Belize Protected Areas Policy and System Plan: RESULT 2: Protected Area System Assessment & Analysis

PUBLIC DRAFT

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APRIL 18, 2005

Report to the Protected Areas Systems Plan Office (PASPO)

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Acronyms.

BAPPA = Belize Association for Private Protected Areas
BAS = Belize Audubon Society
CBWS = Cockscomb Basin Wildlife Sanctuary
CSO = Central Statistical Office
CZMAI = Coastal Zone Management Institute
DEM = Digital Elevation Model
Dept. = Department
FD = Forest Department
FR = Forest Reserve
ft = foot / feet
GIS = Global Information System
GOB = Government of Belize
Ha = hectare
IUCN = World Conservation Union
km = kilometer
km² = square kilometer
LIC = Land Information Center
m = meter
MET = Meteorology Department
NAD = North American Datum
NICH = National Institute of Culture and History
NGO = Non-Governmental Organization
NPAPSP = National Protected Areas Policy and Systems Plan
PA = Protected Area
PASPO = Protected Areas Systems Plan Office
PfB = Programme for Belize
RBCMA = Rio Bravo Conservation and Management Area
shp = shapefile
SPAG = Spawning Aggregation
sq. = square
TF = Task force
TNC = The Nature Conservancy
US = United States
UTM = Universal Transverse Mercator
WCS = Wildlife Conservation Society
WRI = World Resource Institute
WWF = World Wildlife Fund

1. INTRODUCTION

1.1. Background

Belize has a high proportion of its land and sea resources protected under a variety of management structures. This system of Protected Areas has evolved over several decades, reflecting changing conservation attitudes, as has the scope and direction of the various agencies responsible for its administration. However, Belize now finds itself at a crossroads: the system represents a wealth of valuable resources, yet, in the face of calls for additional reserves, how should it be developed, and how should it be integrated more effectively with the national economy?

In October 2003, the Deputy Prime Minister and Minister of Natural Resources and the Environment, in collaboration with the Minister of Agriculture and Fisheries and the Minister of Tourism, established a Task Force – with representation from the relevant administrative agencies – charged with ensuring that a comprehensive National Protected Areas Policy and Systems Plan was prepared.

In 2004 a "Work Plan" has been prepared (Meerman et al, 2004) for the specific purpose of guiding the formulation of the National Protected Areas Policy and System Plan. The fundamental requirements of an inclusive and viable Policy and Systems Plan are set out as five 'Results' – these are the intended goals of the planning process.

Reflecting the current thrust in national development, the Work Plan is founded on the need to ensure that biodiversity conservation becomes an important and integral part of national social and economic development. The adopted guiding principle being that the potential contribution of the Protected Areas System to national development and poverty alleviation is maximized, thereby putting the system on a sound and rational footing.

The five 'Results' build on each other, and each are to be achieved through a series of 'Actions' in a step-by-step approach. Attention has been taken to ensure an efficient flow of activity so that the Work Plan can be completed efficiently, culminating in the National Protected Areas Policy and System Plan.

Of these 5 results, this report deals with **Result Two** – Protected Areas System Assessment & Analysis which was defined as:

> *"A comprehensive system of protected areas, linked to their surrounding land- and seascapes, is proposed based on the Ecosystem Approach*" – focuses on the analysis of the current status of the Protected Areas System, and on opportunities for its optimization.

Within result two, the attributes of Belize's natural resources and the Protected Areas system were to be assessed, including all ecotypes, cultural monuments, critical habitats, watersheds, land suitability, use and ownership, and areas vulnerable to natural or climate-related change. This is assessed in the light of proposals for new and/or consolidated protected areas, and for biological corridors, with regard to identified threats to the system. Moreover, the national list of critical terrestrial/marine species is updated.

Through this process, gaps in the system are identified and a relative scoring system developed to guide proposals for the rationalization of the system.

1.2. Process

To facilitate the Protected Areas System Assessment and Analysis (Result 2), the Project Coordinator implemented a "consortium" of NGO's and Government Departments active in Conservation Management in Belize. In addition, a lead consultant was hired. The function of the lead consultant was to be:

To assist and liaise with the Project Coordinator closely to ensure the successful completion of Result 2: Protected Areas System Assessment and Analysis.

- Facilitate and promote the participation, and work with the members of the Consortium to develop the Result 2.
- To maintain a constant communication with the Consortium members.
- To fill the information gaps to develop properly the actions within Result 2.
- To attend the Consortium technical meetings called by the Project Coordinator, related to issues and decisions to be made on the Result 2.
- To support with personal own data and information the development of the actions.
- To visit, interview and request information from GOB, NGO's and other sources to complete and update the information needed.
- To develop a first draft of a comprehensive Protected Areas System, and present it for discussion to the Project Coordinator and later to the Consortium.
- To present to the Project Coordinator a final draft, reviewed by the Consortium, of comprehensive Protected Areas System document.

The main purpose of the Consortium was to establish a group of experts needed to support the completion of the sub-actions defined in Result 2: Protected Areas System Assessment and Analysis as one component in the development of the National Protected Areas Policy and Systems Plan for protected areas in Belize.

Consortium members for this project included:

- World Wildlife Fund (WWF) a U.S non-profit organization, represented in this statement by Melanie McField in her position as Senior Program Officer/Mesoamerican Reef;
- Programme for Belize (PfB) a Belizean non-profit organization with its head office in the City of Belize, Belize, represented in this statement by Wilber Sabido in his position as Technical Coordinator;
- Wildlife Conservation Society (WCS) a U.S. organization with its head office in New York, United States of America represented in this statement by Janet Gibson, in her position as Associate Conservation Scientist Marine Program – Belize and Bruce Miller, Associate Conservation Zoologist;
- The Nature Conservancy (TNC) a U.S. organization with its head office in Washington D.C., United States of America represented in this statement by Carolyn Goldman in her position as Program Manager, Belize Country Program;
- The Coastal Zone Management Authority Institute (CZMAI) a Belizean organization with its headquarters in Belize City, Belize.
- The National Protected Areas Policy and Systems Plan Project (NPAPSP) a Belizean organization with its headquarters in Belmopan, Belize and represented in this statement by Roger Morales and Yvette Alonso in their position as (acting) Project Coordinators.
- Belize Audubon Society (BAS) a Belizean non-profit organization with its headquarters in Belize City, Belize and represented in this statement by Diane Moore in her position as Advocacy and Policy Program Manager.

- The Fisheries Department of the Ministry of Natural Resources.
- The Forest Department of the Ministry of Natural Resources.

Throughout the process, all consortium members shared information and experiences based on previous or on going programs, projects and actions that were relevant to the development of Result 2. Each member provided the information required for the development of the sub-actions in the most analyzed format based on their capabilities. Members pursued the coordination and harmonization of the development of information contributed aimed at fulfilling specific actions and sub-actions in Result 2 with the lead consultant and the NPAPSP project.

Previous to the NPAPSP Result 2 analyses, a tri-national Ecoregional Planning effort for “Las Selvas Maya. Zoque and Olmeca” was started. The effort is being implemented as a joint project by Pronatura-Península de Yucatán (Mexico), Ecosur (Mexico), Defensores de la Naturaleza (Guatemala), TNC (Mexico, Guatemala, Belize), WCS (Mexico, Guatemala, Belize) and Programme for Belize.

The Ecoregional Plan proposes a network or portfolio of strategic sites which will permit the conservation of natural communities, ecological processes and species that best represent and guarantee the biodiversity of the Selva Maya ecoregion. The sites are selected through a rigorous analysis of existing information on biodiversity within the ecoregion. The Plan also develops strategies for the conservation of the sites identified. The strategies are based on the socio-economic situation and culture of the ecoregion, existing opportunities and threats and institutional capacity.

The process followed by this Ecoregional Planning Process, had so many overlaps with the NPAPSP Result 2 efforts that efforts were coordinated from the very beginning of the study. Both sides gathered and shared data. The principal difference between the two processes being the scale on which each worked. Because of the large size of the Ecoregional Planning Unit, data input was on a relatively coarse scale. The Belize effort could work on a finer scale and thus could access additional data for fine-tuning of the process. Also note that the Ecoregional Planning Process did not address marine conservation efforts. Similar efforts for the Marine component were carried out by both the World Resource Institute - WRI and TNC which have complementing marine data for the entire Caribbean region.

Altogether, this initiative sought to provide an inclusive participation from all those working towards the same goals of protected areas conservation and sustainable management. A flow chart outlining the process followed is represented in Figure 1.

During a final meeting on Monday April 11th, 2005, the consortium approved the lead consultants draft report and analysis based on their combined input. Based on this, this public draft was prepared and distributed on April 18, 2005.

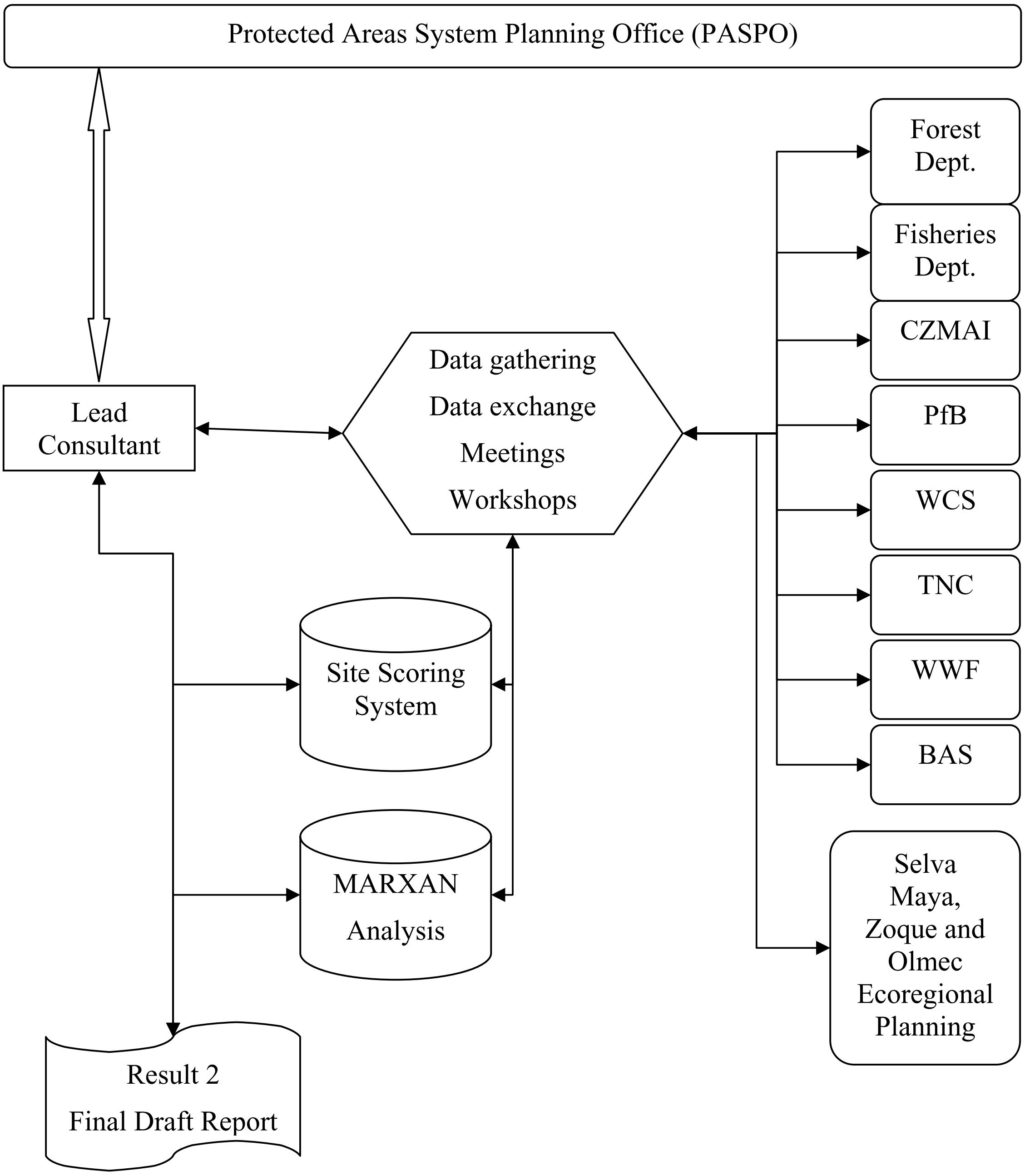


Figure 1. Flowchart showing the process followed during the NPAPSP Result 2 analyses.

2. Analysis of the existing Protected Areas System.

2.1. Size of Belize

Much confusion exists about the true amount of protected areas in Belize and the total coverage of these protected areas in comparison with the total territory of Belize.

An analysis was made using the most recent information on the individual protected areas in Belize (status as per January 1, 2005). The results of this analysis will be discussed below.

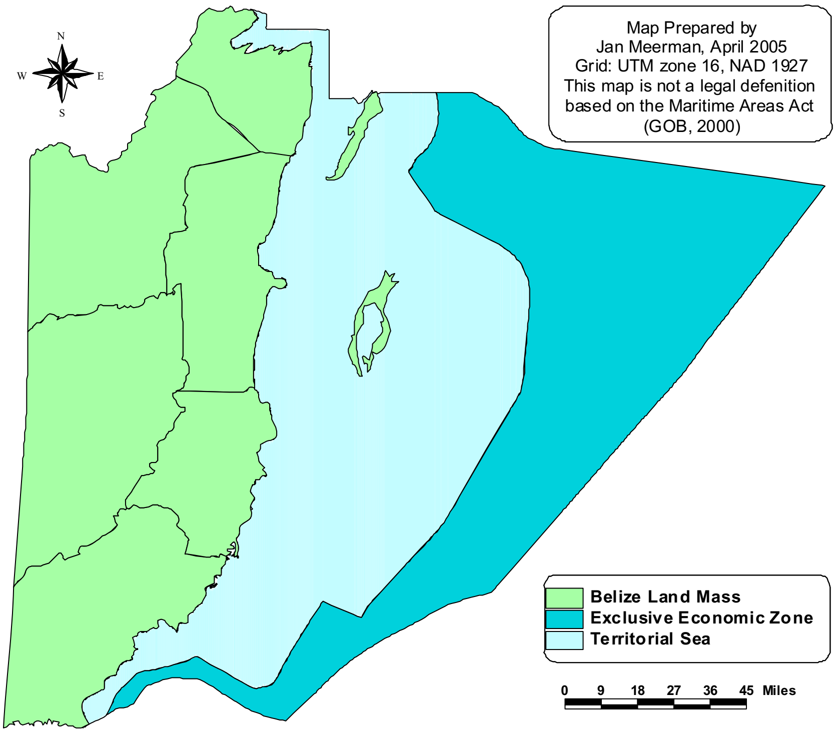


Figure 2, Belize's Territory

In order to put the figures discussed into perspective, it is important to establish the total territory of Belize first. Based on GIS analysis, even when realizing that this does not provide a true surface calculation, the following estimate figures were reached:

Table 1. Land and sea surface area

	Acres	Hectares
Land	5,467,840	2,212,760
Territorial Sea	4,609,230	1,865,300
Exclusive Economic Zone	3,968,190	1,605,880
Total National Territory	14,045,260	5,683,940

These figures by no means assume to be legally correct estimates. They are merely figures to work with. It is important to realize that the "Exclusive Economic Zone" has usually not been considered when estimating the total territory of Belize. This is also the first time this offshore area is being included in any protected areas analysis.

2.2. Protected Area Categories

There exist a total of 94 protected areas in Belize (including archaeological reserves and accepted private reserves)(Figure 3). Several of these reserves, particularly in the Marine realm have gazetted management zonation. When these zones are taking into account the number of "management units" increases to 115. There is also some overlap. Particularly the "Spawning Aggregations", which are technically "Marine Reserves", have often been created partly inside already existing marine reserves and should possibly best be considered a zonation category within these marine reserves.

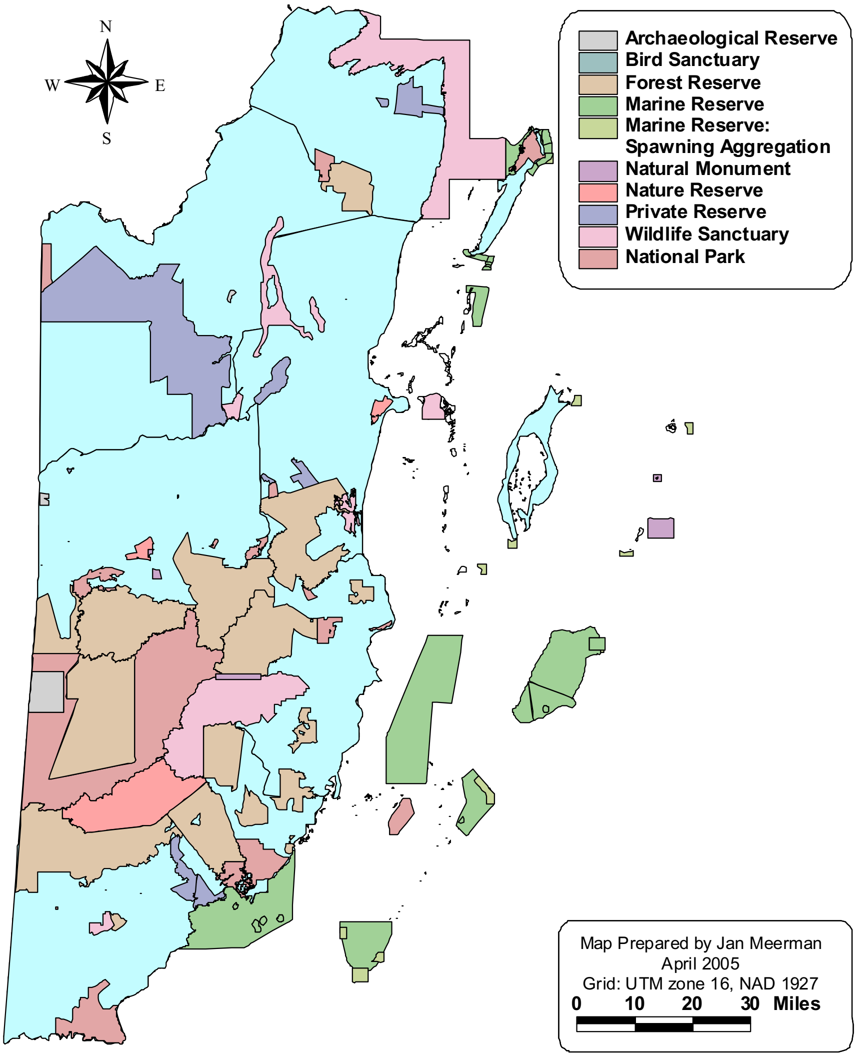


Figure 3. Protected Areas Map of Belize as per January 1, 2005.

A total list of these protected areas can be found in appendix 1. There exist many categories of protected areas but they can be grouped in the following broad categories:

2.2.1. Bird Sanctuaries

Figure 4. Bird Sanctuaries

The 7 Bird Sanctuaries are some of the oldest protected areas (Crown Reserves) that have biodiversity conservation in mind. They were gazetted in 1977 for the protection of waterfowl nesting and roosting colonies. All of them are tiny islands with a combined surface of 14.7 acre/6.0 ha.

There is surprisingly little information on these bird sanctuaries. No recent counts or species occupation data appear to be available. This is a clear data deficiency. Particularly given how easy it would be to gather such data on an annual basis.

2.2.2. Archaeological Reserves

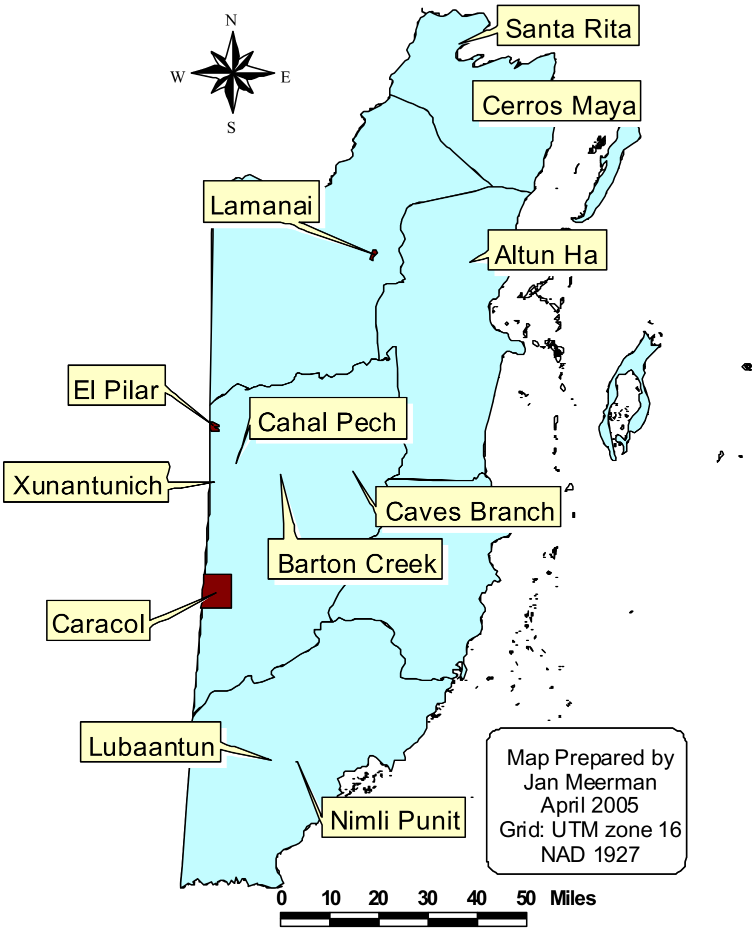


Figure 5. Archaeological Reserves

Archaeological Reserves include a number Maya Sites managed by the National Institute for Culture and History (NICH). Total surface of these sites is approximately 28,620 acres or 11,580 ha (0.2 % of national territory). It is important to notice that essentially all Archaeological Sites are protected under the Ancient Monuments and Antiquities Act of 1972 (Revised 1980). The 12 archeological reserve sites listed here are the only ones included in the analysis. Additional Sites were only available as point data and as such could not be used in the area calculation.

2.2.3. Extractive Reserves

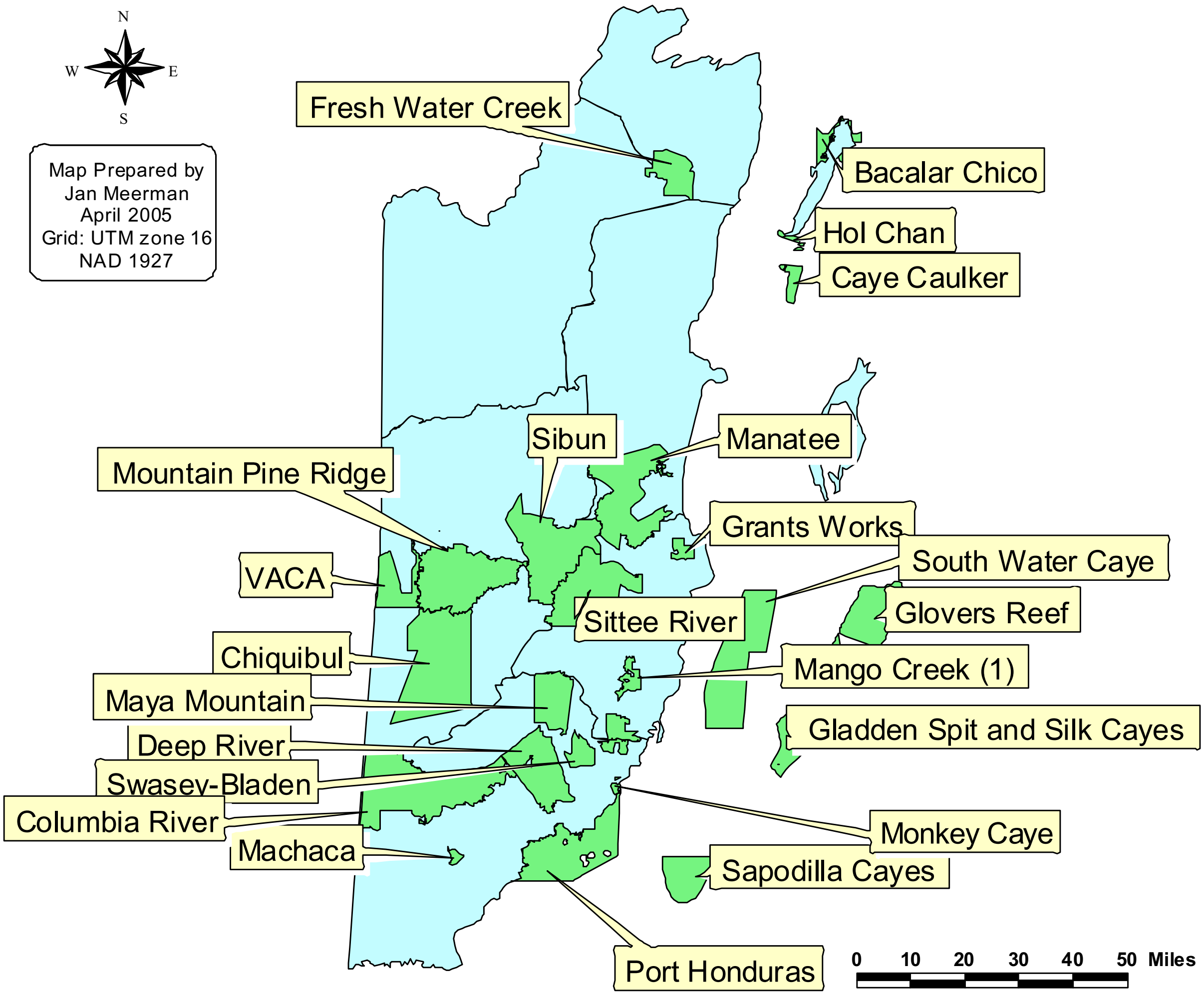


Figure 6. Extractive Reserves

The Extractive Reserves form a grouping of 16 Forest Reserves and 8 Marine Reserves. These management categories were created for the management of extractive resources. This is the largest section of Protected Areas Categories (50 % of total protected area acreage):

- Forest Reserves: 939,815 acres; 380,331 hectares = 6.7 % of Total National Territory
- Marine Reserves: 372,730 acres; 150,839 hectares = 2.7 % of Total National Territory
- Combined coverage 9.4 % of Total National Territory

2.2.4. Conservation management categories

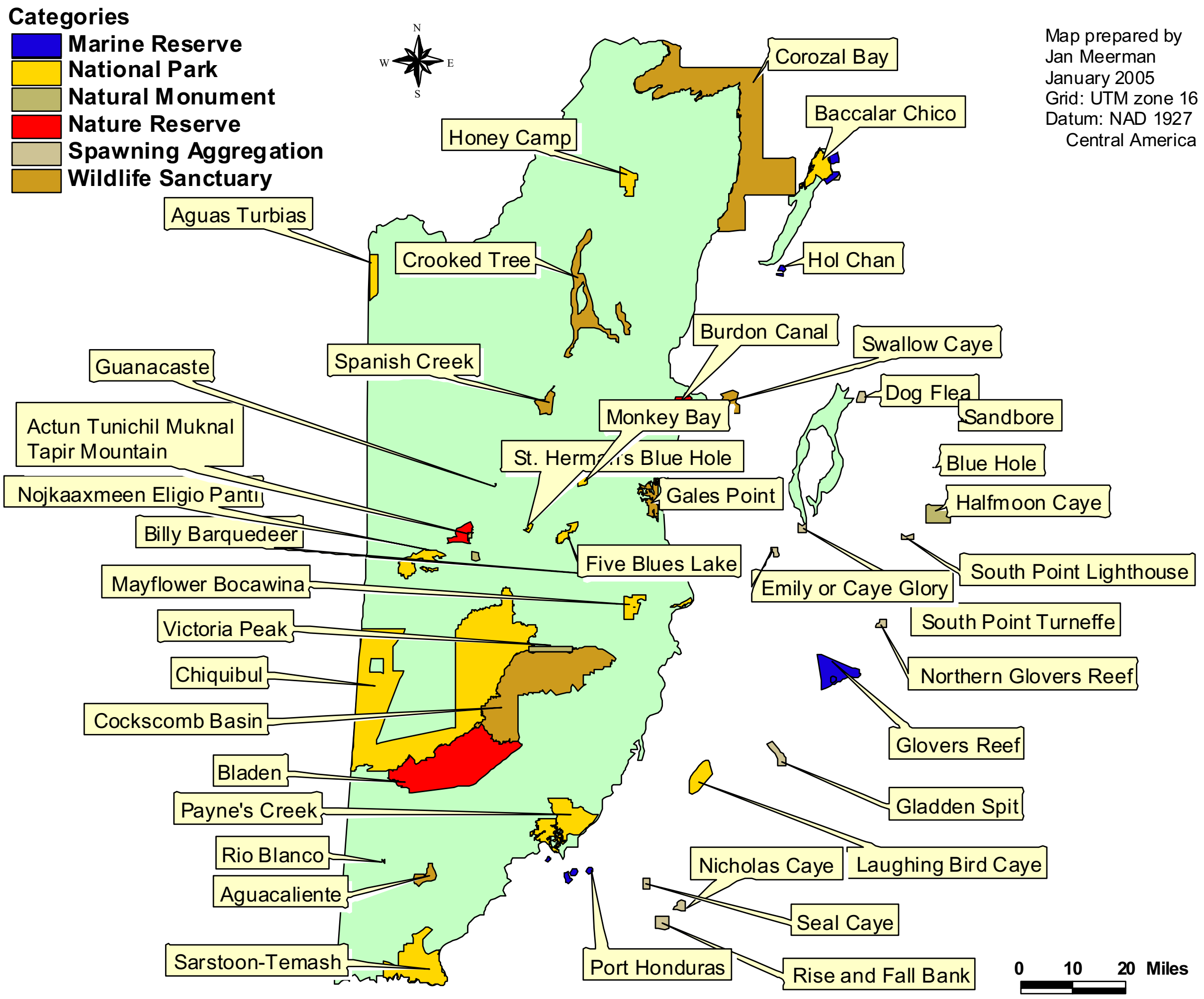


Figure 7. Areas with a stricter conservation mandate

This grouping represents management categories with conservation purposes in mind. This can be conservation of biodiversity (Nature Reserve, Wildlife Sanctuary), natural resources (Marine Reserves), landscapes and special features (National Park, Natural Monument). While these are not designed for extractive use, some forms of extraction are often allowed and these protected areas certainly allow for non-extractive uses. All combined they comprise of a total of 53 areas falling in 6 different classes (including conservation/wilderness/no-take zones of marine reserves). Note that many of the protected Spawning Aggregations fall entirely or largely within already existing marine protected areas. The total national coverage is 6.8 % of the total national territory. There exists the “Sarteneja No Hunting Zone” which seems largely forgotten and does not have any basis in the Park Systems Act.

