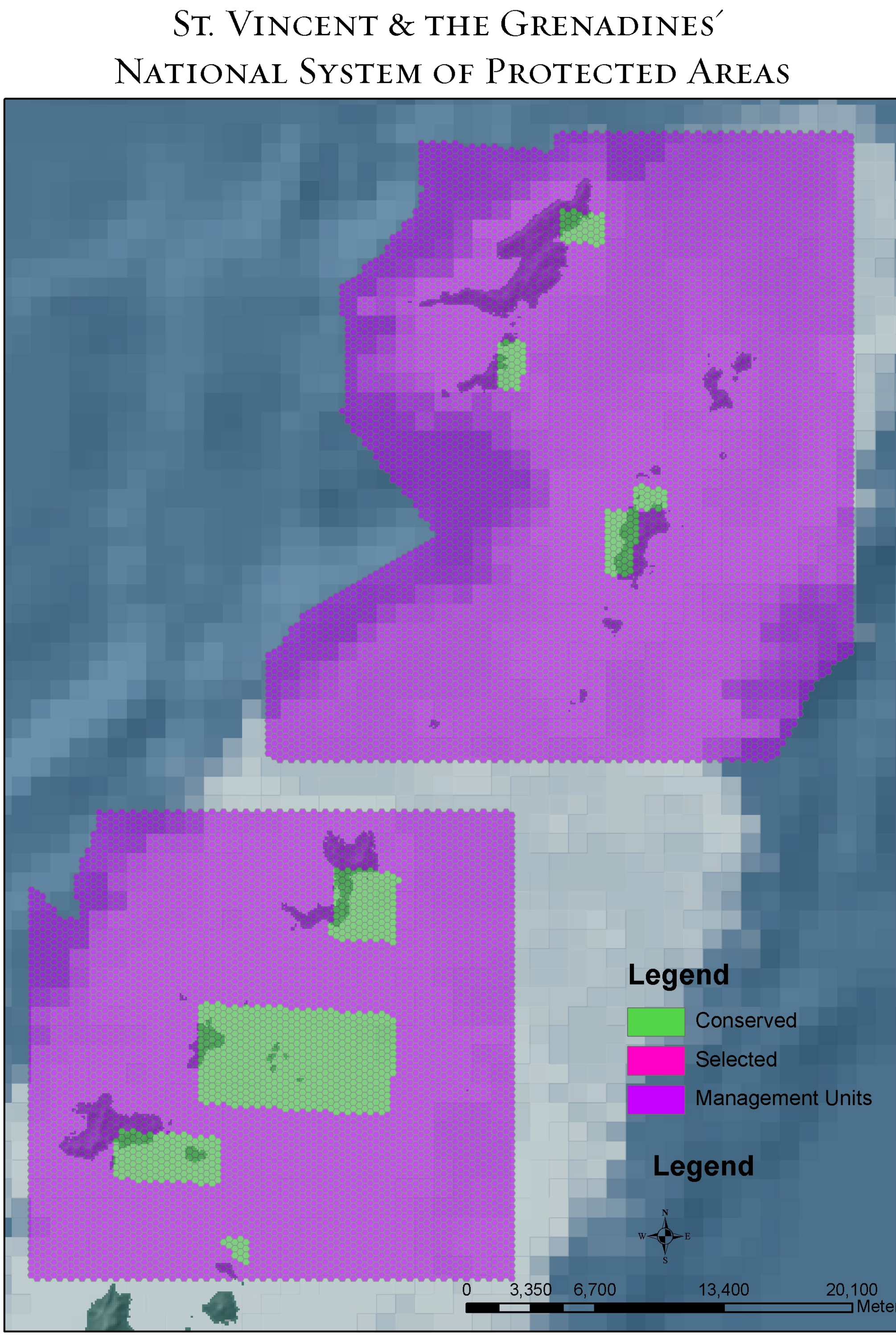

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