2.2.5. Private Protected Areas

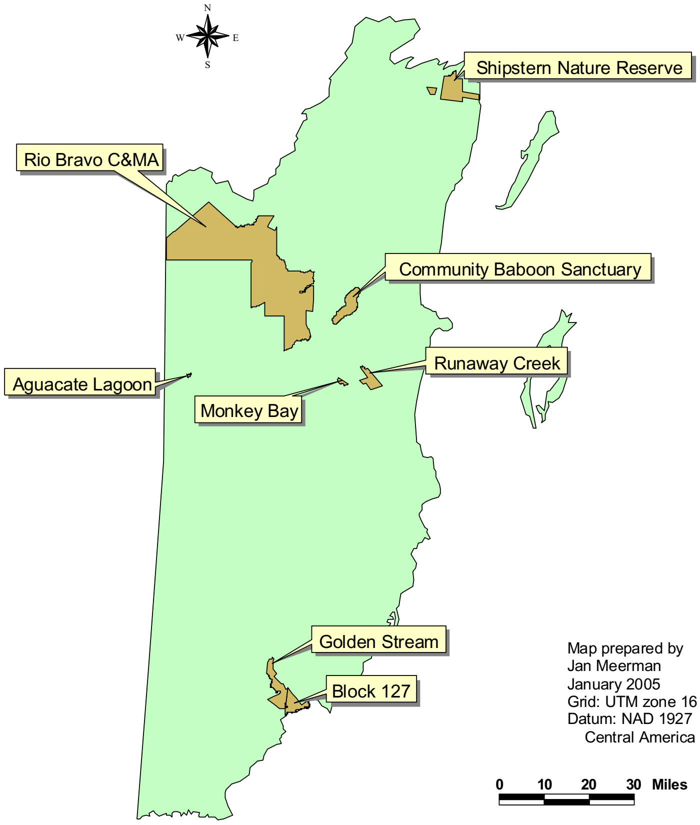


Figure 8. Some Private Protected Areas

In this management category, only those protected areas are included that have a standing agreement with Government (Rio Bravo Conservation and Management Area and Block 127) and those others that have a de-facto recognition + have a management in place (Shipstern, Community Baboon, Runaway Creek, Aguacate Lagoon, Monkey Bay and Golden Stream.

Following this classification, there are 8 Private Protected Areas covering 325,346 acres or 131,663 hectares (2.3 % of National Territory). Most of these Private Reserves are essentially multiple use reserves including managed extraction of resources.

The Belize Association of Private Protected Areas (BAPPA) has a membership of landowners that are trying to manage their land holdings as for conservation purposes (including those land holdings recognized here). The landholdings from

2.3. Total overview of Protected Area Statistics

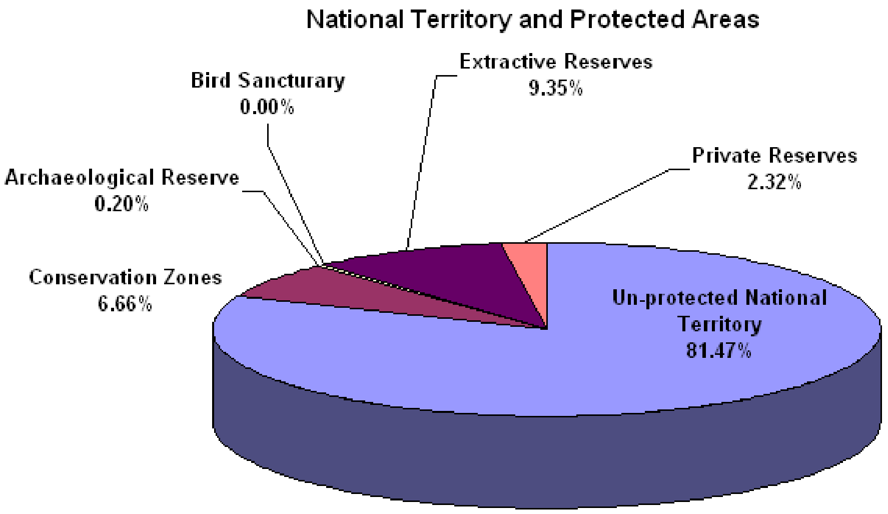
Table 2. Total overview of Protected Area Statistics

	STATUS	COUNT	ACRES	HECTARES	%
Conservation Management Categories	Marine Reserve incl. Spawning Aggregations	11	26,595	10,763	0.19
	National Park	16	410,536	166,138	2.92
	Natural Monument	5	17,382	7,034	0.12
	Nature Reserve	3	111,228	45,013	0.79
	Spawning Aggregation adds[1]	11	916	371	0.01
	Wildlife Sanctuary	7	368,786	149,243	2.63
					6.82
Archaeological Reserves	Archaeological Reserves	12	28,620	11,582	0.20
Bird Sanctuaries	Bird Sanctuaries	7	15	6	0.00
Extractive Reserves	Forest Reserves	16	939,815	380,331	6.69
	Marine Reserves	8	372,730	150,839	2.65
					9.35
Private Reserves	Private Reserves	8	325,346	131,663	2.32
	% of national territory under protection				18.53
Belize Surface	Land		5,467,841	2,212,765	
	Marine (see Figure 2, Table 1)		8,577,430	3,471,176	
			14,045,271	5,683,941	

Based on Table 2, the amount of the national territory under some form of conservation management is 18.5 %. A graphic presentation of how this 18.5% is subdivided is represented in Table 3.

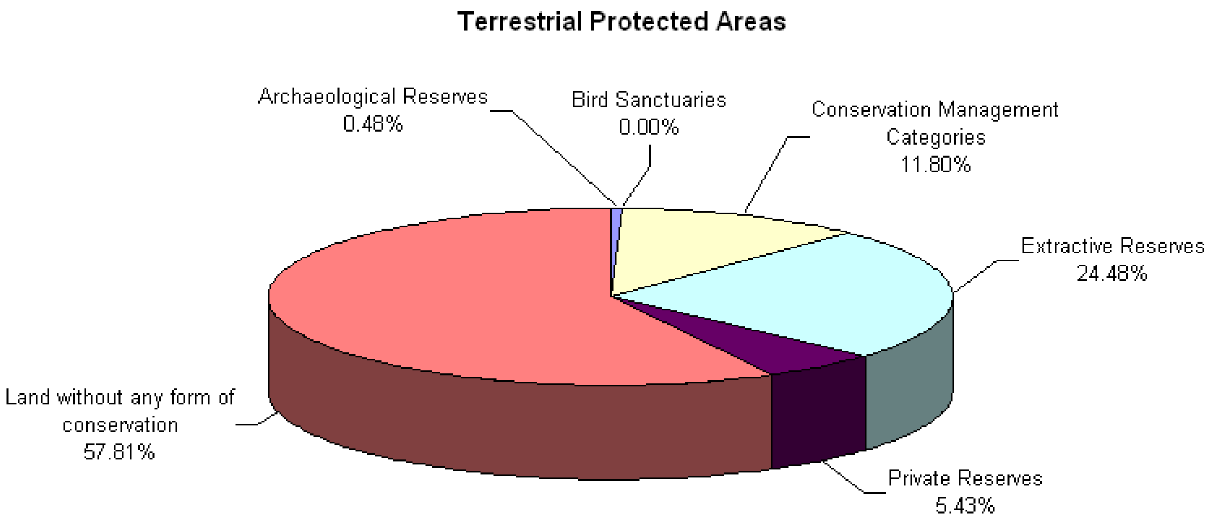
[1] Note that the acreage of "Spawning Aggregations adds" only refers to what is not already within another protected area.

Table 3



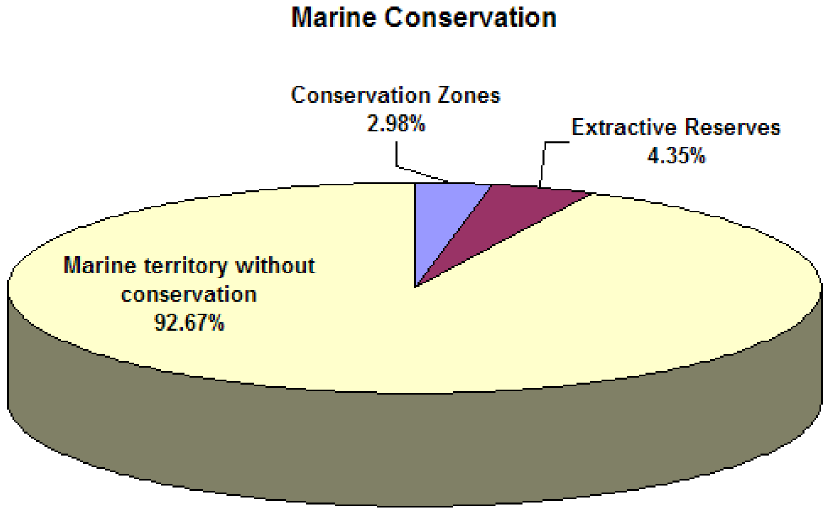
While 18.52 % of the national territory under protection does not sound like much, the picture changes when the terrestrial and marine realms are split up (Tables 4 & 5).

Table 4



For the terrestrial part (with terrestrial defined as everything that is not seawater), the area under conservation is 36.46%. Within the terrestrial protected areas, the extractive reserves still form the largest component.

Table 5



The marine realm, compared with the terrestrial realm is largely un-protected. Only 7.33% is protected and the largest part of that is only as an extractive reserve as well. This large under representation of the marine realm is largely caused by the large portion of very deep water away from the coastal shelf that has been completely ignored as a conservation target.

3. Site scoring system

A site scoring system including key Protected Areas system characteristics was developed by modifying an existing Scoring System developed by the Belize Association for Private Protected Areas (BAPPA). This site scoring system works for all protected areas, Government, Private, Terrestrial and Marine. Incorporated characteristics include those of ecological, cultural, social, resource conservation, and economic value including environmental services (Appendix 2).

A first scoring exercise has been conducted involving 94 protected areas (Appendix 3). The prioritization of the Protected Areas system in this way provides a credible way to prioritize resource allocation, both human and financial. Most sites were scored by individual members of the consortium. Slight differences in interpretation may therefore occur, although care has been taken to avoid such differences. For several protected areas, insufficient information was available to guarantee a totally up-to-date analysis.

A first analysis of this prioritization exercise is presented in Tables 6 through 8 (each Table cut in two pieces for visibility).

The scoring system has two components, one focuses on the biological, ecological and physical attributes of the protected area. The second component looks at management and use issues. This two prong approach allows for three different ways in which to analyze the results. The two components also allows a first analysis of management efficiency/needs. For example, when a protected area has a high biophysical score but a low management/use score, this may be an indication that management of that site needs improvement.

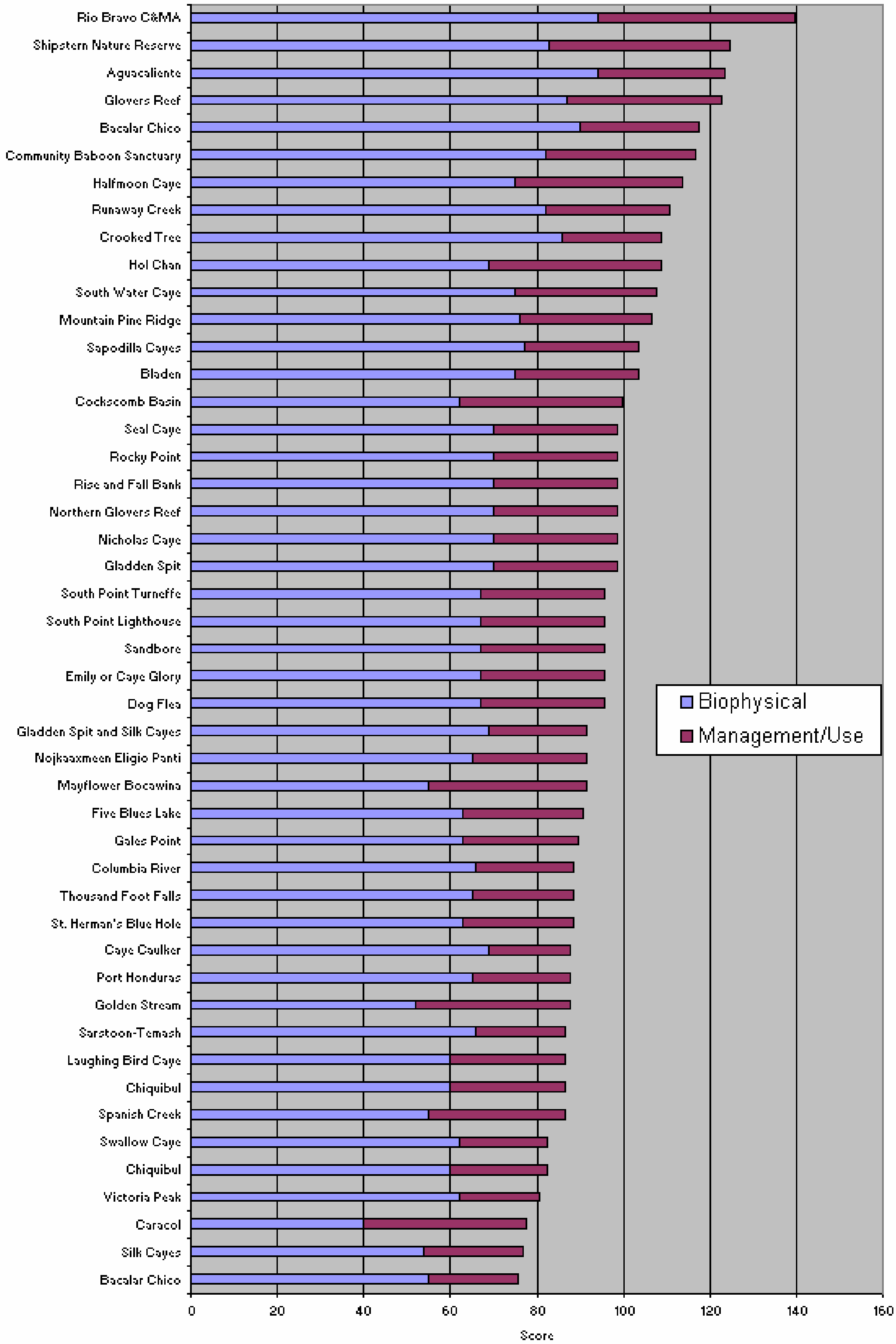
The first approach is by combining both the **Biophysical as well as Management/Land use criteria**. The result of this is presented in Table 6. Top 10 protected areas by this standard are in alphabetical order:

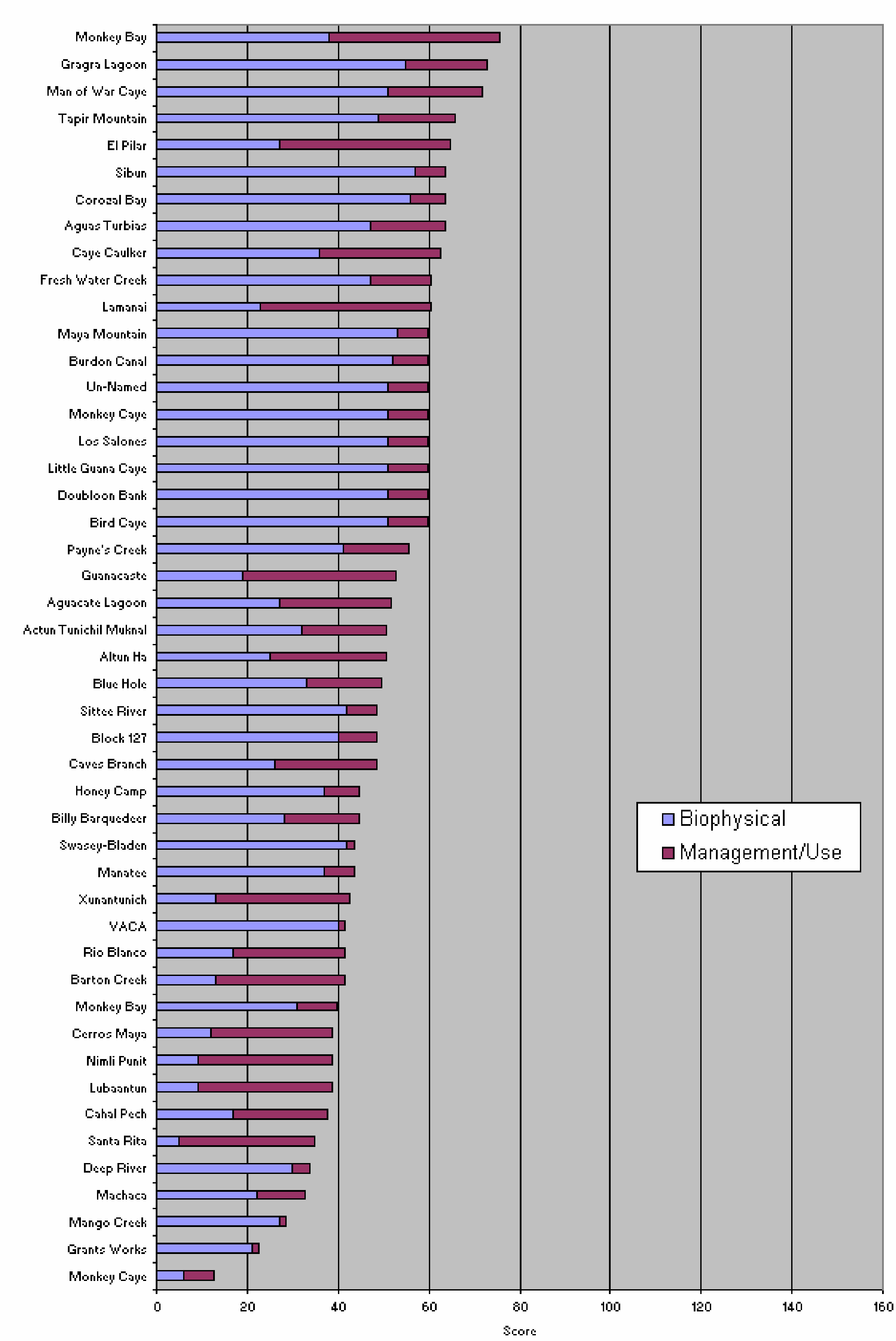
- Aguacaliente Wildlife Sanctuary,
- Bacalar Chico Marine Reserve,
- Community Baboon Sanctuary,
- Crooked Tree Wildlife Sanctuary,
- Glovers Reef Marine Reserve,
- Halfmoon Caye Natural Monument,
- Hol Chan Marine Reserve,
- Rio Bravo Conservation and Management Area,
- Shipstern Nature Reserve and
- Runaway Creek Private Reserve.

Note that there are 4 Private Protected Areas in this top category!

Although size is an important factor in this analysis, the result shows that size is not all-important. Several small sites such as most of the spawning sites come out high in spite of their small size.

Table 6. Protected Area Ranking System combining Biophysical and Management/Use values





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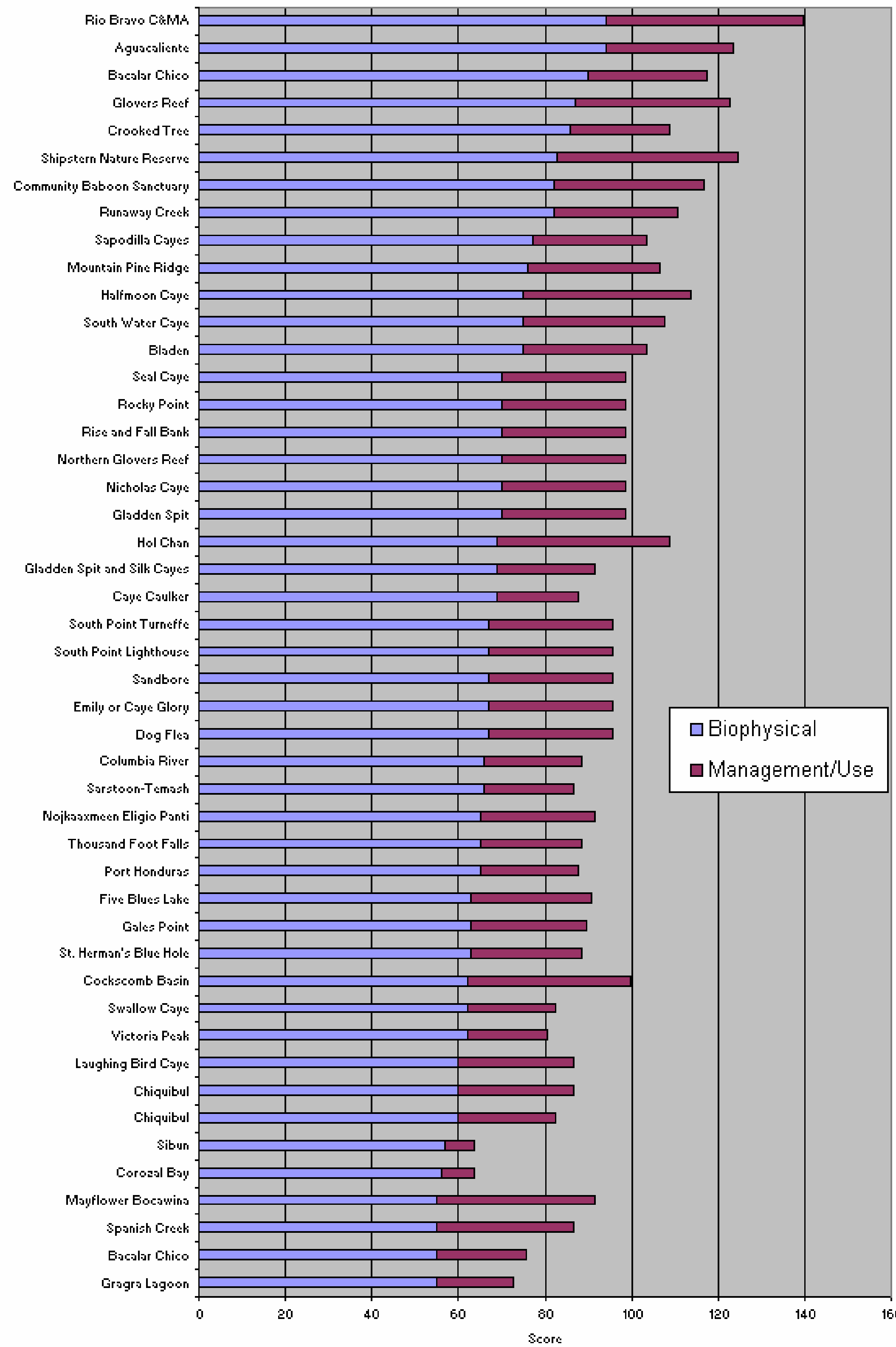
While the previous example incorporated all evaluated criteria including **management and land use characteristics**, it is possible to rank according to Biophysical values only.

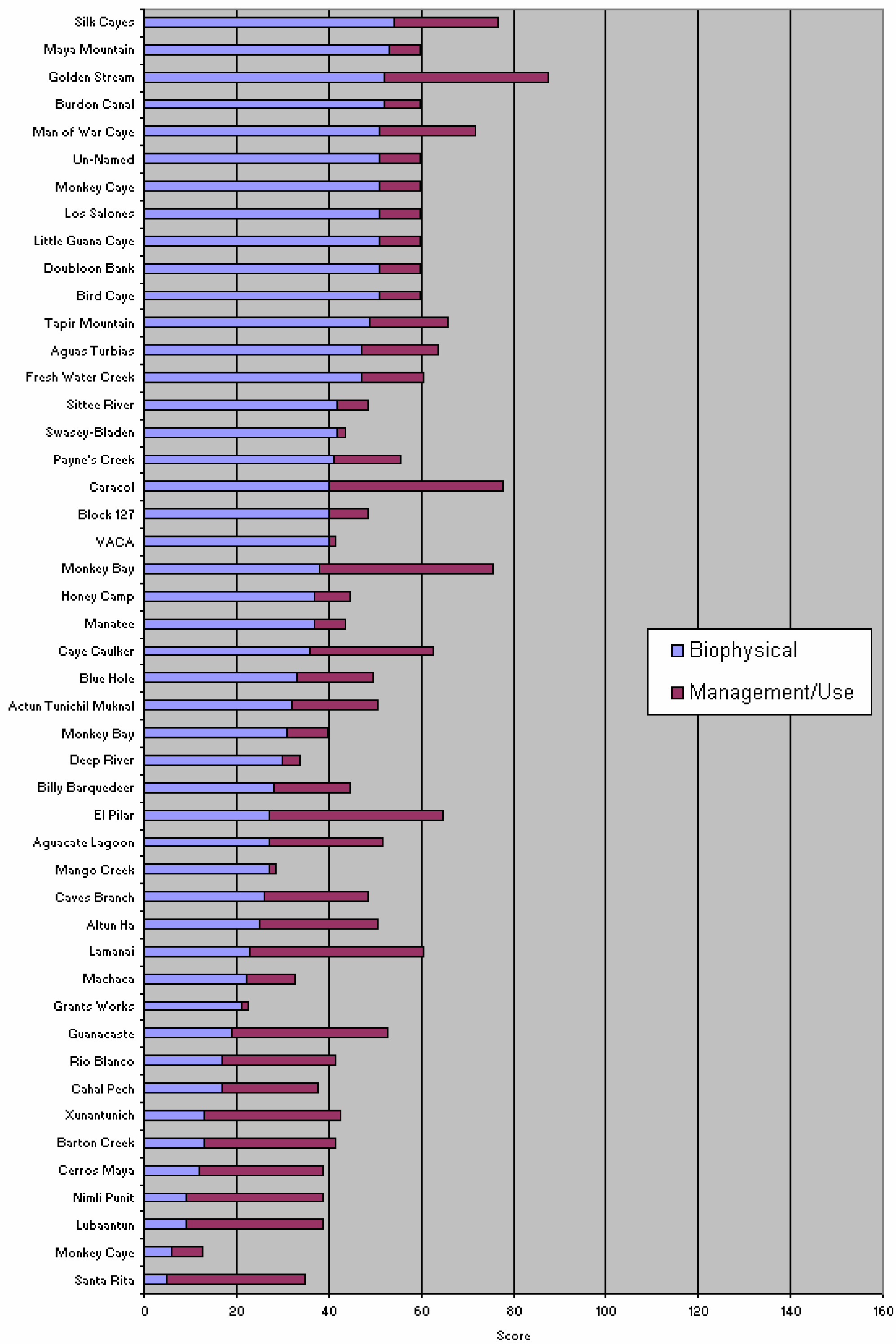
With such a ranking system interpreting the Biophysical values only, the outcome (Table 7) is somewhat similar. By this system, the top 10 most ecologically important areas in alphabetical order are:

- Aguacaliente Wildlife Sanctuary,
- Bacalar Chico Marine Reserve,
- Community Baboon Sanctuary,
- Crooked Tree Wildlife Sanctuary,
- Glovers Reef Marine Reserve,
- Mountain Pine Ridge Forest Reserve,
- Rio Bravo Conservation and Management Area,
- Runaway Creek Private Reserve,
- Sapodilla Cayes Marine Reserve and
- Shipstern Nature Reserve.

Notice that some small reserves (such as spawning aggregations) come out very high as well. Obviously, in spite of their small size, they are of great importance for biodiversity management. Most archaeological reserves come out very low in this system as a result of a focus on biodiversity values of the ranking system.

Table 7. Protected Areas Ranking by Biophysical values




Silk Cayes
Maya Mountain
Golden Stream
Burdon Canal
Man of War Caye
Un-Named
Monkey Caye
Los Salones
Little Guana Caye
Doubloon Bank
Bird Caye
Tapir Mountain
Aguas Turbias
Fresh Water Creek
Sittee River
Swasey-Bladen
Payne's Creek
Caracol
Block 127
VACA
Monkey Bay
Honey Camp
Manatee
Caye Caulker
Blue Hole
Actun Tunichil Muknal
Monkey Bay
Deep River
Billy Barquedeer
El Pilar
Aguacate Lagoon
Mango Creek
Caves Branch
Altun Ha
Lamanai
Machaca
Grants Works
Guanacaste
Rio Blanco
Cahal Pech
Xunantunich
Barton Creek
Cerros Maya
Nimli Punit
Lubaantun
Monkey Caye
Santa Rita
0
20
40
60
80
100
120
140
160
Score
Biophysical
Management/Use

The ranking system takes on a different interpretation when selection is on the **managements and land use criteria only** (Table 8). In this case, the top 10 protected areas are:

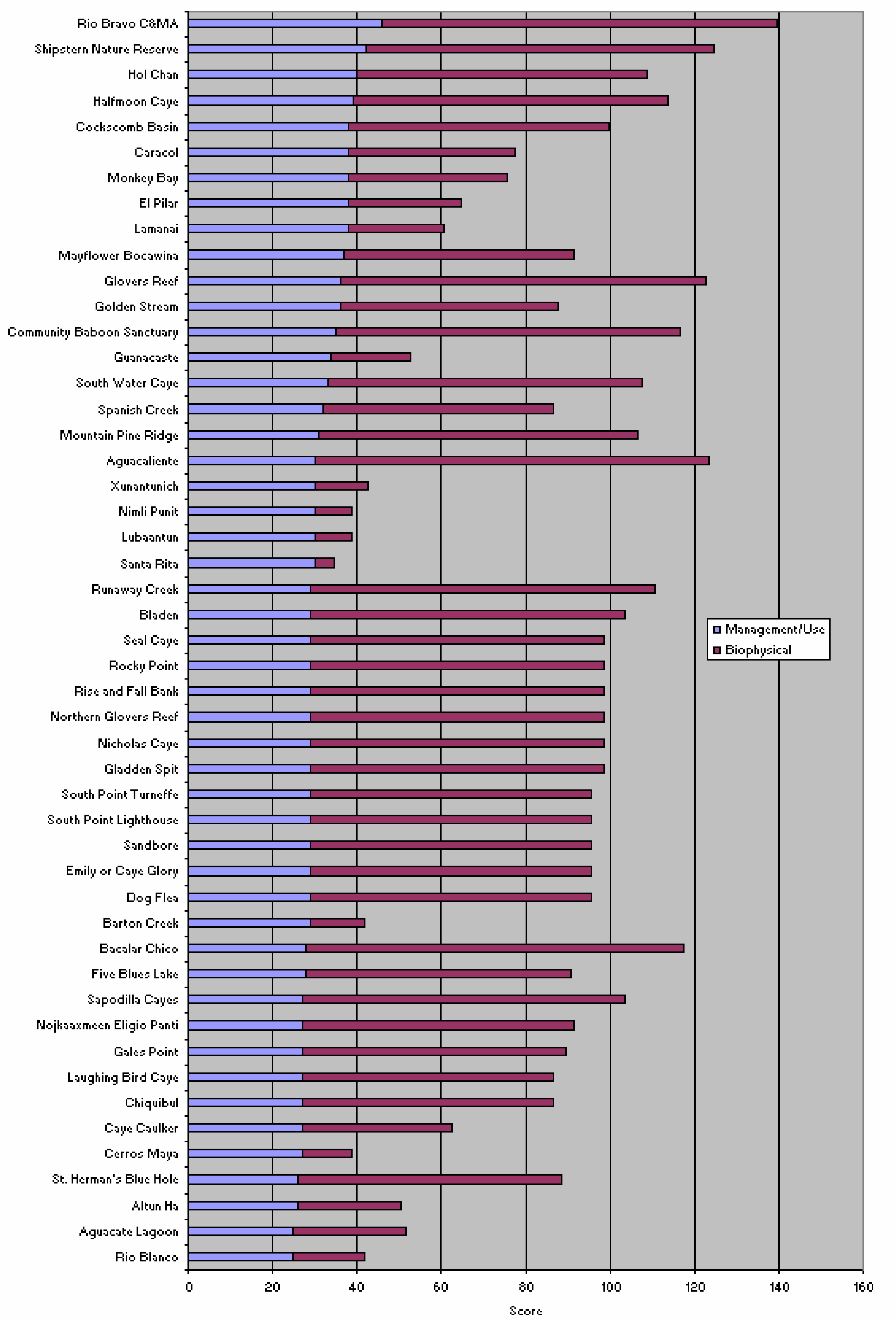
- Caracol Archaeological Reserve,
- Cockscomb Basin Wildlife Sanctuary,
- El Pilar Archaeological Reserve,
- Halfmoon Caye Natural Monument,
- Hol Chan Marine Reserve,
- Lamanai Archaeological Reserve,
- Mayflower Bocawina National Park,
- Monkey Bay Private Reserve,
- Rio Bravo Conservation and Management Area and
- Shipstern Nature Reserve.

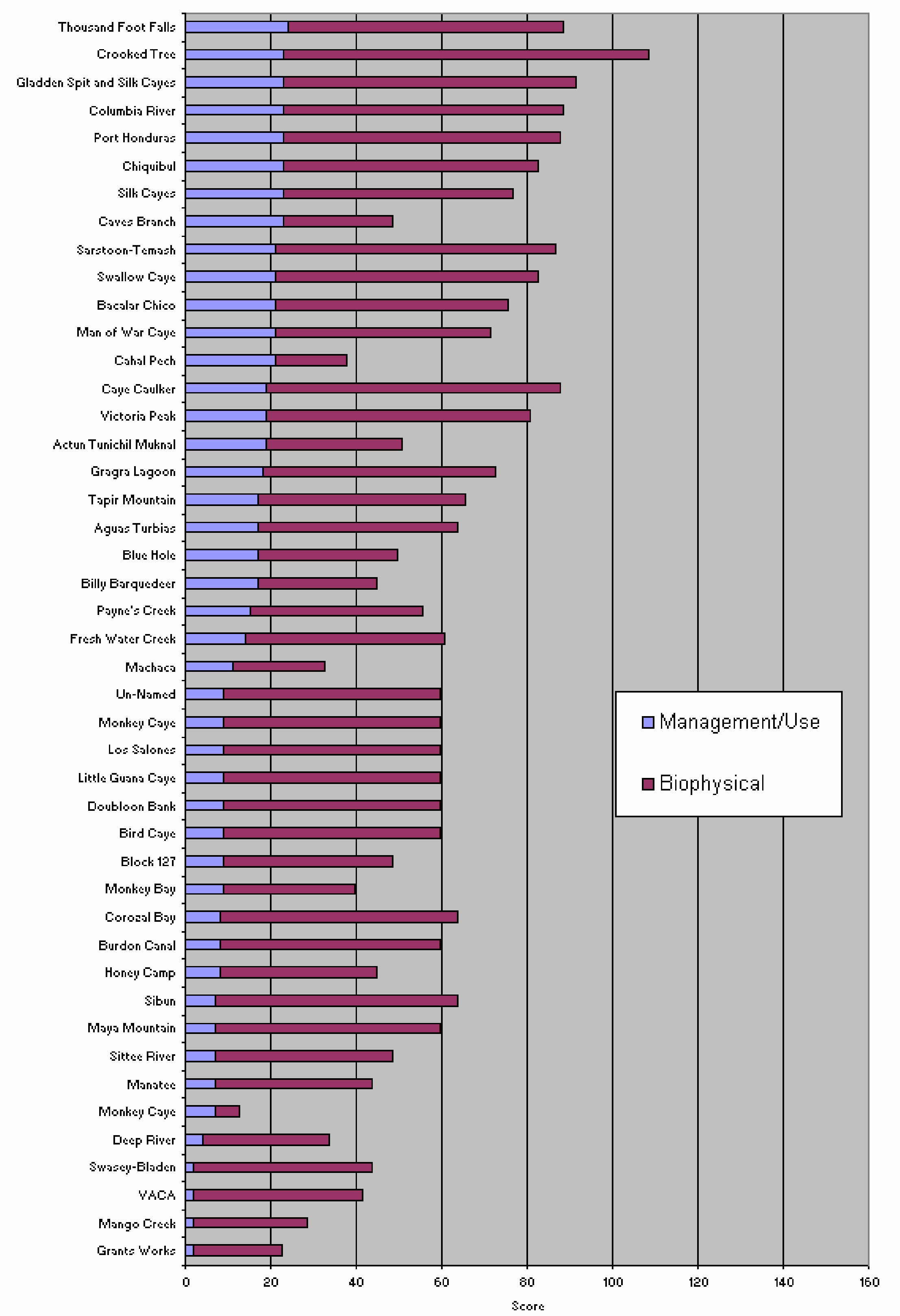
It is also worth noting that in this ranking system, several of the archaeological reserves come out high (while they came out low in the biophysical values ranking).

In this system some obviously important protected areas come out very low due to the (virtual) absence of formalized management. Good examples of these are the bird sanctuaries.

Notice also that Rio Bravo Conservation and Management Area and Shipstern Nature Reserve always come out on top independent of the ranking system. Both are Private Reserves.

Table 8. Protected Areas Ranking by Management/Use values





Thousand Foot Falls
Crooked Tree
Gladden Spit and Silk Cayes
Columbia River
Port Honduras
Chiquibul
Silk Cayes
Caves Branch
Sarstoon-Temash
Swallow Caye
Bacalar Chico
Man of War Caye
Cahal Pech
Caye Caulker
Victoria Peak
Actun Tunichil Muknal
Gragra Lagoon
Tapir Mountain
Aguas Turbias
Blue Hole
Billy Barquedeer
Payne's Creek
Fresh Water Creek
Machaca
Un-Named
Monkey Caye
Los Salones
Little Guana Caye
Doubloon Bank
Bird Caye
Block 127
Monkey Bay
Corozal Bay
Burdon Canal
Honey Camp
Sibun
Maya Mountain
Sittee River
Manatee
Monkey Caye
Deep River
Swasey-Bladen
VACA
Mango Creek
Grants Works
0
20
40
60
80
100
120
140
160
Score
Management/Use
Biophysical

4. Gap Analysis

A gap analysis is meant to identify gaps in an existing system. In a protected areas gap analysis, this would translate to the question; "which conservation targets (species, ecosystems, features or other) are not met within the existing protected areas system.

The principal source of information in the analysis was the 1:250.000 Belize Ecosystems Map (Meerman & Sabido, 2001). This map included all terrestrial ecosystems including some inland water ecosystems.

The Meerman & Sabido (2001) map, was essentially an update of the 1995 Vegetation map of Belize by Iremonger and Browkaw (1995). Meawhile, this Iremonger and Brokaw map borrowed heavily from the Natural Vegetation Map of Belize by Wright et al (1959).

For the marine part, there existed several draft versions of a marine habitat map (Mumby & Harborne, 1999). The scale of the latter map was much finer that that of the Belize Ecosystems Map which made it difficult to integrate it fully in an overall ecosystems map. Also, this marine habitat map existed only in a draft stage and uncertainties remained to which version was the most up to date.

To overcome the inconsistencies caused by the differences and reliability of both products, the various groups of habitats in the marine map were clustered as to represent their main classifications and this result was re-digitized into polygons with a minimum size of 1 acre.

The resulting product was updated and enriched using the following sources:

- Fieldwork data gathered by J. C. Meerman from 2001 through 2004. See http://biological-diversity.info/projects.htm
- Recent Landsat tm images: 1947_2004_02_28; 1948_2004_01_27 and 1949_2004_01_27
- Brokaw & Sabido, 1998. Vegetation of the Rio Bravo Conservation and Management Area.
- Murray et all, 1999. Soil-plant relationships and revised vegetation classification of Turneffe Atoll - Belize.,
- Penn et all, 2004. Vegetation of the Greater Maya Mountains, Belize.
- MET department: Climatological data
- Cornec, 2003. Geology map of Belize
- The Belize Territorial waters extend follows the Maritime Areas Act, (GOB, 2000).

The final product being an all encompassing Belize Ecosystems Map on a scale of 1:100,000 incorporating the main terrestrial and marine habitats (including deep sea habitats). In total 96 habitats were thus mapped:

- 65 Terrestrial classes
- 14 Marine classes
- 7 Agriculture / silviculture / mariculture classes
- 6 Mangrove classes
- 3 Inland water classes
- 1 Urban class

An visualization of the process is presented in Figure 9.

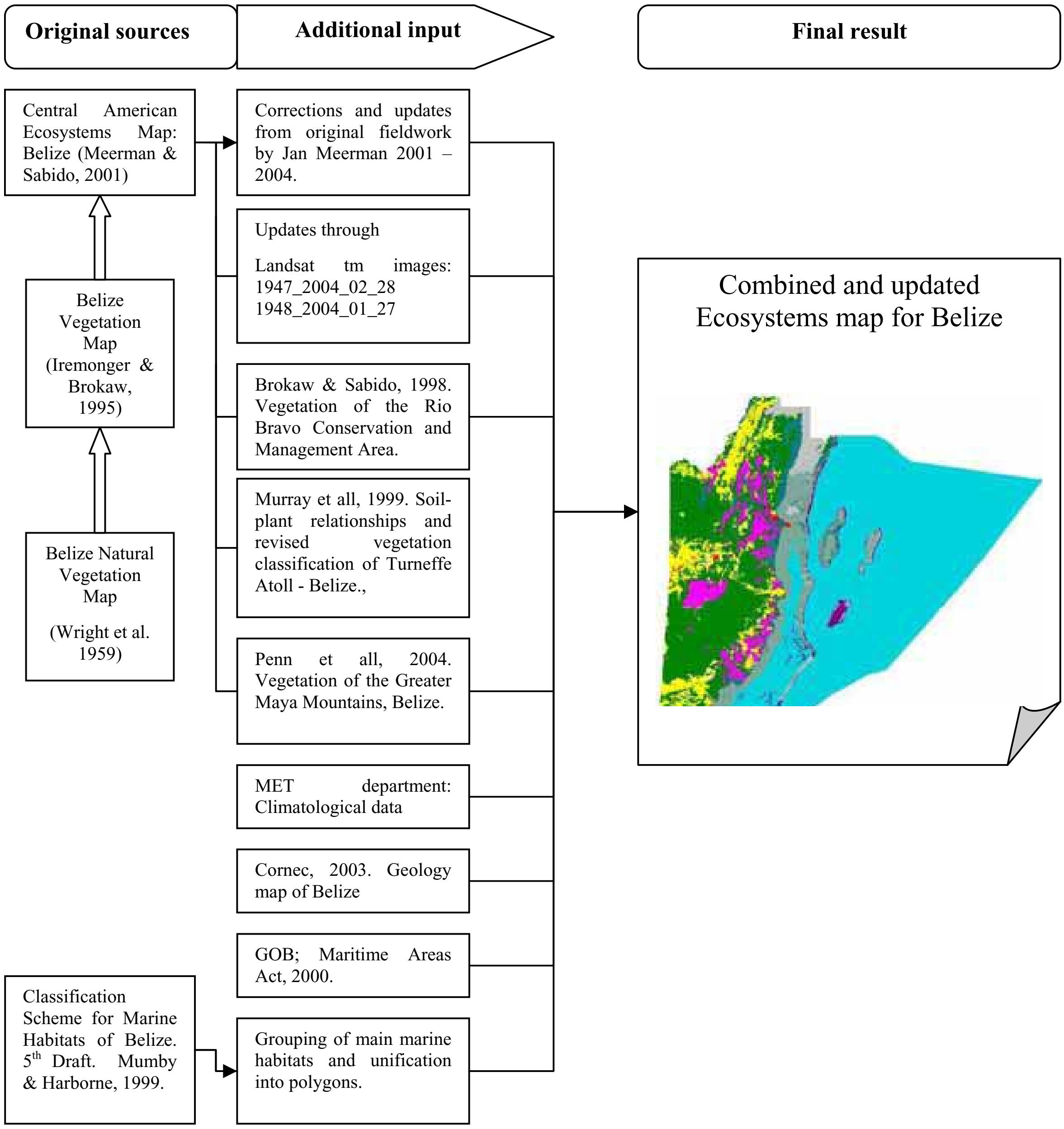


Figure 9. Flowchart showing process leading to updated 2004 Ecosystems Map of Belize

The marine working group of the Consortium however, expressed to prefer a different approach based on bioregions rather than ecosystems.

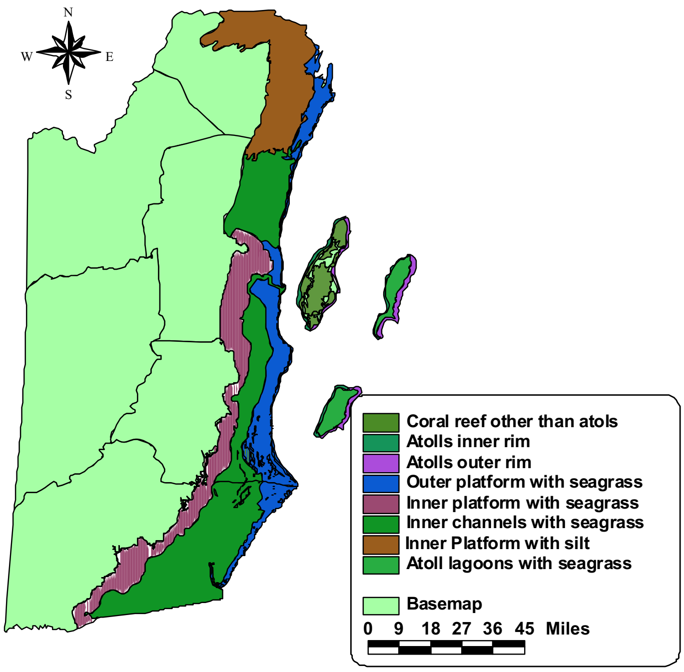


Figure 10. Benthic and Reef bioregions

This bioregion approach is based not on individual ecosystems, but rather of clusters of ecosystems with similar attributes or functions.

In this case the inner lagoon was split up in a variety of benthic regions based on depth, substrate and vegetation (Figure 10.).

Also the coral reefs were split up according to ecological functioning. The outer reefs of the atolls are different from the inner (leeward side) reefs and the shelf/platform reefs form a class in their own.

Secondly, the marine part of the country was split up in 7 different geographic zones: north, central, south plus zones for each of the Atolls and the deeper Caribbean (Figure 11).

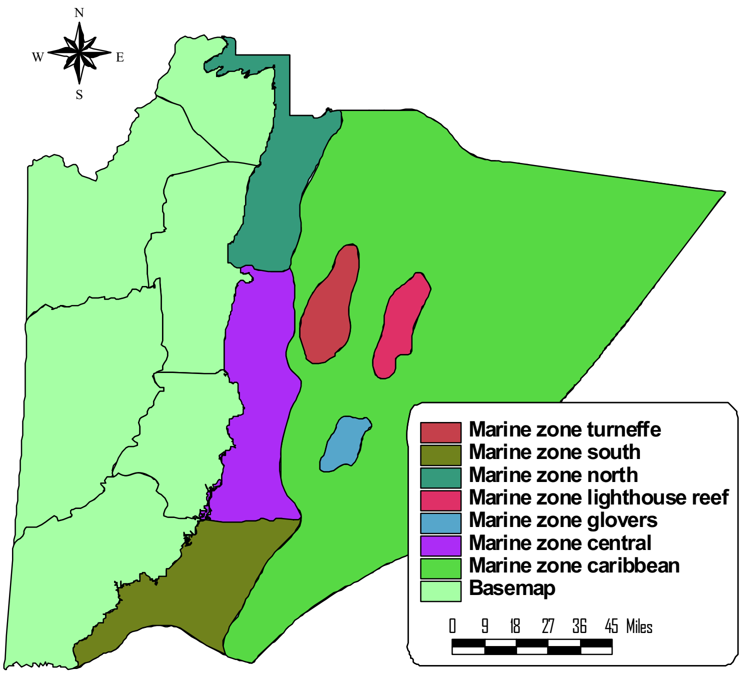


Figure 11. Geographic bioregions

The idea behind this is that these zones all represent different life zones each with its own characteristics. The practical consequence of it being that the MARXAN analysis will be looking to meet targets in each of these geographic zones.

Superimposed on each other these benthic, reef and geographic zones the marine section was analyzed using these 15 marine bioregions rather than the original 14 ecosystems.

4.1. Human footprint

Before continuing with the gap analysis itself, an analysis needed to be made of a human needs or human footprint. Conservation planning needs to look at the human footprint on the landscape. Essentially, the question needs to be asked: which are the areas where human needs come first. For this assessment the following data layers were collected and/or compiled:

Table 9. Human footprint assessment layers

Name	#shp	Source and other details
Communities	701	Lists all the communities in Belize. and assigns 5 km buffers around them. In the case of villages nearly entirely dependant on agriculture, a 7km buffer was assigned. (Meerman & Clabaugh, 2004: Belize Biodiversity Mapping Service)
Poverty assessment	703	Provides a ranking per district based on the assumption that poor communities are more dependant on natural resources than more affluent communities. (CSO data)
Roads-main	705	All the main roads (paved or otherwise) were assigned 5km buffers (Meerman & Clabaugh, 2004: Belize Biodiversity Mapping Service)
Roads-other	706	All other roads were assigned 2 km buffers (Meerman & Clabaugh, 2004: Belize Biodiversity Mapping Service)
Road/tracks	707	Smaller tracks and trails were assigned 500m buffers (forest trails left out especially in areas where these trails serve management purposes) (Meerman & Clabaugh, 2004: Belize Biodiversity Mapping Service)
Good soil	710	Identified as polygons larger than 1000 acres with agricultural land value class 1 and 2 based on King et al 1992.
Fire Risk	720	Based on the assumption that wildfires present an risk for biodiversity conservation. Takes into account only risk classes 10 -18 = highest risk. (Meerman & Clabaugh, 2004: Belize Biodiversity Mapping Service)
Coastal development	730	Various Coastal Developments (based on 19 Oct 2004 Marine Risk Assessment Workshop
Boating Lanes	740	Skiff and boating lanes English Channel, Caye Caulker, San Pedro, South Water Caye etc. Partly based on State of the Coastal Zone Report 1995. Map 4. Value 50 for each hexagon.
Incursions	740	For the terrestrial realm based on the 2004 ecosystems map (Meerman, 2005) and assigned a 4 km buffer + actual penetration on the marine side based on 19 Oct 2004 Marine Risk Assessment Workshop.
Trawling	750	Shrimp trawling (based on 19 Oct 2004 Marine Risk Assessment Workshop
Runoff and land based pollution.	760	Chetumal Bay pollution and agricultural runoff in south (based on 19 Oct 2004 Marine Risk Assessment Workshop
Agriculture	761	Existing Agriculture and aquaculture in all its forms based on the 2005 ecosystems map (Meerman, 2005)

All these above elements are more or less directly human related influences. Fire risk is somewhat of an exception. While most fires in Belize are human induced, it is more a risk than an actual footprint. Weighing this “risk” too heavy might result in including these fire risk areas inside the human needs area while this may not be directly the case (think of savanna's), meanwhile weighing them too heavy might make fire risk areas seem less important for conservation management, while the reality is that fire-management is what is really needed for such areas. For this reason, fire was given a weight of only 0.1, while all other human footprint layers were given a uniform value of 1.

The result of the above analysis using a 10 km² hexagon grid is visualized in Figure 12. Notice that the darker reds indicate highest level of human activities. Notice also that the footprint in the marine sector is not as easy to quantify as in the terrestrial sector and that the Guatemala incursions in the south – and south west also show up in this analysis.

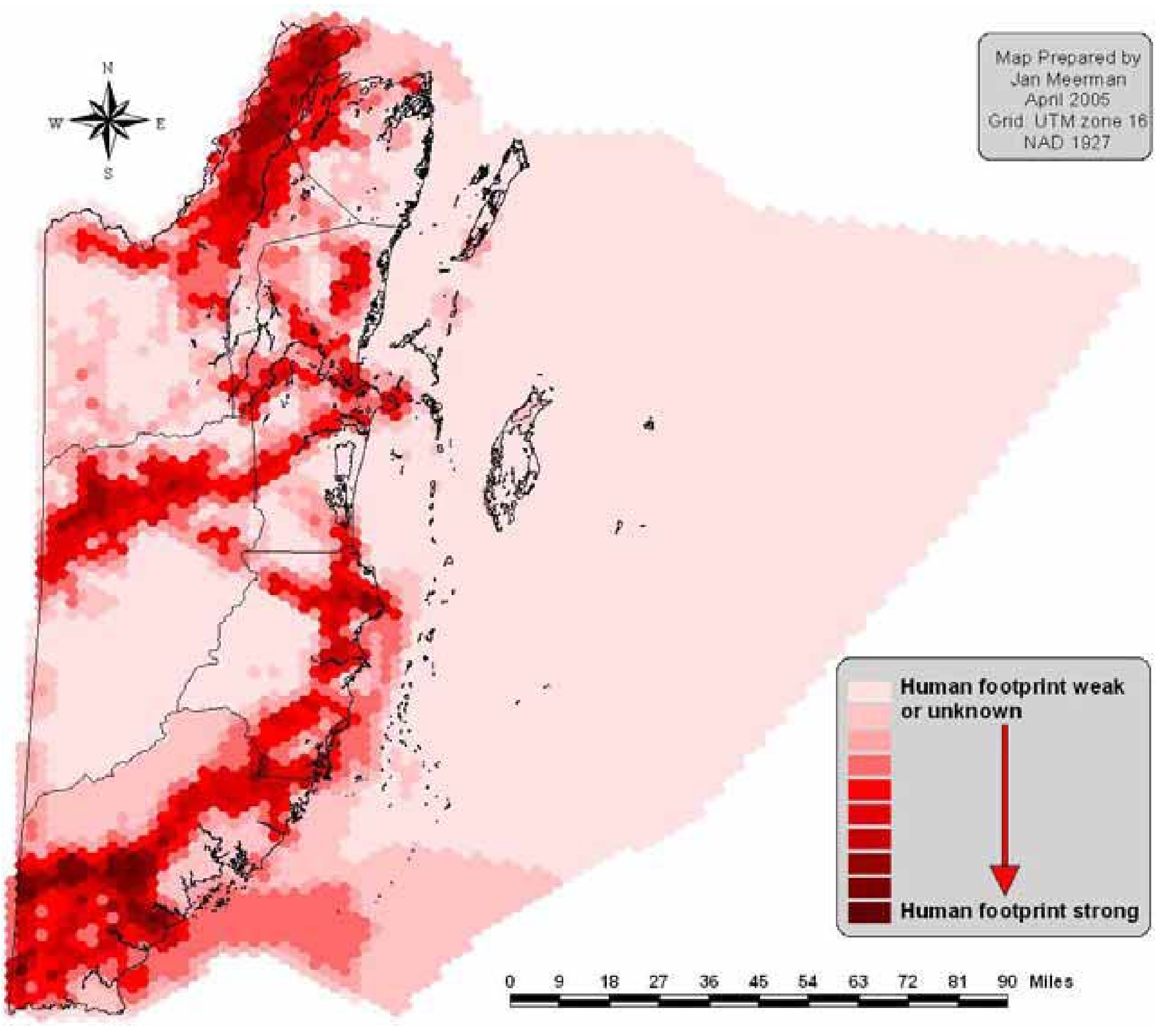


Figure 12. Human footprint

It is interesting to note that two regional efforts to establish a human footprint for the region came up with similar results.

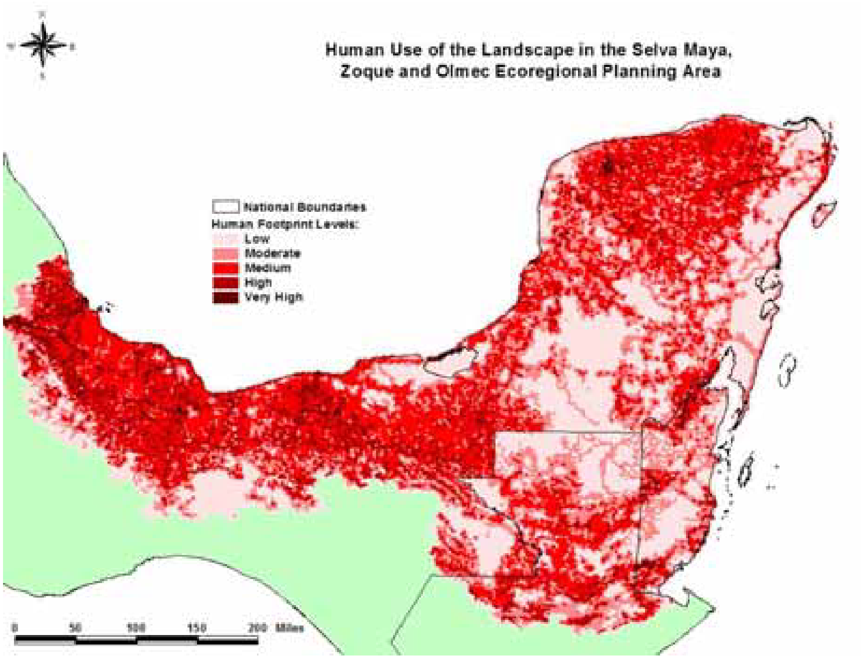


Figure 14. Human footprint as defined by the Selva Maya, Zoque and Olmec Ecoregional Planning initiative (draft 2004)

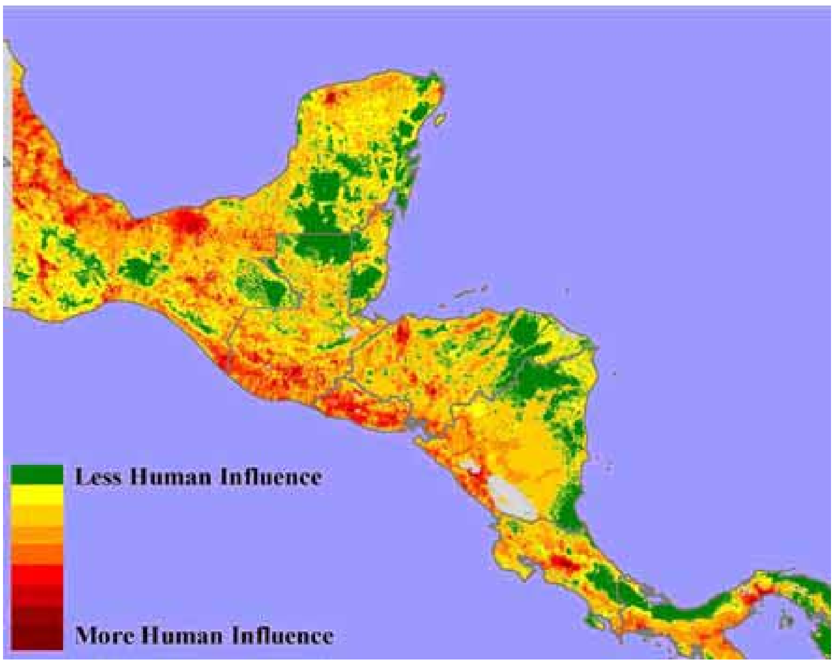


Figure 13 Human footprint as defined byWCS: Human Footprint and last of the Wild: Mesoamerica. Ramos, 2004

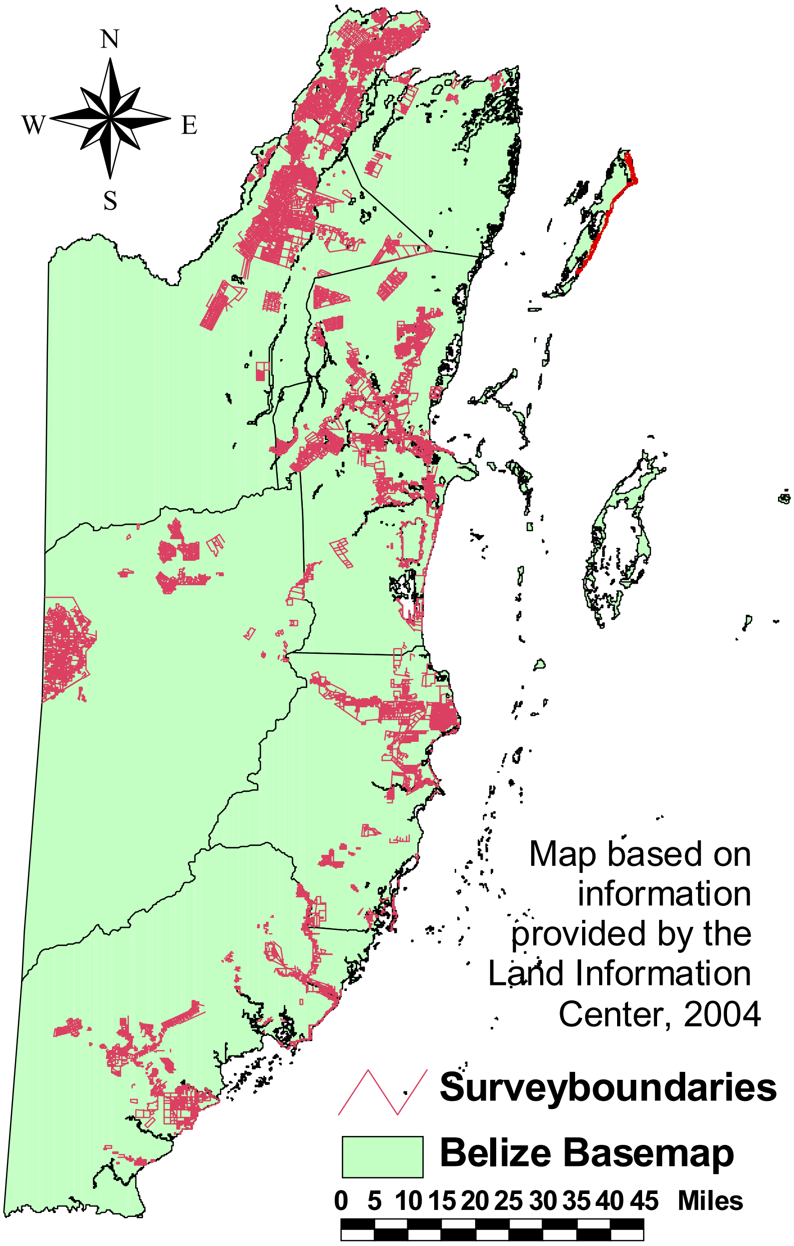


Figure 15. Mapped Subdivisions in Belize (source LIC)

As an extra measure to prevent conflict between human needs and conservation, all areas with mapped subdivisions (Figure 15) were excluded from further analysis. In other words; no conservation targets could be placed within such densely subdivided areas.

4.2. Conservation Targets

Fundamental in this analysis was the underlying thought that a minimum area will be required for each habitat/ecosystem. The World Conservation Union (IUCN) recommends a minimum of 10% under protection for each habitat. Theoretically, this would enable the survival of 50 - 70% of the extant species. The Selva Maya, Zoque and Olmec Ecoregional Planning initiative used a minimum of 30% which would allow the survival of 65 - 85% of the species (see Figure 16).

However, it was felt that the 10% - 30% targets are too arbitrary. There are certain ecosystems that would require more protection than just 10-30%. For example, a very rare ecosystem occurring only on 5 locations with a combined cover of 2000 acres is not served with 10 or even 30 % protection. For such ecosystems, the target should be much higher, but was set not to exceed 95%. Also, there are ecosystems that provide vital environmental services; these too need a higher target. Some ecosystems are not suitable for any type of development and by default are best preserved. Consequently should be identified as conservation targets. Other important functions could also lead to a higher target setting. Throughout a minimum target setting of 20% was maintained.

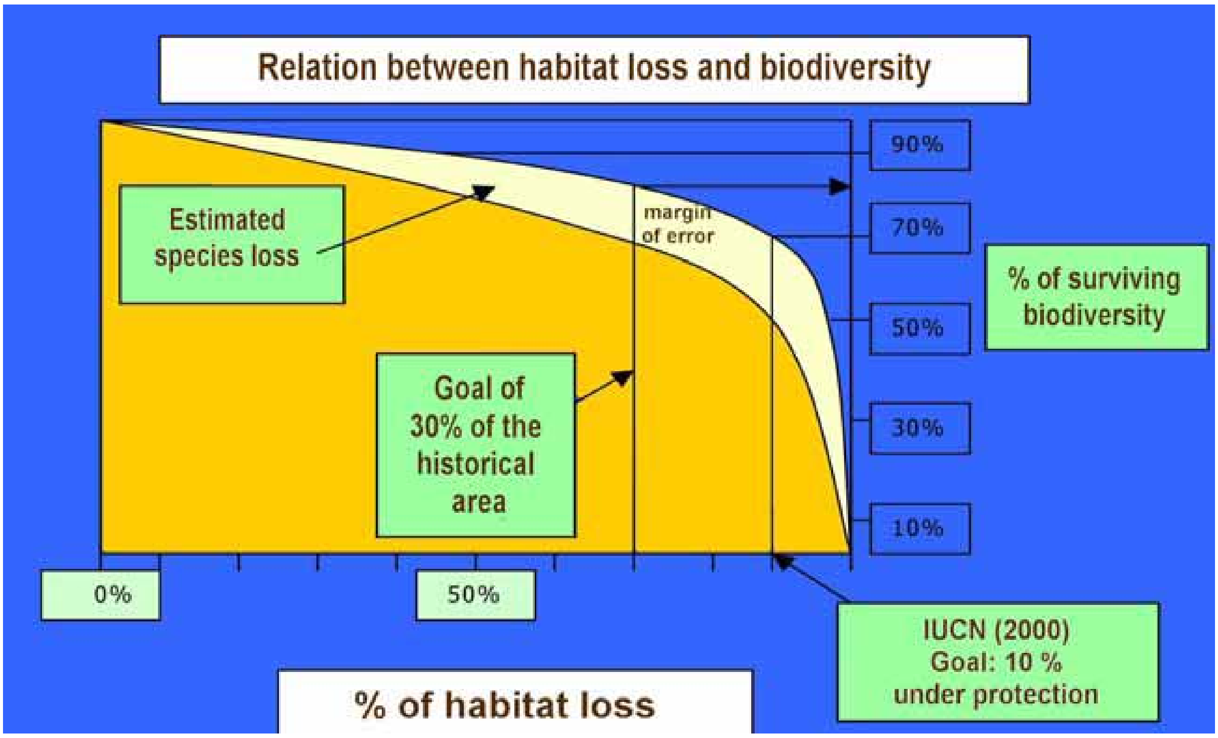


Figure 16. Relation between habitat loss and biodiversity. Addapted from The Selva Maya, Zoque and Olmec Ecoregional Planning initiative, 2004

4.3. Conservation target criteria

If fixed conservation targets are too arbitrary, a system needs to be developed that establishes which criteria should be used for setting this target. Such criteria need to be easy to identify using existing data. Criteria used to establish ecosystem – bioregion targets were:

- Slope: Areas with steep slopes are unsuitable for development and have high erosion risks. Consequently, by default, such areas received high conservation marks. Information was derived from a 90 m Digital Elevation Model (DEM) for Belize.
- Rarity: Ecosystems with coverage of < 5,000 acres were considered "rare". Ecosystems with coverage of 5,000-25,000 acres "uncommon" and ecosystems with 25,000 – 100,000 acres "fairly uncommon" and 100,000 – 1,000,000 acres: "common". The rarest ecosystems received the highest conservation ranks. Information is based on the 2004 ecosystems map (Meerman, 2005).
- Count: Representing the number of polygons for this ecosystem. Anything under a count of 10 polygons received a slightly higher conservation rank. Information is based on the 2004 ecosystems map (Meerman, 2005).
- Environmental Services: In some cases these are particularly pronounced. Example: Coastal fringe mangroves and Riverine mangroves (erosion control, nurseries), the higher mountain ridges are extremely important for watershed functionality and fresh-water supply. Information is based on the 2004 ecosystems map (Meerman, 2005).
- Timber: Some forest types are more important for timber production than others. This is reflected in extra points for timber production. Mahogany rich forests rank highest. Information is based on the 2004 ecosystems map (Meerman, 2005). No other good data exist for this timber analysis. Ideally, all the primary and secondary timber species should be included in this analysis. The current criterion should be seen as a first attempt to quantify production forests.
- Agricultural value: Areas with low agricultural value are less suitable for agricultural development. Consequently, by default, such areas received higher conservation marks. Information based on King et al. 1992
- Wetlands: Wetlands are considered important locations for biodiversity and water control. Consequently, wetlands received extra conservation marks. Information is based on the 2004 ecosystems map (Meerman, 2005).
- Critical interconnected regions in the marine realm defined as Mangrove – Sea grass beds – Coral reef within 2.5 km of each other

Based on the above criteria, the various terrestrial and marine ecosystems were awarded conservation targets varying from 20% to 95%. Some ecosystems would actually reach conservation targets of more than 100% based on their combined criteria. However, for purposes of the analysis, it was decided that a conservation target of 100% would essentially "lock" the target and this would not be conform the decision to use a "seeded" method rather than a "locked" method. For this reason, the maximum target percentage was set as 95%. For an explanation of these terminologies see the following section "MARXAN Analysis".

There exist a number of non-habitat criteria that needed to be included for a proper analysis. These include:

- Marine connectivity zones,
- Reef resiliency,
- Marine Biodiversity Hotspots,
- Marine bioregions,
- Caves and other geological features,
- Historical sites,
- Previously suggested sites for conservation,
- Biological corridors,

4.4. Biodiversity data

Ideally biodiversity should have been included on a large scale while establishing targets criteria for ecosystems. All ecosystems have importance for biodiversity but no doubt, some are more important than other. But since data on this distinction is not readily available, biodiversity could not be a criterion in the analysis.

A similar data problem exists for actual biodiversity data. To establish which biodiversity data were important for inclusion in the analysis, a list of critical terrestrial and marine species was established (Appendix 3). This list follows the IUCN red data list design but should not be marked as a National Red Data List by IUCN standards. In stead, this list could be seen as a first step to the formal acceptance to such a National Red Data List.

Based on this list of critical species, biodiversity data were incorporated in the analysis as much as possible. In general, biodiversity data where included when they were spatially discrete. Unfortunately, for most species, even those species of conservation interest there still exist insufficient accessible spatial data that would allow meaningful inclusion in the MARXAN Analysis. As a result, only the species listed below were included in the analysis. These species included are to a large extend breeding colonies of seabirds as well as a few marine target species and a few endemic species (marked with "E").

Birds
Agami
Boat-billed Heron
Bridled Tern
Brown Noddy
Brown Pelican
Double-cr Cormorant
Great Blue Heron
Great Egret
Green Heron
Keel-billed Motmot
Laughing Gull
Least Tern
Little Blue Heron
Frigatebird
Red-footed Booby
Redish Egret
Roseate Spoonbill
Roseate Tern
Sandwich Tern
Snowy Egret
Sooty Tern
Tricolored Heron
White Ibis
American Woodstork
Yellow-crowned Night Heron
Jabiru
Scarlet Macaw
Waders/ducks/important wetlands

Mammals
Manatee

Reptiles:
Loggerhead Turtle
Hawksbill
Green Turtle
Crocodylus acutus
Phyllodactylus insularis (E)

Amphibians
Rana juliani (E)

Fish
Spawning sites (Lutjanidae, Serranidae)

Invertebrates
Epigomphus maya (E)
Erpetogomphus leptophis (E)
Citheracanthus meermani (E)
Conch nursery sites

Flora
Ceratozamia robusta
Zamia variegata
Zamia sp nov1 (E)
Zamia sp nov2 (E)
Aristolochia belizensis (E)
Passiflora urbaniana (E)
Passiflora lancetillensis

A full list of all the 153 conservation targets together with the file number and the source of the information can be found in appendix 4 and 5.

Similarly, data on species density are largely lacking. But would have been tremendously usefull in the analysis. The WCS holds Jaguar survey data for three discrete areas in Belize (Gallon Jug, Chiquibul and Cockscomb Basin). Apparently there also exist data for the Mountain Pine Ridge FR, but the data are unavailable. The jaguar densities differ quite a bit between the three sites (Figure 17):

- The CBWS study area was 159 km² and the average density was 8.8 Jaguar per 100km²
- The Chiquibul study area was 107 km² and the average density was 6.8 Jaguars per 100km²
- The Gallon Jug study area was 195 km² and the average density was 11.3 Jaguars per 100km²

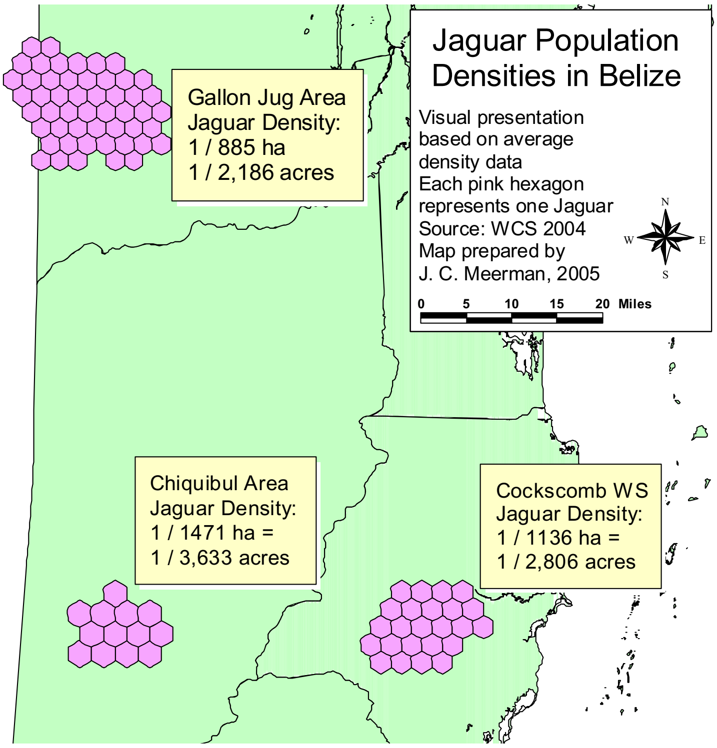


Figure 17. Jaguar Density Data for selected areas of Belize. Each hexagon can be seen as to represent 1 Jaguar.

The difference between these sites can have various explanations. Differences between habitat and resulting habitat suitability may be one. Level of protection may be another very likely reason. The Gallon Jug population is well protected and enjoys a healthy prey base. For the Cockscomb area habitat differences probably play a major role. The relatively low figures found in the Chiquibul area may be the result of a recent collapse of the prey-base as a result of heavy Xatero activity in the area.

Data such as these Jaguar density figures could not be incorporated in the MARXAN analysis but should nevertheless be taken into consideration during the implementation phase of the NPAPSP.

4.5. MARXAN Analysis

All the previously explained data were subjected to a MARXAN analysis. MARXAN is a conservation planning optimization tool (software) that delivers decision support for reserve system design. MARXAN finds reasonably efficient solutions to the problem of selecting a system of spatially cohesive sites that meet a suite of biodiversity targets. Given reasonably uniform data on species, habitats and/or other relevant biodiversity features and surrogates for a number of planning units MARXAN minimizes the "cost" while meeting user-defined biodiversity targets. In many aspects MARXAN is very similar to SPOT, the tool that was used for the Ecoregional Planning analysis.

The Consortium choose to use MARXAN instead of SPOT on the basis that members of the consortium had received training in MARXAN (as part of CZMAI, TNC and WWF input in the consortium) and were thus relatively familiar with the software. Also, MARXAN is supposedly more suitable when marine data are included.

The MARXAN tool allows for the input of numerous variables and can present the results in a number of ways. However, it should be understood that the output is to be used as a tool that will help decision makers come to an ecologically, socially and politically accepTable Protected Areas System design. Central to the analysis is the division of the project area into "planning units". The size of these units is important. Small planning units may give detailed result and thus appear attractive. But the advantage of detailed results is offset by a longer run time of the analysis which can be a very important factor. Also small planning units backfire when relatively few data are available for analysis. In other words, the scale of the planning units needs to be in harmony with the scale of the data input. In this case the size of the (hexagonal) planning units was set at 10 km^2.

One important variable in the MARXAN analysis is the "boundary modifier". This boundary modifier dictates the "clumping" of conservation targets. In other words a tight clumping will result in fewer but larger selected areas giving a reduced boundary effect. A more lose clumping will result in more selected areas that are not necessarily linked. Although the cost of managing such a system is higher (higher boundary effect), it allows for a higher level of freedom for the planner, when decisions have to be made during the implementation phase. For this reason the relatively "loose" boundary modifier of 0.003 was used.

MARXAN essentially selects planning units on the basis of the data input. But every different run (200 runs were made during our analysis) it will start at in a random planning unit. The number of times the program selects a planning unit during the 200 runs is indicative for the importance of that planning unit. The program allows for a number of options in which the selection process is being executed;

- "0" option where selections are made irrespective of an existing Protected Areas System.
- "Locked" option in which the set conservation targets are first placed inside the existing PA system and then starts locating the best position for the "left over" conservation goals (this is a gap-analysis in the true sense)
- "Seeded" option whereby the program starts to fit conservation goals inside an existing PA system but there is no guarantee that a these goals will be maintained within this PA system. This method finds the gaps in the existing PA system but also indicates which parts of the existing PA system experience problems (such as certain outside pressures). It even, to some degree shows which parts of the existing PA system may be redundant.

- "Locked out" option which keeps certain planning units outside the analysis. In our case this option was chosen for planning units with numerous agricultural subdivisions.

During a NPAPSP Task Force meeting in January 2005, the Task force opted to go with the "seeded" method.

In the final output MARXAN presents two options. A "best" result and a "solution" result. The best result gives one optimum outcome of the analysis. The result is presented as either a 1 or a 0. The "solution" option gives for each planning unit, the number of times this planning unit was selected. This latter option gives the planner more freedom to interpret results and for this reason this option will be presented here instead of a "best" result.

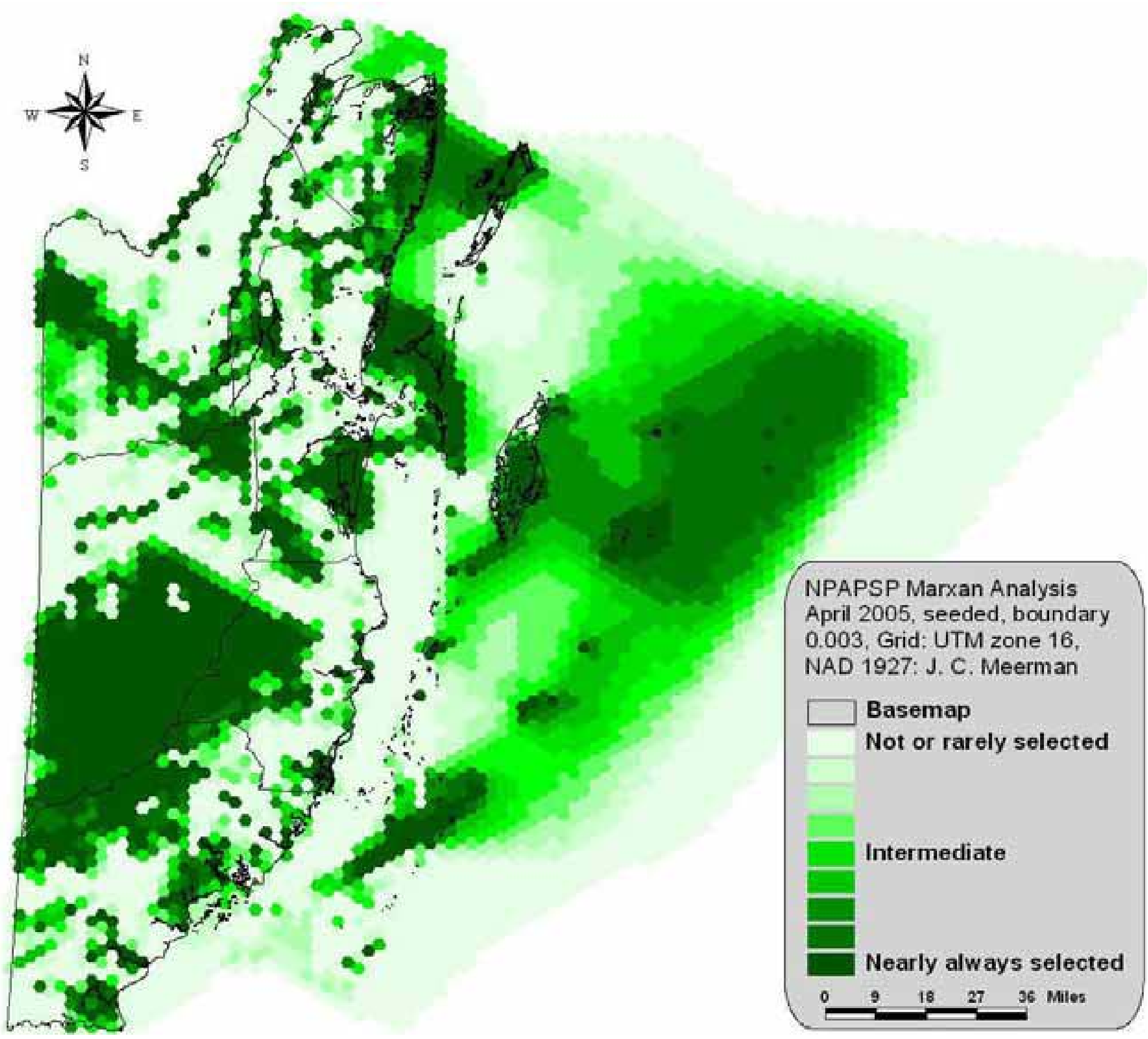


Figure 18. April 2005 MARXAN Analysis Results

The very first conclusion that can be drawn from Figure 18, is that marine area results appear very different from terrestrial results. The primary cause for this lies in the large area outside the reef and atolls; in this "exclusive economic" zone, lie very important deep sea habitats with depths up to more than 4,000 m (12,400 ft). A zone that so far, has eluded the interest of conservation management planners in Belize. However, with the absence of data available for this zone, MARXAN has problems deciding where the optimum planning units are to be placed. Consequently, the picture in the "deep blue" is less defined.

Other reasons for the difference in output between terrestrial and marine sections are that the data are just different. In the terrestrial zone, roads, communities, farming and other land uses are clearly defined and easy to map. In the marine zone, none of this is immediately clear.

For both realms the analysis is hampered by the lack of actual biodiversity data as discussed earlier.

The analysis presented in Figure 18 may be confusing because of its scale. To investigate the results in more detail, the map has been cut up into sections each of which will be discussed separately.

MARXAN Analysis: NE-Belize

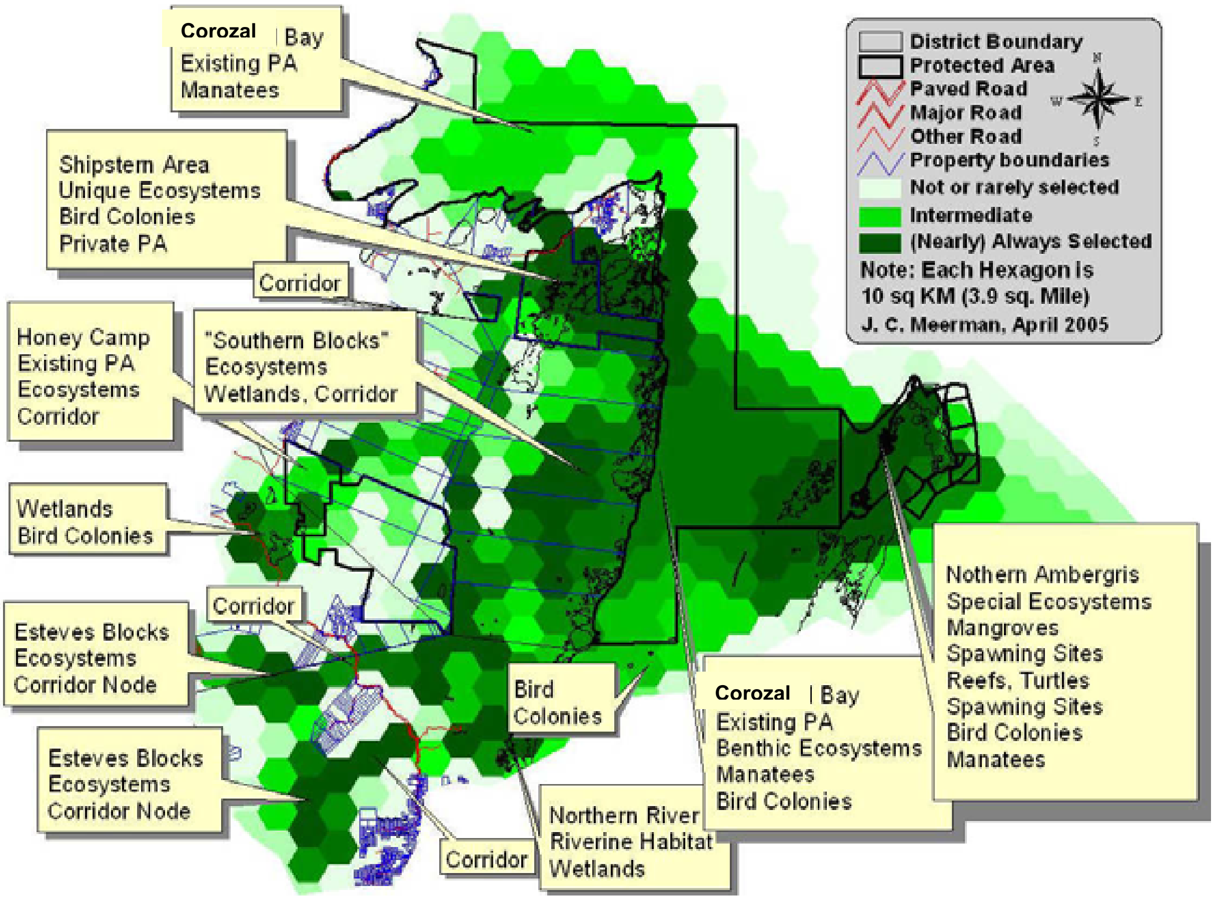


Figure 19. MARXAN analysis NE Belize

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Notes and conclusions:

This area combines many conservation targets and a limited human footprint. Consequently, many areas are selected. Principal challenge in this area is the prevalence of private property. Corridor development is a primary target here. Some other notes:

- Importance of General Shipstern area
- Importance of Northern Ambergris area. Many important conservation targets (marine and terrestrial) within close proximity of each other.
- “Southern Blocks” are important for habitat conservation and biological corridors
- Biological Corridors show up very clearly. Largely these traverse private land. Incentives for landowners to maintain these corridors are needed.
- Honey Camp comes out as a link with wetlands west of it.
- “Esteves blocks” Critical in functioning of Biological Corridors. Private lands!

MARXAN Analysis: N-Belize

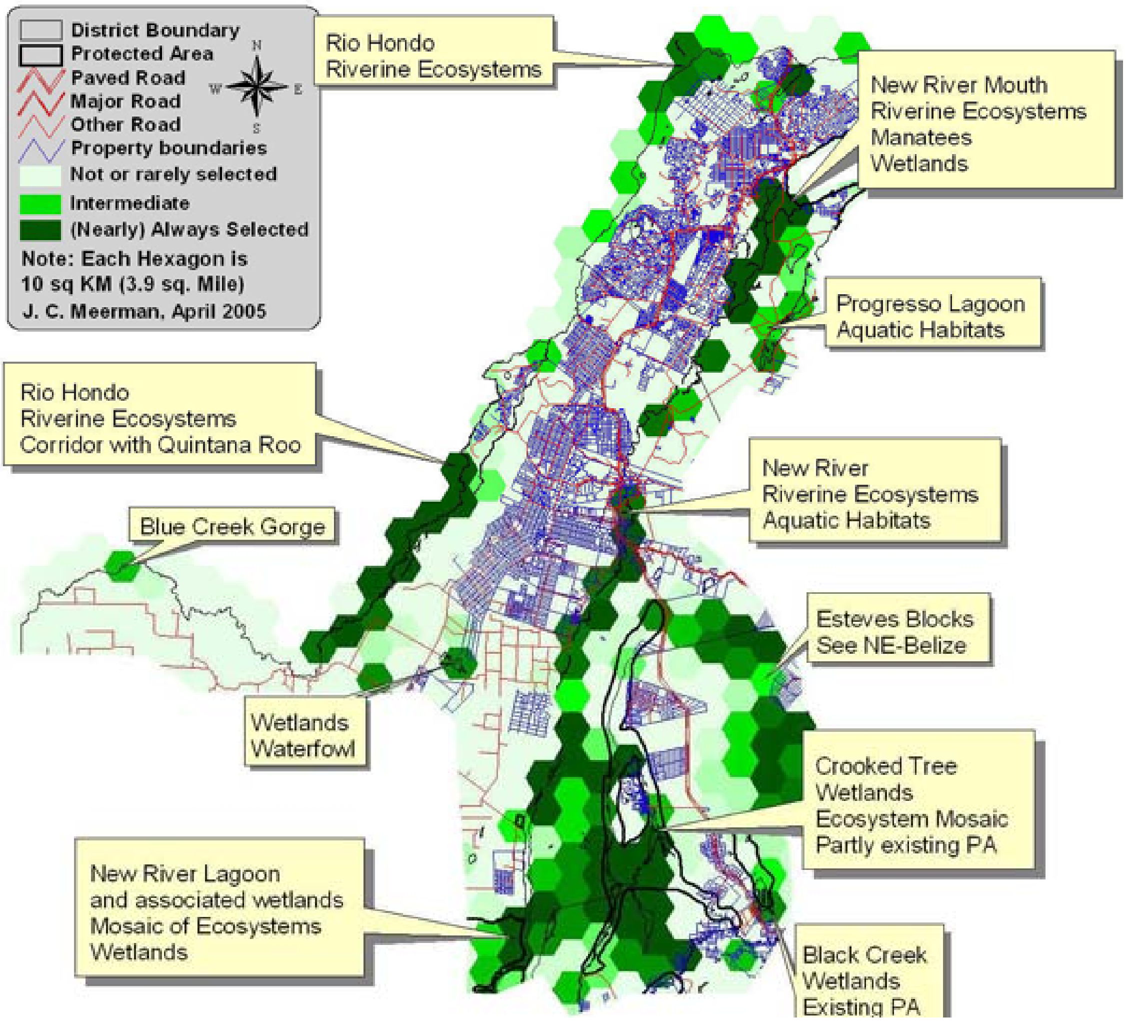

Figure 20. MARXAN Analysis, N Belize

Notes and conclusions:

An area with a very heavy human footprint. Most targets here are riverine or aquatic. Some other notes:

- Both New River and Rio Hondo score high. They have importance as riverine corridors. In addition they are hydrologically important (environmental services).
- Crooked Tree scores very prominently as well as lands south and west of it. A number of different ecosystems are involved here. Crooked Tree is an important part of the Biological Corridor, linking NE Belize with W Belize.

MARXAN Analysis: NW-Belize

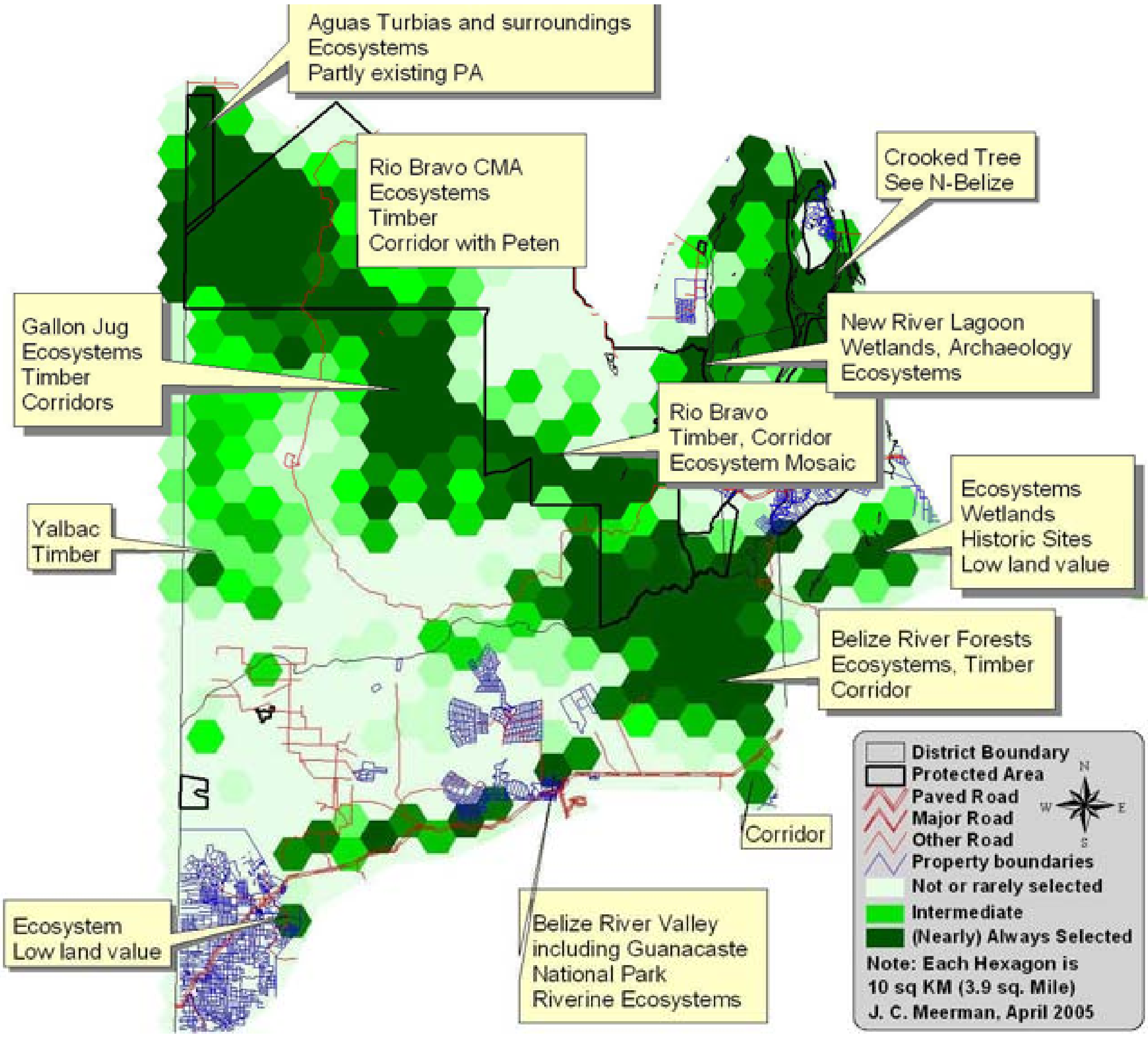

Figure 21. MARXAN Analysis: NW Belize

Notes and conclusions:

This zone includes critical corridor linkages with the rest of Belize but most importantly with the main "Selva Maya" regions of Mexico and Guatemala. Some other notes:

- Selection creates a clear linkages in the biological corridor towards Shipstern to the NE (via Crooked Tree), Guatemala to the West and to Central Belize in the SE (mile 35 corridor and Belize Zoo Corridor).
- Aguas Turbias and adjacent private lands come out strongly.
- Gallon Jug and Yalbac are only moderately selected on the base of current human activities and relatively high agricultural land value.
- A section of the Belize River Valley is fairly strongly selected.
- Belize River Forests were identified as distinct ecosystem, and are essential in the biological corridor and they come out strongly but on private lands. Incentives needed for at least some of it.

MARXAN Analysis: CE-Belize

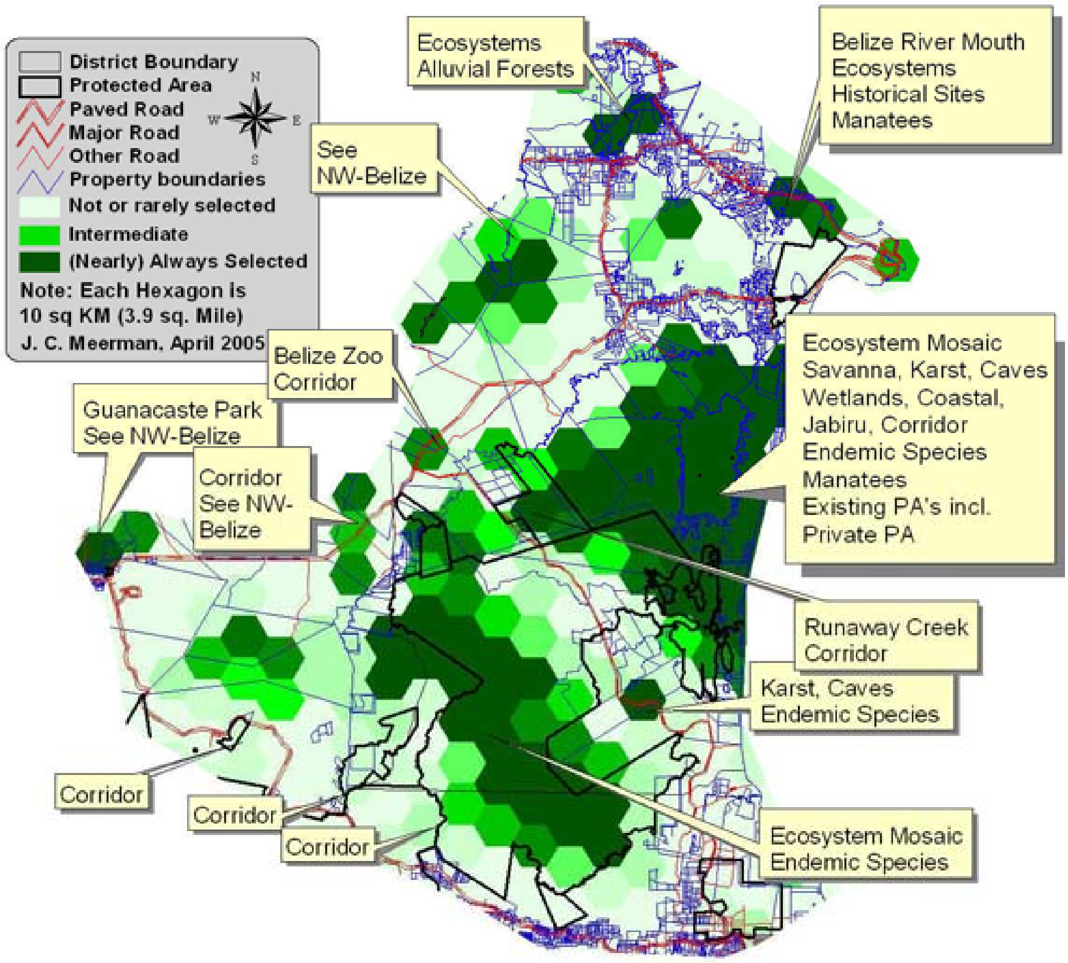

Figure 22. MARXAN Analysis: CE Belize

Notes and conclusions:

This zone has a few relatively isolated blocks with an important mosaic of ecosystems. Maintaining corridor linkages across the highways will present the principal challenge here. Some other notes:

- The highways present a strong influence (human footprint).
- Corridor Linkages (Mile 35, Belize ZOO – Runaway Creek, St. Herman and "Over the Top") all come out but rather weakly due to the heavy footprint imposed by the highways traversing them.

MARXAN Analysis: Maya Mountains Block

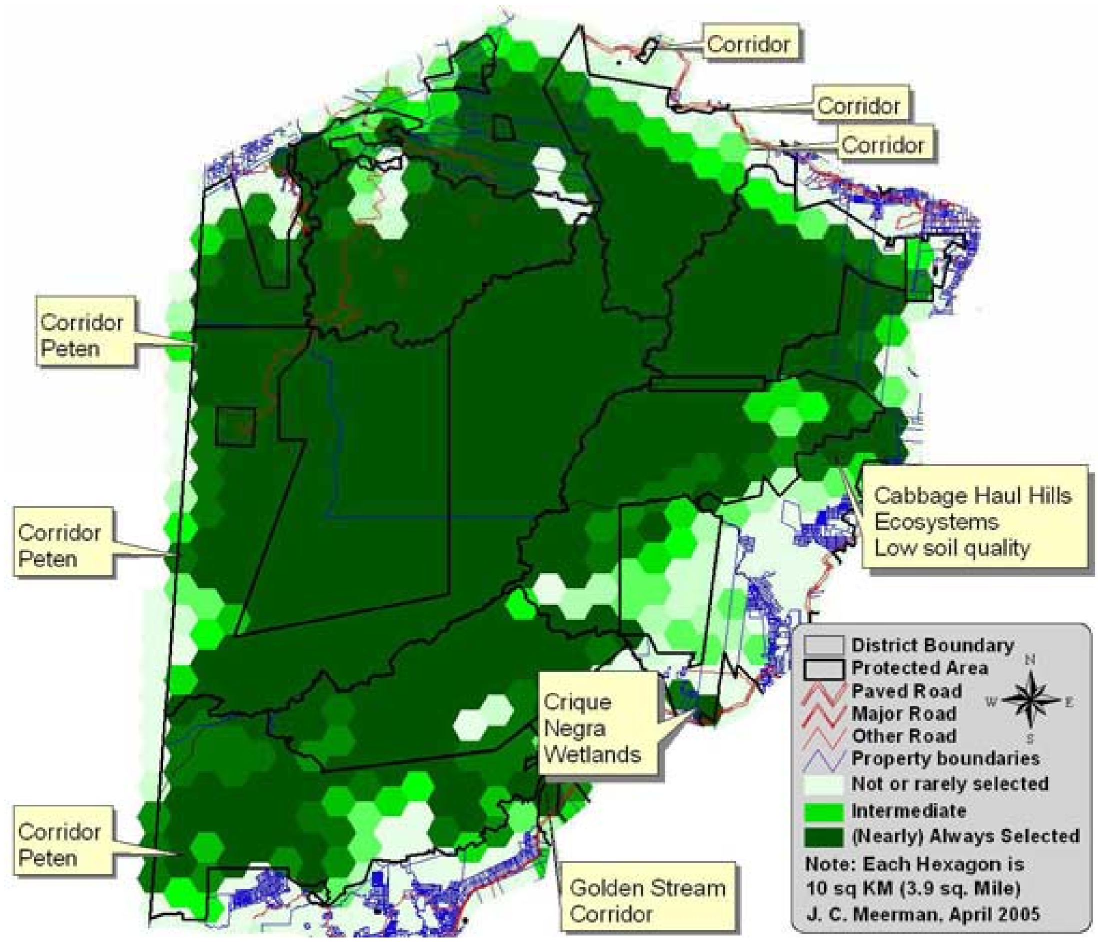

Figure 23. MARXAN Analysis: Maya Mountains Block

Notes and conclusions:

This zone unquestionably forms the largest united block with conservation management needs. It is also to a large extend already covered by a variety of protected areas.

- Hummingbird Highway exerts a strong influence on adjacent existing. PA's Continued conservation of the steeper slopes is still urgent.
- In general the fringes of the Maya Mountain block come out a bit frayed, mostly as a result of strong human footprint input. In many cases the fraying indicates that stronger conservation measures are needed rather than that these areas can be de-reserved. The Guatemalan incursions in the west are a good example here.
- The Maya Mountains Block is a good example of an area that should be managed as one entity with different zonation rather than many separate entities.
- Interesting "additions" include the Cabbage Haul Hills, the Crique Negra wetlands and (private) the gap between the Mountain Pine Ridge and Tapir Mountain.

MARXAN Analysis: S-Belize

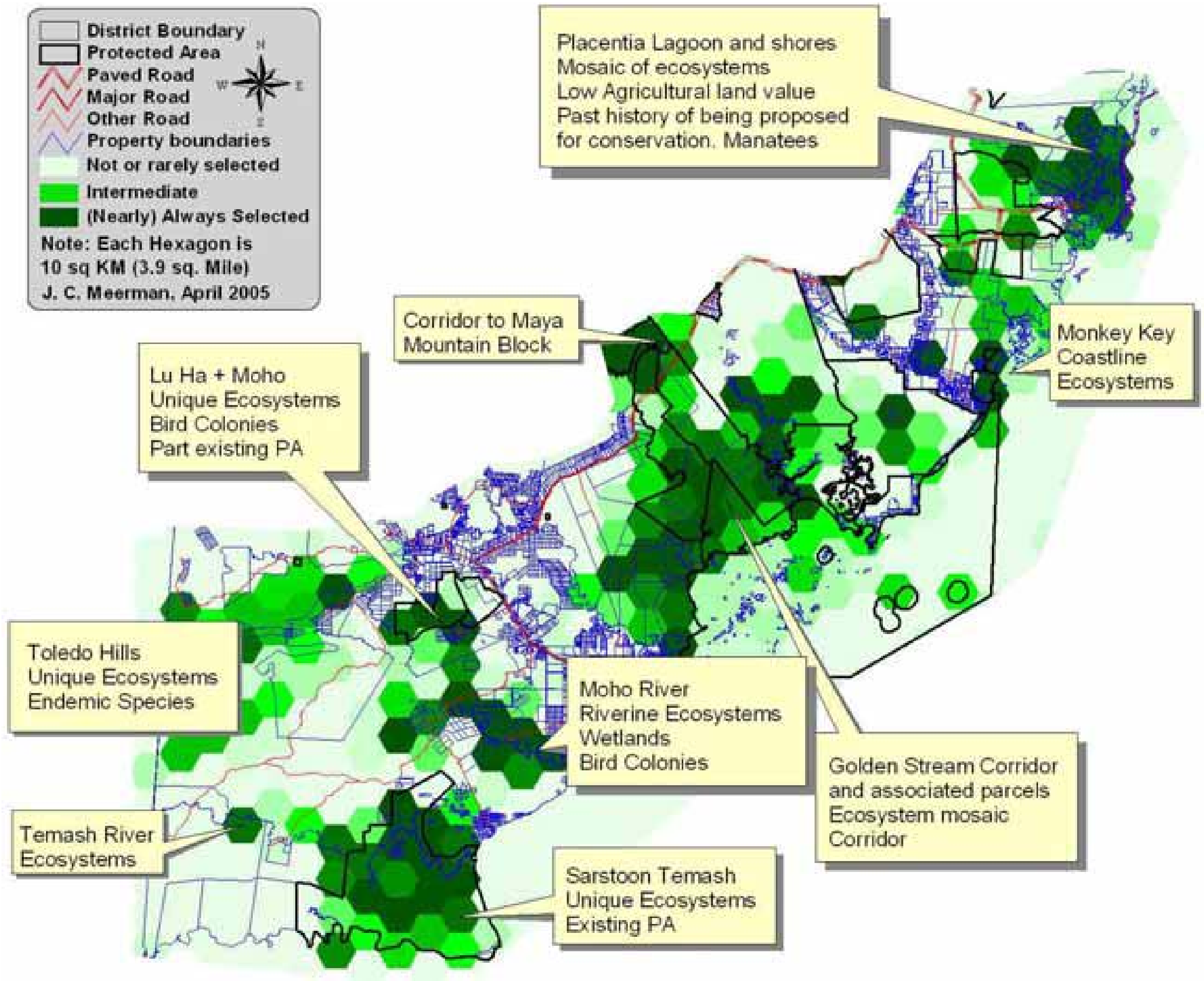

Figure 24. MARXAN Analysis: S. Belize

Notes and conclusions:

This area combines a heavy human footprint and growing development pressure with a diversity of isolated conservation targets. Corridors between the isolated sites are weak. Some other notes:

- Placentia Lagoon and adjacent creeks and wetlands come out strongly based on a large number of ecosystems and conservation targets coming together in a small area. This area is also important for its economic activities. Many of which will be dependant on efficient management of (mostly aquatic) natural resources.
- The coastline north of Monkey River with its mangroves, bird colonies, and wetlands comes out as a small target.
- A large block of targets is centered around the Golden Stream Corridor.
- The Moho River comes out strongly. Important link with Lu Ha
- The Sarstoon Temash NP comes out strongly in spite of strong impacts from the Guatemala side. Also, much of the Temash River outside the PA is selected.
- Interestingly, the steep karstic hills of Western Toledo are also selected. This in spite of a strong human footprint. These hills are clearly important. There are indications that they have important biodiversity but solid data are lacking.

MARXAN Analysis: Marine-Central

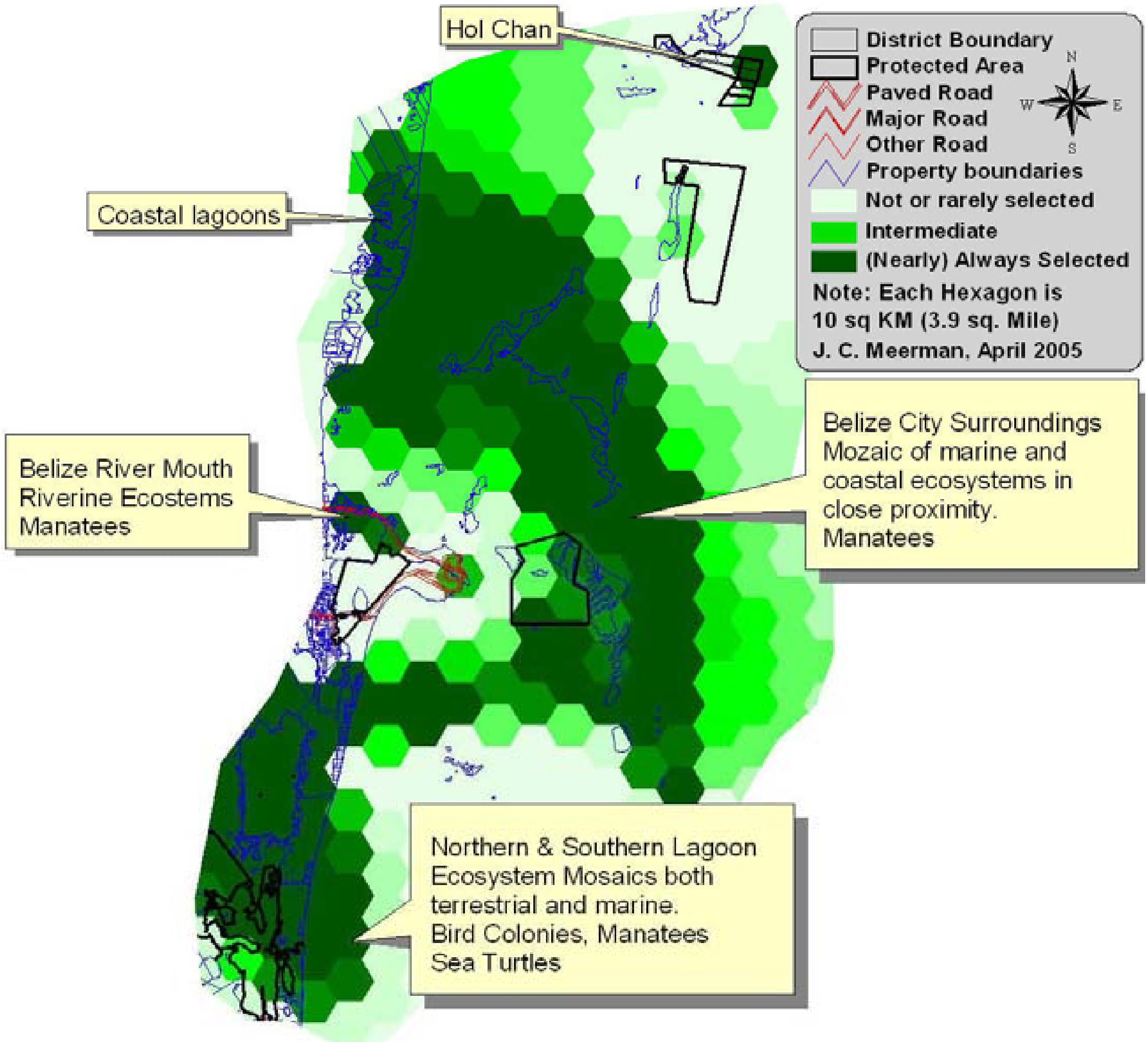

Figure 25. MARXAN Analysis: Marine Central

Notes and conclusions:

This coastal and marine zone comes out as one block. Additional data may be needed to come to a more feasible selection of critical sites. Some other notes:

- The area around Belize City was assigned a strong human footprint but still comes out strongly, there are many important conservation targets within close proximity of each other here.
- Due to the lack of a well-defined human footprint elsewhere, conservation targets are more obviously clustered than in the terrestrial realm. Northern and Southern Lagoon for example come out linked with the reef.

MARXAN Analysis: Marine-South

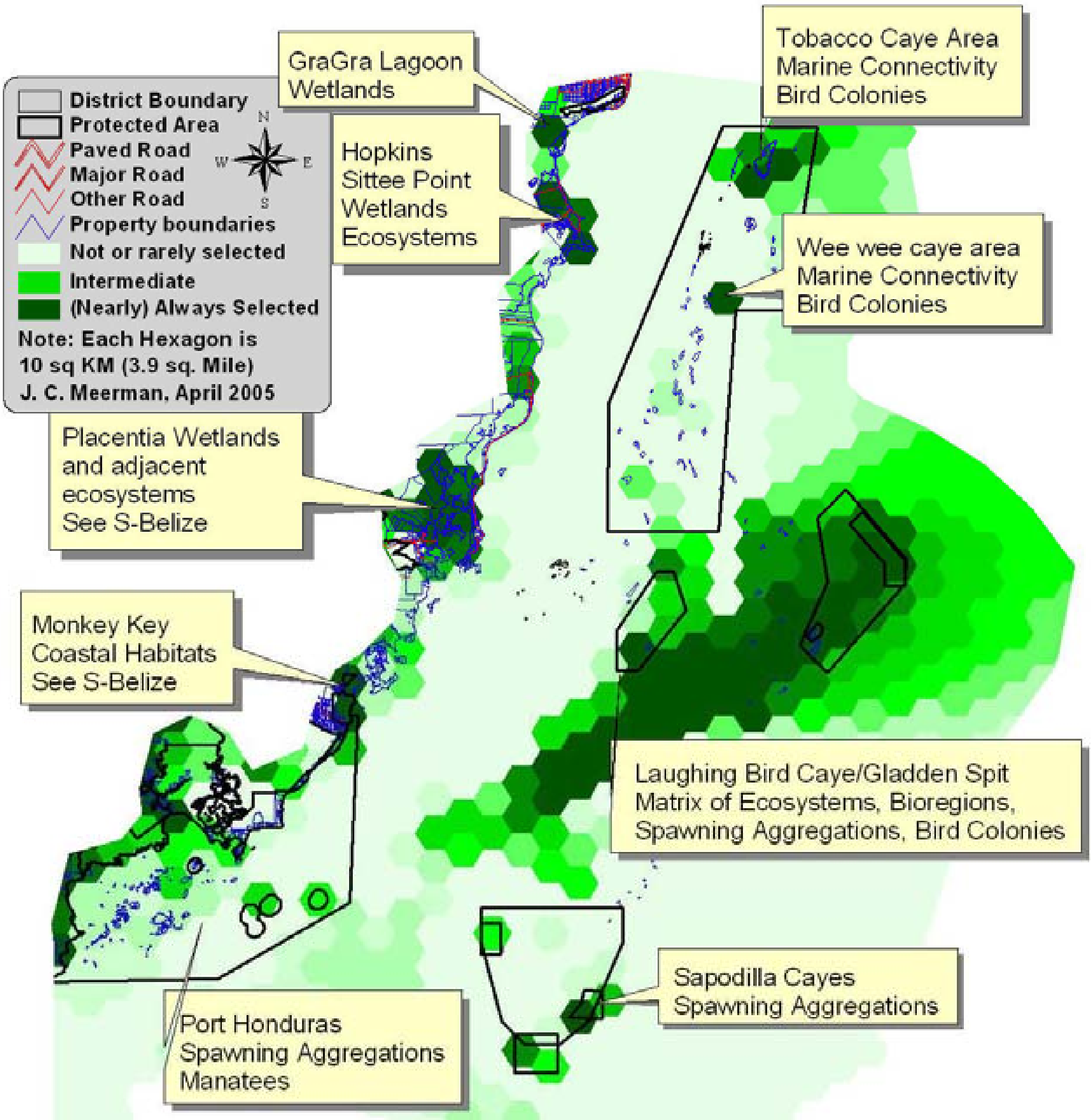

Figure 26. MARXAN Analysis: Marine South

Notes and conclusions:

Additional data may be needed to come to a more feasible selection of critical sites in this zone. Some other notes:

- Placentia Lagoon and adjacent creeks and wetlands come out strongly. See discussion under S – Belize.
- Gladden Spit and Laughing Bird Caye with adjacent waters come out in one block of importance.
- The general Golden Stream Area provides a link with terrestrial habitats
- The relative weak position of Sapodilla Cayes and Port Honduras have to be attributed to reported influence of Guatemalan fishermen.

MARXAN Analysis: Marine-Atolls

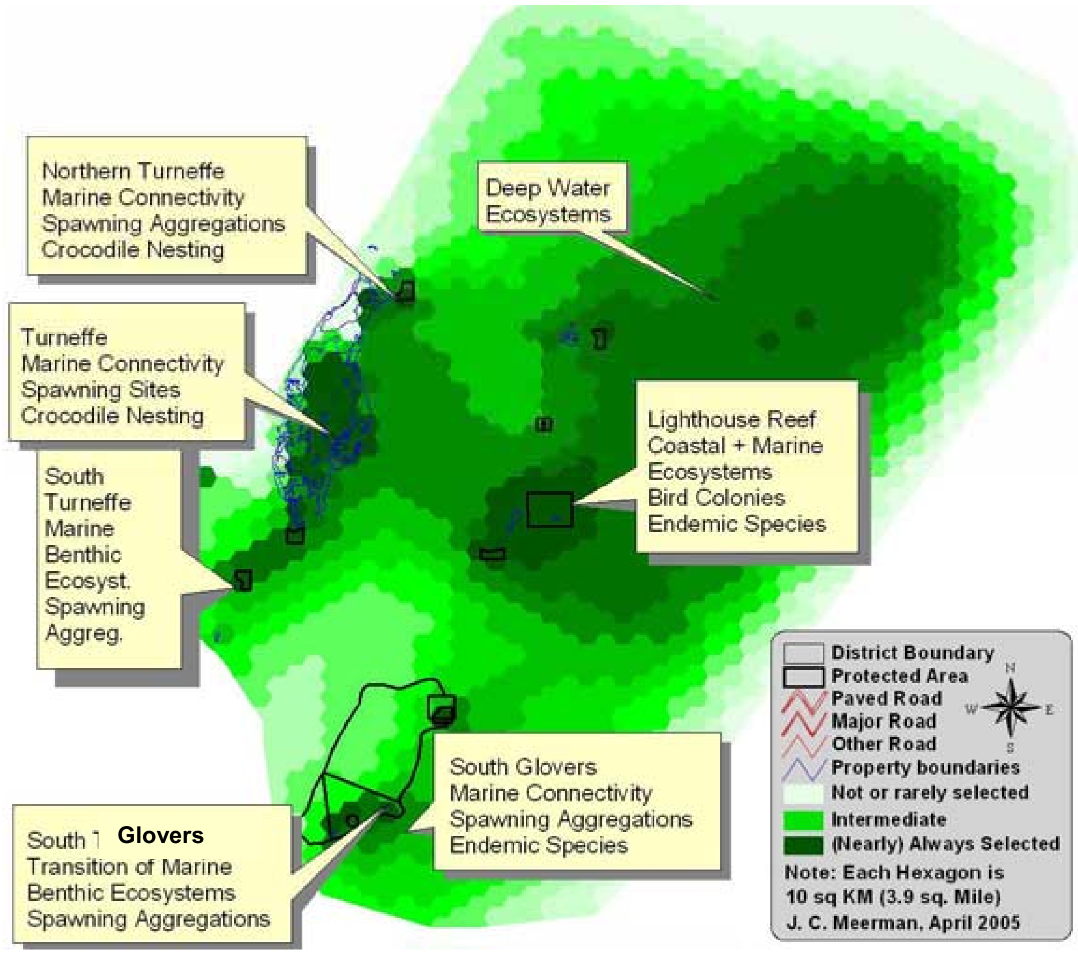

Figure 27. MARXAN Analysis: Marine-Atolls

Notes and conclusions:

This zone is still open to much interpretation. It is also largely in "uncharted waters". Some comments:

- The deep water ecosystems of Belize have never received any attention, consequently, little is known about them and the MARXAN software could not pinpoint real areas of high importance. More data is clearly needed here. Otherwise there is considerable freedom here to position needed conservation areas.
- The Turneffe Atoll comes out very strongly because of its high connectivity. Many different marine and coastal ecosystems occur here in close proximity of each other. Most of the land is in private hands but there is a clear need for marine protected areas here.
- Northern Turneffe is important as the most important nesting site for the American Crocodile.

5. Other considerations

5.1 Mining

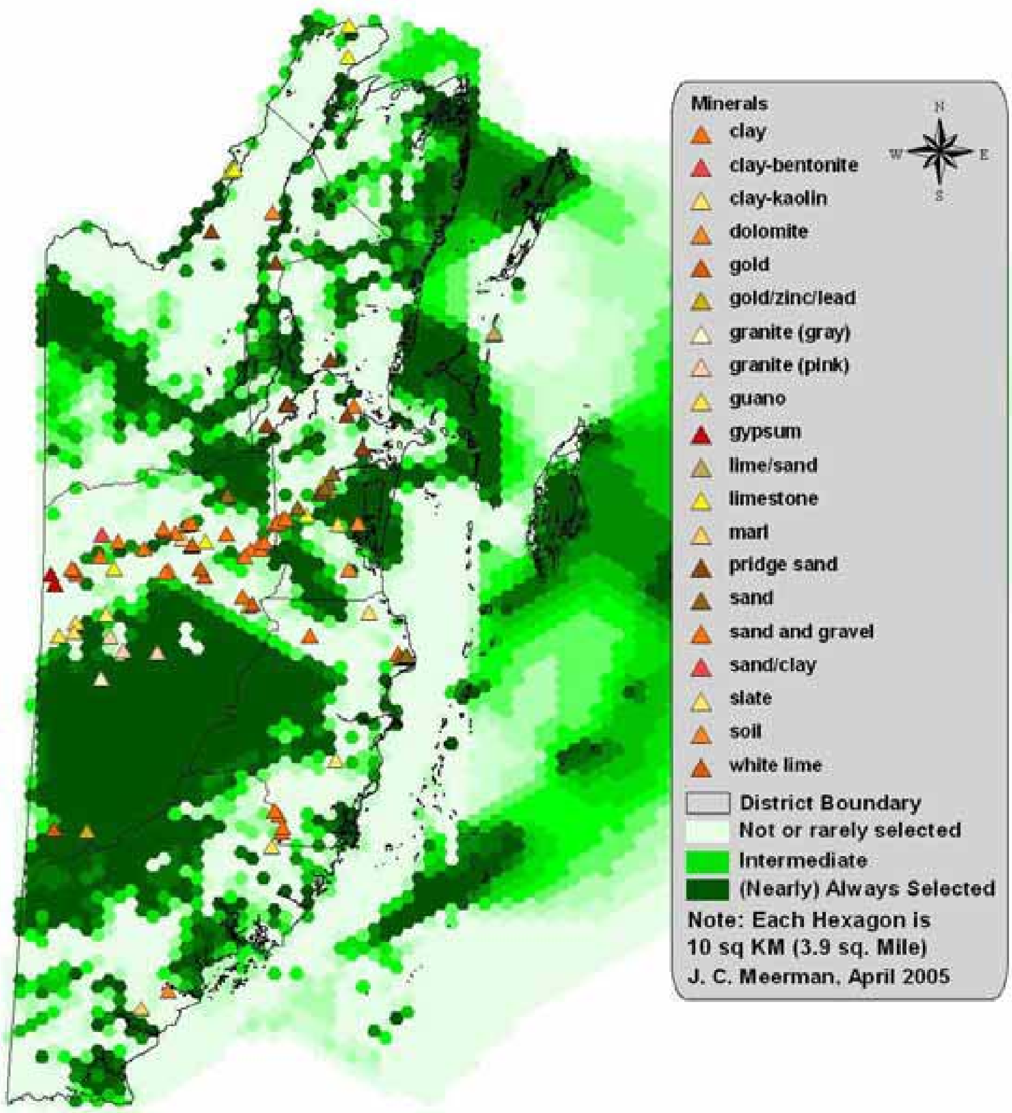

Figure 28. Mineral mining locations. Source; Dept of Geology and Petroleum

While the previous analysis was extensive, it can never be all-encompassing. The lack of suitable biodiversity distribution data is a good example of this.

In addition, there are other considerations for the management of resources including the management of non-renewable resources such as minerals. Figure 28 pictures current known deposits of various minerals that are being mined in Belize. Although there is minimal overlap of such locations with biodiversity conservation priorities, there is some overlap and management planning (through zonation) should allow both natural resource management components to co-exist efficiently.

5.2. Forestry

While the previous analysis includes some forestry related targets (timber production forests), it does not focus on it (compare the maps in Figure 17). No all-encompassing analysis exists of the forest resources of Belize. In 1993, the Forest Department published "A First Approximation at Estimating the Country's Forest Resources" (Bird, 1993). This report estimated that Belize had 1,150,100 ha (2,481,897 acres) of land with potential for timber extraction. Of this only 165,900 ha (409,939 acres) or 14 % was within Forest Reserves. But no quantitative value was assigned to the different forest types.

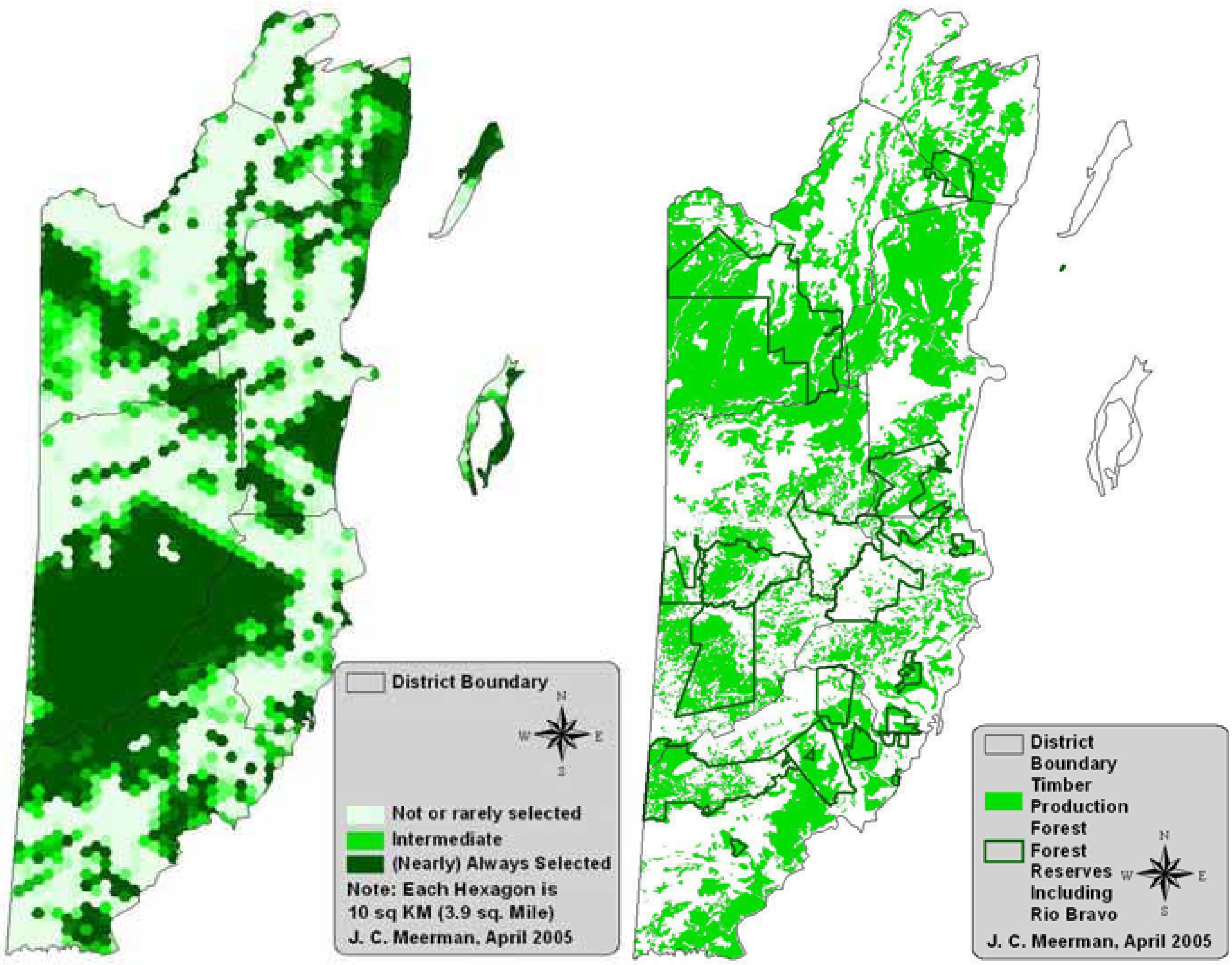

Figure 29. Land with potential for timber extraction (right) compared with result of the current MARXAN analysis (left).

A new analysis carried out as part of the current project sets the amount of land with potential for timber extraction (defined as tall forest classes on slopes of less than 10%) at 981,280 ha (2,424,780 acres) of which 168,510 ha (416,390 acres) or 17 % is within Forest Reserves. If the

RBCMA is included as a Forest Reserve, this amount increases to 246,540 ha (609,220 acres) or 25 %. Note that this analysis is merely a first attempt to establish a extraction forest approximation and does not take into account other factors potentially influencing timber potential.

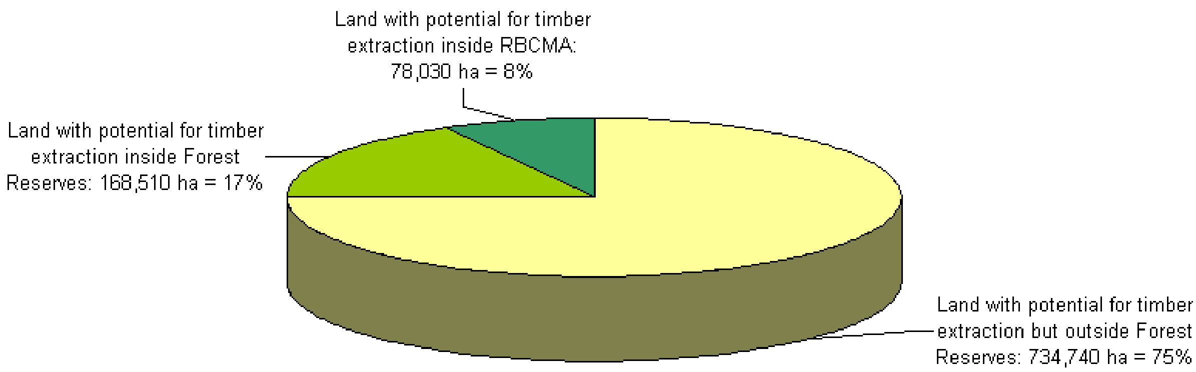

Figure 30. Lands with potential for timber production

Figure 29 clearly shows that currently Forest Reserves are not necessarily where the timber resources are. Some Forest Reserves should possibly be re-designated as a management area with a stricter conservation mandate. Similarly, some sections of National Parks, Wildlife Sanctuaries and Nature Reserve, may need to be re-zoned for the benefit of extractive use. Such an exercise would probably result in major shifts in Protected Area category designations and should not be undertaken until a solid data base is available that qualifies existing forest ecosystems for their standing and potential timber value.

But even a re-designation of Government protected areas, may not be enough to guarantee a sustainable timber industry in Belize. Of all the lands that have potential for timber extraction, much will be in private hands. Under the current Land Tax regime, there is an enormous disincentive for landowners to retain these lands for sustainable timber extraction. While Government retains the right to nationalize lands for which Land Tax can not be collected, this may not the most economic way of guaranteeing sustainable management of these lands.

6. Conclusions

The goal of this assessment and analysis was to identify gaps in the protected areas system of Belize and to develop a tool that will guide the rationalization of the Protected Areas System. The current assessment and analysis was not intended to provide a design for such a rationalization. However, some conclusions can be drawn:

- While Belize considers itself as having an extensive Protected Areas System, the reality is that most of that is for the management of resource use and extraction. With the current needs and expectations of the nation of Belize, such a classification of "Management" rather than "Conservation" per se, is probably a more realistic one. A revised "Protected Areas System" should focus on management of its territory for the use that it is best suited for.

- Using the results of the current analysis, it will be possible to re-designate areas for improved management. This management can be for Extractive uses, areas important for economic species, Tourism, Watershed, Soil, Historical Sites, Special Features etc. etc.

- Re-designing the Protected Areas System should lead to a merging of current protected areas reducing the current number of 115 "management units". In many cases they could be lumped. Examples are Marine Reserves where Spawning Aggregations overlap with other Marine Reserve categories, or the Maya Mountain Block which should be made into one Protected Area with different management zonations based on actual attributes rather than on ancient boundaries.

- The current 115 management units are managed by three departments with a totally different outlook but also with considerably overlap and gray areas. This inefficiency would best be resolved by creating one single agency responsible for all areas of natural resource management.

- The analysis shows many gaps outside currently existing protected areas. It will not be possible or even desirable to transfer all these lands into some protected area category. Many of the identified gaps have current uses and most of them will be on private land. Creating management regimes, in conjunction with private landowners where needed, may in many cases be sufficient. The Belize Association of Private Protected Areas could potentially fill an important role in relieving GOB of some of the conservation "burden".

- Currently some of the top protected areas are Privately Managed Reserves. This illustrates the important role of Private Protected Areas Management. This role can be expanded in order to fill the gaps identified during this analysis.

- There appears to exist a need for community managed conservation areas (Community Baboon Sanctuary, Spanish Creek Wildlife Sanctuary, Mayflower National Park, Rio Blanco National Park etc.). The main desire of these communities is to have an area of "their own" which they can exploit for tourism and recreation or even resource extraction. Principal concern seems to be that many communities feel the need to save certain areas from the ravages of development. In essence, many of the existing or prospective private protected areas come forth out the same perceived need. Aguacate Lagoon near Spanish Lookout is a good example in this aspect. Many of these current and future initiatives may not be within areas currently identified priority areas. Nevertheless, such initiatives still need encouragement and support, but some new management category may need to be created to accommodate such initiatives.

- Biological Corridors can be identified in the MARXAN analysis. Many are also very weak as shown in the analysis. Largely these potential biological corridors traverse private land. Incentives for landowners to maintain these corridors are needed. Again, the Belize Association of Private Protected Areas could potentially assist GOB in this important endeavor.

- Some areas that were identified as a true or relative priority warrant investigation. Most likely, exact data for such area are lacking. Simple Rapid Ecological Assessments could determine the real importance of such areas. When combined with a social assessment, a best management regime could be identified as well in case the area did warrant some form of conservation management.

- The deep water ecosystems of Belize have never received any attention, consequently, little is known about them and the software could not map real areas of high importance. More data is clearly needed here. Otherwise there is considerable freedom here to position needed management areas.

- In general there is still a lack of data that would help conservation planning and management. There is a need for a spatially enabled species database.

- Monitoring of biodiversity is still in its infancy, yet it will be important for the future management of conservation management areas. Sometimes monitoring is complex but sometimes it can be very simple. The apparent absence of monitoring data for bird nesting colonies was noted. Yet, this would be a relatively easy task. There exist good monitoring mechanisms for the marine realm but there is a need for a centralized monitoring database in the terrestrial realm.

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Appendix 1: Timeline

9 Jun 2004 Ecoregional Planning Meeting at PfB

11 Jun 2004 First Consortium meeting

6-8 September 2004. Ecoregional Planning Meeting at Biltmore. At this meeting the ecoregional planning group operating from Merida, Yucatan, presented the results of their conservation priority analysis. In particular, they presented their findings of the "Domain" (BIOMain) analysis that calculated potential distribution of species of concern on the bases of a number of morpho-edaphic and biological parameters. The results of this analysis were very disappointing and the workshop participants did not consider the output a viable product for inclusion in the NPAPSP analysis. After careful analysis it was found that some of the base layers used in the analysis had errors. In particular, the climate data were corrupted. Also it was found that Belize had too few data inputs and this affected the analysis. It was agreed that Jan Meerman would gather additional data and forward these to the group (completed).

29 September 2004. Meeting at LIC. Where after weeks of negotiations, agreement was reached on the type and level of data that would be contributed by LIC. A dataset with Land Tenure information was provided and this has been transformed and analyzed by one of the consortium members (PfB).

7 October 2004: Consortium Meeting at PfB.

19 October 2004: Marine Risk Assessment (CZMAI & WWF). This important workshop was in essence a data collection effort to map threats to the various components of the Marine environment. Similar to the risk analyses carried out by the Ecoregional Planning Group for the terrestrial environments. The data there was available for analysis by the NPAPSP.

2-3 November 2004. "MARXAN" Training organized by WWF, CZMAI and TNC. MARXAN is a Decision Support Tool similar to SPOT that analyzes data and provides a portfolio of areas of conservation importance. MARXAN Training was carried out with the assistance of TNC trainers. This workshop trained a number of consortium members in the use of the MARXAN Decision Support Tool.

4 November 2004. Consortium Meeting. Discussion on data gathered so far. Discussion on the inclusion of the MBC in the NPAPSP planning etc. At this meeting it was decided to use the MARXAN training tool to run the NPAPSP analysis. A similar tool exists (SPOT) and is used by the Ecoregional Planning Group but since we don't have experience with this the meeting chose for MARXAN.

22 November 2004. Meeting with John Day of the Australian Barrier Reef. This meeting proved to be very interesting and the NPAPSP has much to learn from the experiences obtained there.

22 November 2004: Data received from the newly installed director of the Geology and Petroleum Department (Andre Sho). Data will form part of the risk analysis.

29 Nov – 3 December 2004. Ecoregional Planning Meeting in Telchac Puerto, Yucatan, Mexico. This meeting was a final validation workshop involving participants of the three countries (Belize, Guatemala and Mexico). Belize sent 7 delegates including the lead consultant and 3 consortium members. Data and results were presented, discussed and analyzed. The project talks of a "portfolio" of conservation priorities based on data input provided by the countries involved and analyzed using SPOT software. Earlier problems such those noted during the 6-8 September meeting had been corrected solving the most serious problems. Interestingly the results show that in spite of all the efforts that went into collecting and analyzing distributional data of species of concern, the species data did not significantly affect the end product. The results proved to be quite interesting and will need to be incorporated in Belize's NPAPSP. Since the data collected were at a scale that facilitated a regional analysis, the results will not be used as direct results for the NPAPSP, but rather as a comparison as to where the regional priorities are and how Belize should organize its NPAPSP as to match cross-boundary conservation efforts and priorities.

10 Jan 2005 Consortium meeting at PfB with presentation of first MARXAN Results

11 Jan 2005 Marine section of Consortium meets to decide on additional input needed for final MARXAN analysis.

February 1-3, 2005. Reef at Risk GIS Workshop in CZMAI, Belize City. Organized by World Resource Institute and WWF.

February 7, 2005. Final marine data received for inclusion in the analysis

March 8, 2005. Presentation of draft report to Consortium and Task Force at CZMAI conference Room, Belize City.

March 15, 2005. Final comments and additions to draft received from consortium.

April 11, 2005. Presentation of final draft to Consortium and Task Force at CZMAI conference room, Belize City

Appendix 2: Current Protected Areas of Belize

NAME	STATUS	ZONE	IUCN_CAT	GAZETTED	MGMT	CO-MANAGEMENT	ACRES	HECTARES	NOTES
Altun Ha	Archaeological Reserve		II	1995/12/	NICH		38.4	15.6	
Barton Creek	Archaeological Reserve		II	2001/04/	NICH		0.5	0.2	
Cahal Pech	Archaeological Reserve		II	1995/22	NICH		22.4	9.1	
Caracol	Archaeological Reserve		II	1995/55	NICH		25,549.5	10,339.5	
Caves Branch	Archaeological Reserve		II		NICH		15.3	6.2	
Cerros Maya	Archaeological Reserve		II	1976	NICH		24.3	9.9	
El Pilar	Archaeological Reserve		II	1998/052	NICH		1,906.8	771.6	
Lamanai	Archaeological Reserve		II	1985/03/	NICH		979.7	396.5	
Lubaantun	Archaeological Reserve		II		NICH		33.4	13.5	
Nimli Punit	Archaeological Reserve		II	1995/02/	NICH		41.7	16.9	
Santa Rita	Archaeological Reserve		II	1995/02/	NICH		0.1	0.0	
Xunantunich	Archaeological Reserve		II	1995/02/	NICH		7.7	3.1	
Bird Caye	Bird Sanctuary		IV	1977/09/	Forest Dept		1.3	0.5	
Doubloon Bank	Bird Sanctuary		IV	1977/09/	Forest Dept		3.7	1.5	
Little Guana Caye	Bird Sanctuary		IV	1977/09/	Forest Dept		2.6	1.0	
Los Salones	Bird Sanctuary		IV	1977/09/	Forest Dept		2.9	1.2	
Man of War Caye	Bird Sanctuary		IV	1977/09/	Forest Dept	BAS	1.9	0.8	
Monkey Caye	Bird Sanctuary		IV	1977/09/	Forest Dept		1.3	0.5	
Un-Named	Bird Sanctuary		IV	1977/09/	Forest Dept		1.1	0.4	
Caye Caulker	Forest Reserve		VI	1998/28	Forest Dept	FAMRACC	93.7	37.9	
Chiquibul	Forest Reserve		VI	1995/54	Forest Dept		147,823.1	59,822.1	
Columbia River	Forest Reserve		VI	1997/115	Forest Dept		148,303.0	60,016.3	
Deep River	Forest Reserve		VI	1990	Forest Dept		67,304.8	27,237.4	
Fresh Water Creek	Forest Reserve		VI	2001/66	Forest Dept	Friends of Freshwater Creek	33,392.9	13,513.7	
Grants Works	Forest Reserve		VI	1989/95	Forest Dept		7,906.1	3,199.5	Under Review
Machaca	Forest Reserve		VI	1998/86	Forest Dept		3,096.1	1,253.0	
Manatee	Forest Reserve		VI	1959	Forest Dept		103,908.0	42,050.2	Under Review
Mango Creek (1)	Forest Reserve		VI	1989/62	Forest Dept		10,803.2	4,371.9	
Mango Creek (4)	Forest Reserve		VI	1989/62	Forest Dept		19,071.8	7,718.1	
Maya Mountain	Forest Reserve		VI	1997/114	Forest Dept		41,729.9	16,887.6	
Monkey Caye	Forest Reserve		VI	1996/130	Forest Dept		1,654.4	669.5	
Mountain Pine Ridge	Forest Reserve		VI	2000/112	Forest Dept		106,352.7	43,039.6	Under Review
Sibun	Forest Reserve		VI	1977	Forest Dept		106,393.0	43,055.9	Under Review

Sittee River	Forest Reserve		VI	1977	Forest Dept		92,316.6	37,359.4	Under Review
Swasey-Bladen	Forest Reserve		VI	1989/90	Forest Dept		14,778.6	5,980.7	
VACA	Forest Reserve		VI	2003/137	Forest Dept		34,886.8	14,118.2	Under Review
Bacalar Chico	Marine Reserve	General Use	IV	1996/88	Fisheries Dept		11,597.0	4,693.2	
Bacalar Chico	Marine Reserve	No take	IV	1996/88	Fisheries Dept		4,196.8	1,698.4	
Caye Caulker	Marine Reserve		VI	1998/35	Fisheries Dept	FAMRACC	9,670.2	3,913.4	
Dog Flea	Marine Reserve	Spawning Aggregation	IV	2003/161	Fisheries Dept		1,424.3	576.4	
Emily or Caye Glory	Marine Reserve	Spawning Aggregation	IV	2003/161	Fisheries Dept		1,350.9	546.7	
Gladden Spit	Marine Reserve	Spawning Aggregation	IV	2003/161	Fisheries Dept		3,996.9	1,617.5	
Gladden Spit and Silk Cayes	Marine Reserve		IV	2003/95	Fisheries Dept	Friends of Nature	25,978.3	10,513.1	
Glovers Reef	Marine Reserve	Seasonal Closure	IV	2001/137	Fisheries Dept		3,831.5	1,550.6	
Glovers Reef	Marine Reserve	Conservation	IV	2001/137	Fisheries Dept		17,470.9	7,070.3	
Glovers Reef	Marine Reserve	Wilderness	IV	2001/137	Fisheries Dept		667.4	270.1	
Glovers Reef	Marine Reserve	General Use	IV	2001/137	Fisheries Dept		64,683.3	26,176.5	
Hol Chan	Marine Reserve		II	1987/57	Fisheries Dept		624.2	252.6	
Hol Chan	Marine Reserve		II	1987/57	Fisheries Dept		1,458.6	590.3	
Hol Chan	Marine Reserve		II	1987/57	Fisheries Dept		285.9	115.7	
Hol Chan	Marine Reserve		II	1987/57	Fisheries Dept		454.7	184.0	
Hol Chan	Marine Reserve	No Take	II	1987/57	Fisheries Dept		989.8	400.5	
Nicholas Caye	Marine Reserve	Spawning Aggregation	IV	2003/161	Fisheries Dept		1,663.3	673.1	
Northern Glovers Reef	Marine Reserve	Spawning Aggregation	IV	2003/161	Fisheries Dept		1,536.1	621.7	
Port Honduras	Marine Reserve		IV	2000/9	Fisheries Dept	TIDE	96,731.1	39,145.9	
Port Honduras	Marine Reserve	No Take	IV	2000/9	Fisheries Dept	TIDE	3,270.0	1,323.3	
Rise and Fall Bank	Marine Reserve	Spawning Aggregation	IV	2003/161	Fisheries Dept		4,252.2	1,720.8	

Rocky Point	Marine Reserve	Spawning Aggregation	IV	2003/161	Fisheries Dept		1,408.8	570.1	
Sandbore	Marine Reserve	Spawning Aggregation	IV	2003/161	Fisheries Dept		1,288.3	521.4	
Sapodilla Cayes	Marine Reserve		IV	1996/117	Fisheries Dept	TASTE	38,594.0	15,618.5	
Seal Caye	Marine Reserve	Spawning Aggregation	IV	2003/161	Fisheries Dept		1,600.8	647.8	
Silk Cayes	Marine Reserve		IV	2003/95	Fisheries Dept	Friends of Nature	378.3	153.1	
South Point Lighthouse	Marine Reserve	Spawning Aggregation	IV	2003/161	Fisheries Dept		1,316.5	532.8	
South Point Turneffe	Marine Reserve	Spawning Aggregation	IV	2003/161	Fisheries Dept		1,378.7	557.9	
South Water Caye	Marine Reserve		IV	1996/118	Fisheries Dept		117,874.9	47,702.5	
Aguas Turbias	National Park		II	1994/44	Forest Dept		8,750.4	3,541.2	
Bacalar Chico	National Park		V	1996/89	Forest Dept		11,145.2	4,510.3	
Billy Barquedeer	National Park		II	2001/176	Forest Dept	Friends of the Valley	1,639.1	663.3	
Chiquibul	National Park		II	1995/55	Forest Dept		264,003.3	106,838.8	
Five Blues Lake	National Park		II	1994/52	Forest Dept	BAS	4,061.2	1,643.5	
Gragra Lagoon	National Park		II	2002/86	Forest Dept	Friends of GraGra	1,319.7	534.1	
Guanacaste	National Park		II	1994/46	Forest Dept	BAS	57.6	23.3	
Honey Camp	National Park		II	2001/65	Forest Dept		7,772.0	3,145.2	
Laughing Bird Caye	National Park		II	1996/94	Forest Dept	Friends of Nature	10,119.6	4,095.3	
Mayflower Bocawina	National Park		II	2001/139	Forest Dept	Friends of Mayflower/Boca	7,854.0	3,178.4	Under Review
Monkey Bay	National Park		II	1994/45	Forest Dept		2,122.2	858.8	
Nojkaaxmeen Eligio Panti	National Park		II	2001/177	Forest Dept	Tanah - Nojkaaxmeen EP	12,657.3	5,122.2	
Payne's Creek	National Park		II	2004/149	Forest Dept	TIDE	36,420.5	14,738.9	
Rio Blanco	National Park		II	1994/41	Forest Dept	Friends of Rio Blanco	94.3	38.2	
Sarstoon-Temash	National Park		II	1994/42	Forest Dept	SATIIM	41,854.7	16,938.1	
St. Herman's Blue Hole	National Park		II	1986/109	Forest Dept	BAS	664.5	268.9	
Actun Tunichil Muknal	Natural Monument		Ia	2004/15	Forest Dept	BAS	457.3	185.1	
Blue Hole	Natural Monument		III	1996/96	Forest Dept	BAS	946.5	383.0	
Blue Hole	Natural Monument		III	1996/96	Forest Dept	BAS	76.6	31.0	
Halfmoon Caye	Natural Monument		II	1982/30	Forest Dept	BAS	9,770.9	3,954.2	
Thousand Foot Falls	Natural Monument		III	2004/79	Forest Dept		1,290.4	522.2	
Victoria Peak	Natural Monument		III	1998/47	Forest Dept		4,840.6	1,958.9	

Bladen	Nature Reserve	Ia	1990/66	Forest Dept	BMC	99,673.8	40,336.7	
Burdon Canal	Nature Reserve	Ia	1992/88	Forest Dept		5,254.8	2,126.6	Under Review
Tapir Mountain	Nature Reserve	II	2004/15	Forest Dept	BAS	6,299.6	2,549.4	
Aguacate Lagoon	Private Reserve	IV		Private		283.9	114.9	
Block 127	Private Reserve	IV		TIDE		9,231.8	3,736.0	
Community Baboon Sanctuary	Private Reserve	IV		Private		12,980.1	5,252.9	
Golden Stream	Private Reserve	IV		YCT		15,038.1	6,085.7	
Monkey Bay	Private Reserve	IV		Private		1,150.0	465.4	
Rio Bravo C&MA	Private Reserve	IV		PfB		259,205.7	104,897.2	
Runaway Creek	Private Reserve	IV		BWB/ASF		7,123.8	2,882.9	
Shipstern Nature Reserve	Private Reserve	IV		ITCF		20,332.8	8,228.4	
Aguacaliente	Wildlife Sanctuary	IV	1998	Forest Dept	Aquacaliente Mgmt Team	5,467.9	2,212.8	
Cockscomb Basin	Wildlife Sanctuary	IV	1997/113	Forest Dept	BAS	122,260.1	49,477.1	
Corozal Bay	Wildlife Sanctuary	IV	1998/48	Forest Dept		180,508.3	73,049.4	
Crooked Tree	Wildlife Sanctuary	IV	1984/95	Forest Dept	BAS	36,479.3	14,762.7	RAMSAR
Gales Point	Wildlife Sanctuary	IV	1998/92	Forest Dept		9,096.8	3,681.4	
Spanish Creek	Wildlife Sanctuary	IV	2002/87	Forest Dept	Rancho Dolores Dev. Group	6,001.3	2,428.7	
Swallow Caye	Wildlife Sanctuary	IV	2002/102	Forest Dept	Friends of Swallow Caye	8,972.1	3,630.9	

Appendix 3: National list of critical species

The IUCN Red List of Threatened Animals is internationally recognised as the list that categorises the status of globally threatened animal species. It provides taxonomic, conservation status and distribution information on species that have been evaluated using the IUCN Red List categories. This system is designed to determine relative risk of extinction, and the main purpose of the Red List is to catalogue the species that are regarded as threatened at global level, i.e. at risk of overall extinction. See: http://www.redlist.org. While this list is a global assessment, several national or regional red lists exist and the IUCN has prepared guidelines to prepare such lists. See: http://www.iucn.org/themes/ssc/redlists/regionalguidelines.htm

Assessment of extinction risk and setting conservation priorities are two related but different processes. Assessment of extinction risk, such as the assignment of IUCN Red List Categories, generally precedes the setting of priorities. The purpose of the Red List categorization is to produce a relative estimate of the likelihood of extinction of the taxon. Setting conservation priorities, on the other hand, which normally includes the assessment of extinction risk, also takes into account other factors such as ecological, phylogenetic, historical, or cultural preferences for some taxa over others, as well as the probability of success of conservation actions, availability of funds or personnel to carry out such actions, and legal frameworks for conservation of threatened taxa. In the context of regional risk assessments, a number of additional pieces of information are valuable for setting conservation priorities. For example, it is important to consider not only conditions within the region but also the status of the taxon from a global perspective and the proportion of the global population that occurs within the region. Consequently, it is recommended that any publication that results from a regional assessment process should include at least three measures: (1) the regional Red List Category, (2) the global Red List Category, and (3) an estimate of the proportion (%) of the global population occurring within the region. Decisions on how these three variables, as well as other factors, are used for establishing conservation priorities is a matter for the regional authorities to determine. The authorities may also wish to consider other variables in setting priorities, which are to a large degree region-specific and therefore not covered by the Guidelines. However, one particular situation merits special attention.

The application of the Red List Criteria, may under some circumstances result in a taxon qualifying for listing in a higher category at the global level than the regional level. This may be the case when the regional population is more or less sTable but constitutes only a small percentage of the global population, which is experiencing a net decline. Such species should be given particular attention at the regional level because of their significance for global status.

Categories applied in the IUCN Red Data list are as follows:

EXTINCT (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)
A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)
A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)
A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

CONSERVATION DEPENDENT (CD). Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)
A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

Under the NPAPSP project, the consortium made an attempt to create a first national list of critical terrestrial and marine species (including plants and fishes). This list as produced here could be seen as the first step to prepare a Belize Red Data List. While this list does use IUCN terminology it does not claim to have followed the IUCN Red Data methodology to the full extend. It is also felt that an official Red Data List should have a broader backing than just the consortium involved in the NPAPSP analysis.

Order	*Species*	English Name	IUCN class	Status in Belize	Justification
Amphibians	*Agalychnis moreletii*		CR	DD	3
Amphibians	*Bolitoglossa dofleini*		NT	DD	3
Amphibians	*Bufo campbelli*		NT	LC	3
Amphibians	*Smilisca cyanosticta*		NT	DD	3
Amphibians	*Eleutherodactylus chac*		NT	DD	3
Amphibians	*Eleutherodactylus laticeps*		NT	DD	3
Amphibians	*Eleutherodactylus leprus*		VU	DD	3
Amphibians	*Eleutherodactylus psephosypharus*		VU	DD	3
Amphibians	*Eleutherodactylus sabrinus*		EN	DD	3
Amphibians	*Eleutherodactylus sandersoni*		EN	DD	3
Amphibians	*Hyla bromeliacia*		EN	DD	3
Amphibians	*Rana juliani*		NT	LC	2
Birds	*Agamia agami*	Agami Heron		VU	6,8
Birds	*Ajaia ajaja*	Roseate Spoonbill		VU	6
Birds	*Amazona oratrix*	Yellow-Headed Amazon		EN	4,8,9,10
Birds	*Amazona xantholora*	Yellow-Lored Parrot		VU	10
Birds	*Anous stolidus*	Brown Noddy		VU	6
Birds	*Ara macao cyanoptera*	Scarlet Macaw		EN	4,8,9
Birds	*Ardea herodias*	Great Blue Heron		VU	4,10
Birds	*Asio stygius*	Stygian Owl		VU	10
Birds	*Bubo virginianus*	Great Horned Owl		VU	10
Birds	*Cairina moschata*	Muscovy Duck		VU	4
Birds	*Columba leucocephala*	White-Crowned Pigeon	NT	VU	4,7
Birds	*Contopus cooperi*	Olive-Sided Flycatcher	NT	DD	
Birds	*Crax rubra*	Great Curassow	NT	VU	4,9
Birds	*Dendrocygna autumnalis*	Black-Bellied Whistling Duck		VU	4,10
Birds	*Dendrocygna bicolor*	Fulvous Whistling Duck		VU	4,10
Birds	*Dendroica cerulea*	Cerulean Warbler	VU	VU	
Birds	*Egretta rufescens*	Reddish Egret		VU	6,10
Birds	*Egretta thula*	Snowy Egret		VU	6,10
Birds	*Egretta tricolor*	Tricolored Heron		Vu	6,10
Birds	*Electron carinatum*	Keel-Billed Motmot		VU	3,8,9
Birds	*Eudocimus albus*	White Ibis		VU	6
Birds	*Falco deiroleucus*	Orange-Breasted Falcon		VU	8,9
Birds	*Fregata magnificens*	Magnificent Frigatebird		VU	6
Birds	*Harpia harpyja*	Harpy Eagle	NT	CR	4,7,9,10
Birds	*Harpyhaliaetus solitarius*	Solitary Eagle	NT	CR	4,7,10
Birds	*Jabiru mycteria*	Jabiru		VU	4,7,9,10
Birds	*Laterallus jamaicensis*	Black Rail	NT	DD	
Birds	*Melanoptila glabrirostris*	Black Catbird	NT	NT	8,9
Birds	*Meleagris ocellata*	Ocellated Turkey	NT	VU	3,4,9
Birds	*Morphnus guianensis*	Crested Eagle	NT	CR	4,7,10
Birds	*Mycteria americana*	Wood Stork		VU	4,6,10
Birds	*Nyctanassa violacea*	Yellow-Crowned Night-Heron		VU	6
Birds	*Nycticorax nycticorax*	Black-Crowned Night-Heron		VU	6

Birds	*Pelecanus occidentalis*	Brown Pelican		VU	6,10
Birds	*Penelope purpurascens*	Crested Guan		VU	4
Birds	*Phalacrocorax auritus*	Double-Crested Cormorant		VU	4,6,10
Birds	*Phalacrocorax brasilianus*	Neotropic Cormorant		VU	4,6,10
Birds	*Pionopsitta haematotis*	Brown-Hooded Parrot		DD	
Birds	*Sarcoramphus papa*	King Vulture		VU	7,8,9
Birds	*Sterna anaethetus*	Bridled Tern		VU	6
Birds	*Sterna antillarum*	Least Tern		VU	6
Birds	*Sterna dougallii*	Roseate Tern		VU	6
Birds	*Sterna fuscata*	Sooty Tern		VU	6
Birds	*Sterna sandvicensis*	Sandwich Tern		VU	6
Birds	*Sula leucogaster*	Brown Booby		VU	6
Birds	*Sula sula*	Red-Footed Booby		VU	6
Corals	*Anthozoa – all species*	Gorgonians, Telestaceans, Soft Corals, Black Corals, Stony Corals	VU	VU	9
Corals	*Hydrozoa – all species*	Fire Corals, Lace Corals	VU	VU	9
Fishes	*Balistes vetula*	Queen Triggerfish	VU	VU	4,5
Fishes	*Dermatolepis inermis*	Marbled Grouper	VU	MD	1,4,5,6
Fishes	*Epinephelus itajara*	Goliath Grouper	CR	MD	1,4,5,6,9
Fishes	*Epinephelus morio*	Red Grouper	NT	MD	1,4,5,6
Fishes	*Epinephelus nigritus*	Warsaw Grouper	CR	MD	1,4,5,6
Fishes	*Epinephelus niveatus*	Snowy Grouper	VU	MD	1,4,5,6
Fishes	*Epinephelus striatus*	Nassau Grouper	EN	MD	1,4,5,6,9
Fishes	*Hippocampus erectus*	Lined Seahorse	VU	DD	
Fishes	*Hippocampus reidi*	Longsnout Seahorse	DD	DD	
Fishes	*Lachnolaimus maximus*	Hogfish	VU	VU	4,5
Fishes	*Lutjanus analis*	Mutton Snapper	VU	VU	4,5,6
Fishes	*Lutjanus cyanopterus*	Cubera Snapper	VU	VU	4,5,6
Fishes	*Mycteroperca venenosa*	Yellowfin Grouper	NT	MD	1,4,5,6
Fishes	*Pagrus pagrus*	Red Porgy	EN	DD	4,5
Fishes	*Sanopus astrifer*	Whitespotted Toadfish	VU	DD	
Fishes	*Sanopus greenfieldorum*	Whitelined Toadfish	VU	DD	
Fishes	*Sanopus reticulatus*	Reticulated Toadfish	VU	DD	
Fishes	*Sanopus splendidus*	Splendid Toadfish	VU	DD	
Fishes	*Scarus guacamaia*	Rainbow Parrotfish	VU	VU	4,5
Fishes-Sharks	*Carcharhinus leucas*	Bull Shark	NT	NT	4,5,9,10
Fishes-Sharks	*Carcharhinus limbatus*	Blacktip Shark	NT	NT	4,5,9,10
Fishes-Sharks	*Carcharhinus longimanus*	Oceanic Whitetip Shark	NT	NT	4,5,9,10
Fishes-Sharks	*Carcharhinus plumbeus*	Sandbar Shark	NT	NT	4,5,9,10
Fishes-Sharks	*Galeocerdo cuvier*	Tiger Shark	NT	NT	4,5,9,10
Fishes-Sharks	*Isurus oxyrinchus*	Shortfin Mako	NT	NT	4,5,9,10
Fishes-Sharks	*Mustelus canis*	Dusky Smoothhound	NT	DD	
Fishes-Sharks	*Negaprion brevirostris*	Lemon Shark	NT	NT	4,5,9,10
Fishes-Sharks	*Prionace glauca*	Blue Shark	NT	NT	4,5,9,10
Fishes-Sharks	*Pristis pectinata*	Smalltooth Sawfish	NT	CR	4,5
Fishes-Sharks	*Pristis perotteti*	Largetooth Sawfish	CR	CR	4,5
Fishes-Sharks	*Rhincodon typus*	Whale Shark	VU	VU	7,8,9
Fishes-Sharks	*Sphyrna lewini*	Scalloped Hammerhead	NT	NT	4,5,9,10
Fishes-Sharks	*Sphyrna mokarran*	Great Hammerhead	DD	DD	4,5,9,10
Fishes-Sharks	*Sphyrna zygaena*	Smooth Hammerhead	NT	NT	4,5,9,10
Mammals	*Alouatta pigra*	Mexican Black Howler Monkey	EN	VU	3,9
Mammals	*Ateles geoffroyi*	Central American Spider Monkey	VU	VU	9
Mammals	*Balaenoptera physalus*	Fin Whale	EN	DD	9
Mammals	*Balantiopteryx io*	Thomas's Sac-winged Bat,	EN	VU	8
Mammals	*Bauerus dubiaquercus*	Van Gelder’s Bat,	VU	VU	8
Mammals	*Cabassous centralis*	Northern Naked-Tailed Armadillo	DD	DD	8
Mammals	*Centronycteris centralis*	Shaggy Bat	VU	VU	8
Mammals	*Dicotyles pecari*	White-Lipped Peccary	VU	VU	4,7,10

Mammals	*Globicephala macrorhynchus*	Short-finned Pilot Whale	VU	DD	9
Mammals	*Herpailurus yaguarondi*	Yaguarundi	VU	LC	10
Mammals	*Leopardus pardalis*	Ocelot	VU	VU	4,9,10
Mammals	*Leopardus wiedii*	Margay	VU	VU	9,10
Mammals	*Lontra longicaudis*	Neotropical River Otter	DD	VU	10
Mammals	*Mazama pandora*	Yucatan Brown Brocket Deer	DD	DD	3,4
Mammals	*Molossops greenhalli*	Greenhall's mastiff Bat	VU	VU	8
Mammals	*Mormoops megalphylla*	Ghost-faced Bat	NT	NT	8
Mammals	*Myotis elegans*	Elegant Myotis	VU	VU	8
Mammals	*Panthera onca*	Jaguar	NT	NT	4,7,9,10
Mammals	*Physeter macrocephalus*	Sperm Whale	VU	DD	9
Mammals	*Pteronotus gymnonotus*	Greater Naked-back Bat	NT	NT	8
Mammals	*Puma concolor*	Puma	NT	NT	4,7,9,10
Mammals	*Stenella frontalis*	Atlantic Spotted Dolphin	VU	VU	9
Mammals	*Stenella Iongirostris*	Spinner Dolphin	VU	DD	9
Mammals	*Steno bredanensis*	Rough-Toothed Dolphin	VU	DD	9
Mammals	*Tapirus bairdii*	Central American Tapir	EN	VU	4,9,10
Mammals	*Thyroptera tricolor*	Spix's Disk-winged Bat,	VU	VU	8
Mammals	*Trichechus manatus*	West Indian Manatee	VU	VU	4,9
Mammals	*Turiopsis truncatus*	Bottlenose Dolphin	VU	VU	9
Plants	*Ceratozamia robusta*		VU	VU	3
Plants	*Pithecellobium johansenii*		EN	DD	
Plants	*Quiina schippii*		EN	DD	
Plants	*Schippia concolor*	Mountain Pimento	VU	LC	2
Plants	*Swietenia macrophylla*	Large-Leaved Mahogany	VU	VU	5,9
Plants	*Zamia prasina*		CE	DD	2,8
Plants	*Zamia* sp. Nov.	Un-described Zamia		VU	2,8
Plants	*Zamia variegata*	Variegated Zamia	EN	VU	3,9
Reptiles	*Caretta caretta*	Loggerhead	EN	EN	4,5,6,9
Reptiles	*Chelonia mydas*	Green Turtle	EN	EN	4,5,6,9
Reptiles	*Crocodylus acutus*	American Crocodile		NT	4,9,10
Reptiles	*Crocodylus moreletii*	Morelet's Crocodile		CD	3,4,5,9,10
Reptiles	*Dermatemys mawii*	Central American River Turtle	EN	EN	3,4,5,9
Reptiles	*Dermochelys coriacea*	Leatherback	CR	CR	4,9
Reptiles	*Eretmochelys imbricata*	Hawksbill Turtle	CR	CR	4,5,6,9
Reptiles	*Phyllodactylus insularis*	Island Gecko		NT	2
Reptiles	*Staurotypus triporcatus*	Mexican Musk Turtle	NT	NT	4
Reptiles	*Trachemys scripta*	Common Slider	NT	LC	4

Justification:

1. The Fisheries Department expressed that it is aware of present trends in the global populations of all Groupers. Measures have been taken to protect spawning sites of these fish in Belize and the Department is attempting to introduce measures that will allow it to sustainably manage this resource. For this reason the grouper all have been placed in the CD = Conservation Dependant category.
2. Endemic species
3. Small Range – Regional Endemic
4. Hunted – Fished
5. Economic importance
6. Colony breeder (restricted number of breeding colonies/locations)
7. Needs large range
8. Specialized ecological requirements
9. Charismatic species drawing national and international attention
10. Prosecuted as perceived pest

Appendix 4: Conservation Targets (ecosystems) based on Meerman 2005, Ecosystems map of Belize

ID	UNESCO_CODE	UNESCO_DESCRIPTION	Count	Acre	Hectare	Target %	Target cover acres
301	IA1a(1)(a)-C	Tropical evergreen broad-leaved lowland hill forest, Callophyllum variant	3	22720	9195	60	5517
302	IA1a(1)(a)-VT	Tropical evergreen broad-leaved lowland hill forest, Vochysia-Terminalia variant	3	20486	8290	95	7876
303	IA1a(1)(a)K-r	Tropical evergreen broad-leaved lowland hill forest on rolling karstic terrain	14	54346	21993	50	10996
304	IA1a(1)(a)K-s	Tropical evergreen broad-leaved lowland hill forest on steep karstic terrain	17	92939	37611	70	26328
305	IA1a(1)(b)K	Tropical evergreen broad-leaved lowland forest on calcareous soils	9	4671	1890	80	1512
306	IA1a(1)(b)P	Tropical evergreen broad-leaved lowland forest on poor or sandy soils	41	164828	66704	40	26682
307	IA1b(1)	Tropical evergreen broad-leaved submontane forest	2	64426	26073	95	24769
308	IA1b(1)K-r	Tropical evergreen broad-leaved submontane forest on rolling karstic hills	4	29010	11740	80	9392
309	IA1b(1)K-s	Tropical evergreen broad-leaved submontane forest on steep karstic hills	7	32000	12950	95	12302
310	IA1b(3)	Tropical evergreen broad-leaved submontane palm forest	3	29789	12055	95	11453
311	IA1c(1)	Tropical evergreen broad-leaved lower-montane forest	2	2138	865	95	822
312	IA1c(4)	Tropical evergreen broad-leaved lower montane palm forest	2	1541	624	95	593
313	IA1f(2)	Tropical evergreen broad-leaved alluvial forest	10	6094	2466	60	1480
314	IA1f(2)(a)K	Tropical evergreen broad-leaved alluvial forest on calcareous soils	32	31423	12716	60	7630
315	IA1g(1)(a)	Tropical evergreen broad-leaved lowland swamp forest	28	49770	20141	40	8057
316	IA1g(1)(a)-AC	Tropical evergreen broad-leaved lowland swamp forest, Aguacaliente variant	1	1082	438	80	350
317	IA1g(1)(b)	Tropical evergreen broad-leaved permanently waterlogged lowland swamp forest	9	8477	3431	60	2058
318	IA1g(2)(b)-MA	Tropical evergreen broad-leaved permanently waterlogged lowland swamp forest with palms. Manicaria variant	4	6092	2465	60	1479
319	IA2a(1)(a)-ST	Tropical evergreen seasonal broad-leaved lowland hill forest, Simarouba-Terminalia variant	9	296915	120158	60	72095
320	IA2a(1)(a)-VT	Tropical evergreen seasonal broad-leaved lowland hill forest, Virola-Terminalia variant	9	68967	27910	80	22328
321	IA2a(1)(a)K-r	Tropical evergreen seasonal broad-leaved lowland hill forest, on rolling karstic terrain	23	92543	37451	40	14980
322	IA2a(1)(a)K-s	Tropical evergreen seasonal broad-leaved lowland hill forest on steep karstic terrain	50	163958	66352	80	53082
323	IA2a(1)(b)K	Tropical evergreen seasonal broadleaf lowland forest over lime-rich alluvium	53	84099	34034	40	13613
324	IA2a(1)(b)K-BR	Tropical evergreen seasonal broad-leaved lowland forest on calcareous soils, Belize River variant	6	41090	16629	40	6652

325	IA2a(1)(b)K-CE	Tropical evergreen seasonal broad-leaved lowland forest on calcareous soils, Central Eastern variant	15	147368	59638	40	23855
326	IA2a(1)(b)K-CW	Tropical evergreen seasonal broad-leaved lowland forest on clacareous soils, Central West variant	16	133938	54203	40	21681
327	IA2a(1)(b)K-TP	Tropical evergreen seasonal broad-leaved lowland forest on calcareous soils, Tehuantepec-Peten variant	32	337578	136613	40	54645
328	IA2a(1)(b)K-Y	Tropical evergreen seasonal broad-leaved lowland forest on calcareous soils, Yucatan variant	31	116967	47335	40	18934
329	IA2a(1)(b)S	Tropical evergreen seasonal broad-leaved lowland forest on poor or sandy soils	54	63272	25606	40	10242
330	IA2a(1/2)(a)	Tropical evergreen seasonal mixed lowland hill forest	4	935	378	95	359
331	IA2a(2)(a)	Tropical evergreen seasonal needle-leaved lowland hill forest	4	22986	9302	60	5581
332	IA2a(2)(b)	Tropical evergreen seasonal needle-leaved lowland forest	40	44283	17921	40	7168
333	IA2b(1)	Tropical evergreen seasonal broad-leaved submontane elfin forest	2	255	103	95	98
334	IA2b(1)-ST	Tropical evergreen seasonal broad-leaved submontane forest, Simarouba-Terminalia variant	10	111487	45117	80	36094
335	IA2b(1)-VT	Tropical evergreen seasonal broadl-leaved submontane forest: Virola-Terminalia variant	4	135857	54980	95	52231
336	IA2b(1)K-r	Tropical evergreen seasonal broad-leaved submontane forest on rolling karstic hills	5	71866	29083	80	23267
337	IA2b(1)K-s	Tropical evergreen seasonal broad-leaved submontane forest on steep karstic hills	8	72376	29289	95	27825
338	IA2b(1/2)	Tropical evergreen seasonal mixed submontane forest	2	36942	14950	95	14202
339	IA2b(2)	Tropical evergreen seasonal needle-leaved submontane forest	5	43151	17463	95	16589
340	IA2c(1)	Tropical evergreen seasonal broad-leaved lower montane elfin forest	1	26	11	95	10
341	IA2f(2)(a)	Tropical evergreen seasonal broad-leaved alluvial forest	51	34485	13955	40	5582
342	IA2g(1)(a)-SC Doubtfully distict, merged with 344	Tropical evergreen seasonal broad-leaved lowland swamp forest, Stann Creek variant	6	4704	1904	95	1808
343	IA2g(1)(a)-Sh	Tropical evergreen seasonal broad-leaved lowland swamp forest, short tree variant	55	95092	38483	30	11545
344	IA2g(1)(a)-T	Tropical evergreen seasonal broad-leaved lowland swamp forest, tall variant	183	305534	123646	40	49458
345	IA3a(1)(a)	Tropical semi-deciduous broad-leaved lowland forest	4	15049	6090	60	3654
346	IA5a(1)(a)	Caribbean mangrove forest; dwarf mangrove scrub	25	40674	16460	40	6584
347	IA5a(1)(b)	Caribbean mangrove forest; freshwater mangrove scrub	14	28154	11394	40	4557
348	IA5a(1)(c)	Caribbean mangrove forest; mixed mangrove scrub	152	66436	26886	40	10790
349	IA5a(1)(d)	Caribbean mangrove forest; coastal fringe mangrove	455	60917	24652	60	14791

350	IA5a(1)(e)	Caribbean mangrove forest; riverine mangrove	51	11900	4816	80	3853
351	IA5a(1)(f)	Caribbean mangrove forest; basin mangrove	91	27881	11283	40	4513
352	IB1a(2)	Tropical deciduous microphyllous lowland forest	4	1016	411	80	329
353	IIIA1b(1)(a)K-s	Tropical evergreen broad-leaved shrubland on steep karstic hills	15	829	336	95	319
354	IIIA1b(a)LE	Evergreen broad-leaved lowland shrubland dominated by leguminous shrubs	84	78295	31685	30	9505
355	IIIA1b(a)MI	Evergreen broad-leaved lowland shrubland, Miconia variant	28	51470	20829	30	6249
356	IIIA1f	Evergreen broad-leaved lowland peat shrubland with Sphagnum	5	3715	1503	80	1203
357	IIIB1b(a)	Deciduous broad-leaved lowland shrubland, well-drained, over poor soils	8	5994	2426	40	970
358	IIIB1b(a)2	Deciduous broad-leaved lowland disturbed shrubland	56	45654	18476	30	5543
359	IIIB1b(b)	Deciduous mixed submontane shrubland over poor soils	24	35479	14358	80	11486
360	IIIB1b(f)H	Deciduous broad-leaved lowland riparian shrubland in hills	5	7012	2838	40	1135
361	IIIB1b(f)P	Deciduous broad-leaved lowland riparian shrubland of the plains	39	11122	4501	40	1800
362	SA1a	River	17	21822	8831	60	5299
363	SA1b(4)(b)	Freshwater Lake	58	15748	6373	60	3824
364	SA1b(5)	Brackish/saline lake	133	65673	26577	40	10631
370	SA3c	Caribbean open sea	1	177929	72005	30	21602
371	SA3d	Caribbean open sea	2	183873	74411	30	22323
372	SA3f	Caribbean open sea - mesopelagic/bathyal	1	1237423	500769	30	150231
373	SA3g	Caribbean open sea - bathyal	1	2340947	947351	30	284205
374	SA3h	Caribbean open sea - abyssal	1	2616269	1058771	30	317631
375	VA2a(1)(2)	Short-grass savanna with scattered needle-leaved trees	50	218741	88522	30	26557
376	VA2b(2)	Short-grass savanna with shrubs	73	251561	101803	30	30541
377	VA2c(g)	Short-grass swamp savanna without trees or shrubs	5	372	150	80	120
	VD1a(1) merged with 376	Eleocharis marsh	6	1416	573		
379	VE1a(1)	Marine salt marsh rich in succulents	45	48622	19677	30	5903
380	VF1c(1)L	Fire-induced lowland fern thicket	4	5040	2040	60	1224
390	VF1c(1)SM	Fire-induced submontane fern thicket	1	258	104	95	99
391	VIB3a	Tropical coastal vegetation on recent sediments	31	3932	1591	60	955
392	VIIB1a	Tropical freshwater reed-swamp	7	3267	1322	80	1058
393	VIIB4	Tropical lowland tall herbaceous swamp	93	92827	37566	30	11270

Appendix 5: Conservation Targets other than ecosystems

ID	Name of Target	Type	Source	Count	Acre	Hectare	Target %	Target cover acres
401	Corridor_primary	Polygon	Meerman et al 2000, Herrera et al., 2002)			103199	80	82559
402	Corridor_secondary	Polygon	Meerman et al 2000, Herrera et al., 2002)			42371	50	21186
403	Corridor_crossboundary	Polygon	Meerman et al 2000, Herrera et al., 2002) + Ecoregional Planning 2004			208875	80	167100
404	Connectivity (buffered) Marine Connectivity expressed as Mangrove – Sea grass beds – Coral reef within 2.5 km of each other	Polygon	Consortium		611789	247783	20	49557
405	Resiliance: Reef sections that appear more resilient to disturbance than other sections.	Polygon	Consortium	44	86802	35128	20	7026
406	Marine Biodiversity Hotspots	Polygon	Consortium	8			20	0
410	Caves (Waterfalls, Sinkholes, Natural Arch etc.)	Point	1:50000 Topo maps + NICH			121	30	36
411	Geologic	Point	Cornec 2003			212	30	64
412	Historical (Maya sites, colonial sites)	Point	1: 50000 Topo maps + NICH			428	30	128
415	Low_land_value: Areas with low agricultural land value	Polygon	King et al. 1992			831308	50	415654
420	SDA_protected. Areas suggested for protection under the SDA scheme	Polygon	LIC			140082	50	70041
421	Estap_protected Areas identified for protection by ESTAP	Polygon	ESTAP			69461	30	20838
422	Narmap managed: Gaps in Protected Areas System identified by 1995 NPAPSP	Polygon	Programme for Belize 1995				30	
430	Marine Zone Glovers	Polygon	Consortium	1	85183	34472	20	6894
431	Marine Zone Turneffe	Polygon	Consortium	1	213382	86353	20	17271
432	Marine Zone Lighthouse	Polygon	Consortium	1	154348	62463	20	12493
433	Marine Zone Northern	Polygon	Consortium	1	595754	241094	20	48219
434	Marine Zone Central	Polygon	Consortium	1	801950	324538	20	64908
435	Marine Zone South	Polygon	Consortium	1	706466	285897	20	57179
436	Marine Zone Caribbean	Polygon	Consortium	1	6114035	2473867	20	494773
440	Inner Platform with seagrass	Polygon	Consortium				20	
441	Inner Channel with seagrass	Polygon	Consortium				20	
442	Outer Platform with seagrass	Polygon	Consortium				20	
443	Atoll Lagoons with seagrass	Polygon	Consortium				20	
444	Atolls Inner Rim	Polygon	Consortium				30	
445	Atolls Outer Rim	Polygon	Consortium				30	
446	Northern Coastal Inner Platform with silt	Polygon	Consortium				30	
447	Coral Reef (without Atolls)	Polygon	Consortium				30	
501	Agami	Point	H. Lee Jones	1	1	1	95	10
502	BoatBilledHeron	Point	Consortium	9			60	5
503	Bridledtern	Point	H. Lee Jones + Consortium	6			60	4
504	BrownNoddy	Point	H. Lee Jones + Consortium	5			60	3
505	BrownPelican	Point	Consortium	11			60	7
506	DoubleCrestedCormorant	Point	Consortium	10			60	6
507	GreatBlueHeron	Point	Consortium	5			60	3

508	GreatEgret	Point	Consortium	11			60	7
509	GreenHeron	Point	Consortium	12			60	7
510	LaughingGull	Point	H. Lee Jones + Consortium	10			60	6
511	LeastTern	Point	H. Lee Jones + Consortium	9			60	5
512	LittleBlueHeron	Point	Consortium	11			60	7
513	FrigateBird	Point	H. Lee Jones + Consortium	19			60	11
514	RedFootedBooby	Point	H. Lee Jones + Consortium	5			60	3
515	RedishEgret	Point	H. Lee Jones + Consortium	6			60	4
516	RoseateSpoonbill	Point	H. Lee Jones + Consortium	1			60	1
517	RoseateTern	Point	H. Lee Jones + Consortium	8			60	5
518	SandwichTern	Point	H. Lee Jones + Consortium	5			60	3
519	SnowyEgret	Point	Consortium	5			60	3
520	SootyTern	Point	H. Lee Jones + Consortium	3			60	2
521	TricoloredHeron	Point	Consortium	5			60	3
522	WhiteIbis	Point	Consortium	11			60	7
523	Woodstork	Point	Consortium + Meerman database	8			60	5
524	YellowCrNightHeron	Point	Consortium	6			60	4
525	Jabiru	Point	Omar Figuroa	18			60	11
526	Scarlet Macaw	Polygon	Consortium	1	388761	157326	60	94396
527	Waders_ducks	Polygon	Consortium	25	182671	73924	60	44354
528	Kbmotmot	Point	Consortium + Meerman database	42			60	25
540	Loggerhead	Point	Consortium	2			60	1
541	Hawksbill	Point	Consortium	42			60	25
542	GreenTurtle	Point	Consortium	12			60	7
543	Acutus	Point	Steven Platt + Consortium	218			60	131
544	Ranajuliani	Point	Meerman database	6			60	4
545	Acutus important nests	Polygon	Steven Platt	2			60	1
546	Phyllodactylus insularis	Polygon	Meerman database	5			60	3
550	Manatee	Polygon	Consortium	7	537590	217576	30	65273
560	Epigomphusmaya	Point	Meerman database	3			60	2
561	Erpetogomphus	Point	Meerman database	1			60	1
562	Citheracanthus meermani	Point	Meerman database	6			60	4
570	Spawningsites	Polygon	Consortium	24	35215	14251	80	11401
572	ConchSpawning	Polygon	Consortium				60	0
601	Ceratozamia	Point	Meerman database	5			60	3
602	Zamiavariegata	Point	Meerman database	15			60	9
603	Zamiaspnov	Point	Meerman database	5			80	4
604	Zamiasp	Point	Meerman database	2			60	1
610	AristolochiaBelizensis	Point	Meerman database	4			60	2
620	Passifloraurbaniana	Point	Meerman database	19			60	11
621	Passifloralancetillensis	Point	Meerman database	10			60	6

Appendix 6: Log of MARXAN run March 27, 2005.

Using 10 km² hexagonal planning units.

Number of Planning Units 5957
Number of Planning Units excluded 976
Number of Planning Units locked in 5
Number of Planning Units seeded 1112
Number of Conservation Values 152
Starting proportion 0.00
Boundary length modifier 0.003

Clumping - default step function
Algorithm Used :Annealing and Iterative Improvement
No Heuristic used
Number of iterations 1000000
Initial temperature set adaptively
Cooling factor set adaptively
Number of temperature decreases 10000

Cost Threshold Disabled
Threshold penalty factor A N/A
Threshold penalty factor B N/A

Random Seed -1
Number of runs 200

"Conservation Feature","Feature Name","Target","Amount Held","Occurrence Target ","Occurrences Held","Separation Target ","Separation Achieved","Target Met"

621,Passifloralancetillensis,6.000000,6.000000,0,6,0,0,yes
620,Passifloraurbaniana,10.800000,11.000000,0,10,0,0,yes
610,AristolochiaBelizensis,2.400000,2.000000,0,2,0,0,no
604,Zamiasp,1.200000,2.000000,0,2,0,0,yes
603,Zamiaspnov,4.000000,4.000000,0,3,0,0,yes
602,Zamiavariegata,9.000000,9.000000,0,8,0,0,yes
601,Ceratozamia,3.000000,5.000000,0,5,0,0,yes
572,ConchSpawning,2490.150000,3837.150000,0,24,0,0,yes
570,Spawningsites,1061.768000,1062.330000,0,47,0,0,yes
562,Citheracanthus,3.600000,4.000000,0,4,0,0,yes
561,Erpetogomphus,0.600000,1.000000,0,1,0,0,yes
560,Epigomphusmaya,1.800000,2.000000,0,2,0,0,yes
550,Manatee,12322.068000,12345.140000,0,178,0,0,yes
546,Phyllodactylus insularis,209.646000,349.410000,0,11,0,0,yes
545,Acutus important nests,350.616000,584.360000,0,2,0,0,yes
544,Ranajuliani,3.600000,6.000000,0,6,0,0,yes
543,Acutus,130.800000,139.000000,0,31,0,0,yes
542,GreenTurtle,7.200000,8.000000,0,7,0,0,yes
541,Hawksbill,24.600000,25.000000,0,20,0,0,yes
540,Loggerhead,12.000000,14.000000,0,11,0,0,yes
528,KBMotmot,25.200000,36.000000,0,19,0,0,yes
527,Waders_ducks,4435.512000,4442.670000,0,107,0,0,yes
526,Scarlet Macaw,9439.614000,14221.710000,0,187,0,0,yes
525,Jabiru,10.800000,11.000000,0,11,0,0,yes
524,YellowCrNightHeron,3.000000,3.000000,0,3,0,0,yes
523,Woodstork,3.600000,5.000000,0,5,0,0,yes

522,WhiteIbis,4.800000,6.000000,0,5,0,0,yes
521,TricoloredHeron,3.000000,4.000000,0,4,0,0,yes
520,SootyTern,1.800000,2.000000,0,2,0,0,yes
519,SnowyEgret,1.200000,2.000000,0,2,0,0,yes
518,SandwichTern,1.800000,2.000000,0,2,0,0,yes
517,RoseateTern,4.200000,5.000000,0,5,0,0,yes
516,RoseateSpoonbill,4.200000,6.000000,0,5,0,0,yes
515,RedishEgret,3.600000,6.000000,0,6,0,0,yes
514,RedFootedBooby,2.400000,4.000000,0,2,0,0,yes
513,FrigateBird,6.000000,9.000000,0,6,0,0,yes
512,LittleBlueHeron,4.200000,5.000000,0,5,0,0,yes
511,LeastTern,3.600000,4.000000,0,4,0,0,yes
510,LaughingGull,2.400000,4.000000,0,3,0,0,yes
509,GreenHeron,5.400000,6.000000,0,6,0,0,yes
508,GreatEgret,3.000000,3.000000,0,3,0,0,yes
507,GreatBlueHeron,2.400000,4.000000,0,4,0,0,yes
506,DoubleCrestedCormorant,4.200000,5.000000,0,5,0,0,yes
505,BrownPelican,5.400000,7.000000,0,7,0,0,yes
504,BrownNoddy,2.400000,4.000000,0,3,0,0,yes
503,Bridledtern,2.400000,3.000000,0,3,0,0,yes
502,BoatBilledHeron,5.400000,8.000000,0,8,0,0,yes
501,Agami,0.950000,1.000000,0,1,0,0,yes
447,Coral Reef,4909.146000,5017.830000,0,63,0,0,yes
446,Northern Coastal Inner Platform with silt,41283.411000,62508.200000,0,76,0,0,yes
445,Atolls Outer Rim,6223.227000,19356.030000,0,72,0,0,yes
444,Atolls Inner Rim,3450.573000,6989.160000,0,45,0,0,yes
443,Atoll Lagoons with seagrass,14972.656000,62802.400000,0,113,0,0,yes
442,Outer Platform with seagrass,32506.850000,62602.490000,0,104,0,0,yes
441,Inner Channel with seagrass,76592.486000,108521.140000,0,130,0,0,yes
440,Inner Platform with seagrass,36807.708000,37283.900000,0,71,0,0,yes
436,MarineZoneCaribbean,49477.342000,81118.480000,0,879,0,0,yes
435,MarineZoneSouth,5717.952000,6842.690000,0,91,0,0,yes
434,MarineZoneCentral,6490.762000,7011.020000,0,101,0,0,yes
433,MarineZoneNorthern,4819.136000,12757.700000,0,155,0,0,yes
432,MarineZoneLighthouse,1249.248000,6246.240000,0,88,0,0,yes
431,MarineZoneTurneffe,1727.056000,5883.610000,0,72,0,0,yes
430,MarineZoneGlovers,689.452000,3242.300000,0,46,0,0,yes
422,Narmap managed,11881.995000,23046.210000,0,81,0,0,yes
421,Estap_protected,34730.275000,34812.620000,0,79,0,0,yes
420,SDA_protected,70040.770000,78330.320000,0,181,0,0,yes
415,Low_land_value,415654.025000,495250.770000,0,908,0,0,yes
412,Historical,128.400000,130.000000,0,105,0,0,yes
411,Geologic,63.600000,168.000000,0,71,0,0,yes
410,Caves,36.300000,69.000000,0,40,0,0,yes
406,Hotspots_biodiversity,4025.638000,13140.600000,0,35,0,0,yes
405,Resiliance,6999.050000,27614.540000,0,95,0,0,yes
404,Connectivity,17634.296000,51840.600000,0,106,0,0,yes
403,Corridor_frontera,167099.712000,167298.410000,0,201,0,0,yes
402,Corridor_secondary,21185.545000,23916.410000,0,69,0,0,yes
401,Corridor_primary,82558.768000,82769.340000,0,168,0,0,yes
393,VIIB4,11239.395000,13802.680000,0,99,0,0,yes
392,VIIB1a,1057.648000,1058.210000,0,8,0,0,yes
391,VIB3a,954.804000,970.840000,0,35,0,0,yes
390,VF1c(1)SM,99.037500,104.250000,0,1,0,0,yes
380,VF1c(1)L,1223.712000,1281.590000,0,5,0,0,yes

379,VE1a(1),5902.989000,9507.740000,0,57,0,0,yes
377,VA2c(g),120.320000,141.710000,0,3,0,0,yes
376,VA2b(2),30712.995000,30790.560000,0,94,0,0,yes
375,VA2a(1)(2),26556.537000,27125.170000,0,83,0,0,yes
374,SA3h,317631.162000,317739.110000,1,351,0,0,yes
373,SA3g,284205.387000,284571.340000,0,358,0,0,yes
372,SA3f,150230.847000,242771.360000,0,356,0,0,yes
371,SA3d,22323.378000,46672.070000,0,157,0,0,yes
370,SA3c,21601.620000,21625.280000,0,35,0,0,yes
364,SA1b(5),10630.764000,18490.920000,0,91,0,0,yes
363,SA1b(4)(b),3823.722000,3832.240000,0,41,0,0,yes
362,SA1a,5269.626000,5272.040000,0,127,0,0,yes
361,IIIB1b(f)P,1800.348000,1817.590000,0,21,0,0,yes
360,IIIB1b(f)H,1135.032000,2623.600000,0,35,0,0,yes
359,IIIB1b(b),11486.440000,11838.700000,0,50,0,0,yes
358,IIIB1b(a)2,5542.707000,6357.160000,0,45,0,0,yes
357,IIIB1b(a),970.260000,1106.550000,0,13,0,0,yes
356,IIIA1f,1202.656000,1241.310000,0,7,0,0,yes
355,IIIA1b(a)MI,6248.775000,6911.170000,0,35,0,0,yes
354,IIIA1b(a)LE,9505.443000,9549.950000,0,66,0,0,yes
353,IIIA1b(1)(a)K-s,318.896000,335.680000,0,7,0,0,yes
352,IB1a(2),328.912000,406.770000,0,3,0,0,yes
351,IA5a(1)(f),4513.176000,4756.400000,0,54,0,0,yes
350,IA5a(1)(e),3852.544000,3863.250000,0,45,0,0,yes
349,IA5a(1)(d),14814.558000,14815.290000,0,154,0,0,yes
348,IA5a(1)(c),10780.492000,14015.080000,0,114,0,0,yes
347,IA5a(1)(b),4557.504000,7221.410000,0,31,0,0,yes
346,IA5a(1)(a),6584.028000,10950.490000,0,44,0,0,yes
345,IA3a(1)(a),3654.120000,4837.600000,0,17,0,0,yes
344,IA2g(1)(a)-T,50219.612000,50222.160000,0,183,0,0,yes
343,IA2g(1)(a)-Sh,11544.786000,13505.430000,0,67,0,0,yes
341,IA2f(2)(a),5408.256000,5429.840000,0,32,0,0,yes
340,IA2c(1),10.070000,10.600000,0,2,0,0,yes
339,IA2b(2),16589.365500,16828.300000,0,42,0,0,yes
338,IA2b(1,14202.281500,14635.800000,2,37,0,0,yes
337,IA2b(1)K-s,27825.025000,28971.830000,0,72,0,0,yes
336,IA2b(1)K-r,23266.672000,27999.190000,0,62,0,0,yes
335,IA2b(1)-VT,52230.572500,52418.510000,0,107,0,0,yes
334,IA2b(1)-ST,36093.696000,42527.950000,0,97,0,0,yes
333,IA2b(1),98.078000,103.240000,0,3,0,0,yes
332,IA2a(2)(b),7168.372000,7185.720000,0,38,0,0,yes
331,IA2a(2)(a),5581.206000,5739.330000,0,22,0,0,yes
330,IA2a(1,718.865000,756.560000,2,6,0,0,yes
329,IA2a(1)(b)S,10242.204000,10380.150000,0,50,0,0,yes
328,IA2a(1)(b)K-Y,18933.964000,19061.950000,0,50,0,0,yes
327,IA2a(1)(b)K-TP,54645.292000,54810.460000,0,87,0,0,yes
326,IA2a(1)(b)K-CW,21681.232000,21823.060000,0,41,0,0,yes
325,IA2a(1)(b)K-CE,23855.136000,24319.970000,0,58,0,0,yes
324,IA2a(1)(b)K-BR,6651.512000,6803.450000,0,15,0,0,yes
323,IA2a(1)(b)K,13613.484000,13956.390000,0,63,0,0,yes
322,IA2a(1)(a)K-s,53081.528000,53100.970000,0,109,0,0,yes
321,IA2a(1)(a)K-r,14980.320000,15612.840000,0,60,0,0,yes
320,IA2a(1)(a)-VT,22328.040000,26694.770000,0,60,0,0,yes
319,IA2a(1)(a)-ST,72094.590000,72372.090000,0,144,0,0,yes
318,IA1g(2)(b)-MA,1479.222000,1572.520000,0,8,0,0,yes

317,IA1g(1)(b),2058.360000,2203.270000,0,12,0,0,yes
316,IA1g(1)(a)-AC,350.296000,424.890000,0,3,0,0,yes
315,IA1g(1)(a),8056.524000,9873.150000,0,38,0,0,yes
314,IA1f(2)(a)K,7629.840000,7662.460000,0,51,0,0,yes
313,IA1f(2),1479.768000,1500.990000,0,11,0,0,yes
312,IA1c(4),592.600500,623.790000,0,5,0,0,yes
311,IA1c(1),822.111000,823.730000,0,5,0,0,yes
310,IA1b(3),11452.649000,11615.360000,0,32,0,0,yes
309,IA1b(1)K-s,12302.462000,12309.430000,0,30,0,0,yes
308,IA1b(1)K-r,9391.880000,9682.090000,0,30,0,0,yes
307,IA1b(1),24768.932000,25052.520000,0,52,0,0,yes
306,IA1a(1)(b)P,26681.520000,26958.190000,0,69,0,0,yes
305,IA1a(1)(b)K,1512.144000,1767.440000,0,16,0,0,yes
304,IA1a(1)(a)K-s,26327.938000,26592.350000,0,66,0,0,yes
303,IA1a(1)(a)K-r,9896.841000,12710.650000,0,43,0,0,yes
302,IA1a(1)(a)-VT,7875.690000,8003.600000,0,30,0,0,yes
301,IA1a(1)(a)-C,5516.730000,5565.580000,0,15,0,0,yes

Protected Area Scoring System Version 4.

(12 November 2004)

The following document is a relative scoring system developed to guide protected area ranking as part of an effort to come to a comprehensive National Protected Areas System.

The scoring system consists of a questionnaire in two parts:

1. **Bio-physical Characteristics;** which values the Biological, Ecological and Physical qualities of the proposed private protected area. The resulting value reflects the intrinsic biological value of the area.
2. **Land Use Characteristics;** which reflects management and uses. The resulting value is subject to fluctuations depending on management input of the owner/managing body.

The end results are two sets of figures. They can be judged separately when there is a need to judge bio-physical and land-use characteristics separately. Conversely they can be added up to get an overall idea of the conservation value of the property.

In the case of private protected area, only properties with clear titles or long term leases (>50 years) can be considered.

The scoring system is intended to be completed by an independent committee. In the case of a private protected area this will be an committee appointed for this purpose by the Belize Association of Private Protected Areas (BAPPA).

The scoring system was developed originally for BAPPA by Jan Meerman, but later adapted to be applicable for all protected areas, including marine protected areas.

The system was tested, adapted and approved by members of both the National Protected Areas Policy and System Plan (NPAPSP) consortium and BAPPA.

Protected Areas Scoring System – Sheet 1

Bio-physical characteristics		Points	Site
Location of property			
	Choose only one		
See note below	In Proposed Belize Biological Corridor	10	
	Within 5 miles of proposed BBC	6	
	In local Corridor (provides important linkage between ecologically valuable areas outside the BBC, in the marine area channels might provide such a function)	6	
	Adjacent to other, existing protected area	3	
Size of property	*Choose only one*		
	> 2000 acres	15	
	500 - 1999 acres	12	
	100 - 499 acres	8	
	20 - 199 acres	4	
	< 20 acres	0	
Special habitats	*Choose only one. Last two choises are for Private PA's only*		
See note below	Particularly rare (< 5,000 acres in Belize) and/or threathened habitats (such as Intact Littoral Forest)	12	
	Property covers habitat not or insufficiently (<10%) covered by existing National Protected Areas System (other than private).	8	
	Property covers habitat that is poorly covered (10 – 20%) by existing Protected Areas System	6	
Special features	*More than one choice is possible*		
	Important wildlife refugia/source	10	
	Property includes features of high landscape/scenic value such as waterfalls, caves, cultural, historic, geological features.	5	
	Property provides significant environmental services (e.g. important for watershed functioning, filtering function, buffer for sensitive areas etc)	5	
State of habitat	*Choose only one*		
	Ecosystem intact and fully functional	10	
	Partly intervened (grade according to level of disturbance)	2 to 8	
	Regenerating	2	
Special species	*More than one choice is possible*		
	Contains important breeding/nursery grounds (Bird Nesting Colonies, Iguana, Turtle, Crocodile Nesting Sites, Spawning Sites, etc)	15	
	Contains important roosting sites for birds and/or critical feeding grounds	8	
	Contains species endemic strictly to Belize	8	
	Contains species listed as endangered (IUCN)	6	
	Contains critical habitat for species listed as endangered (IUCN)	4	
Total Bio-physical Characteristics			

Biological Corridor Note: There is no officially accepted Biological Corridor Route in Belize, But two reports indicate feasible routes: Meerman, J. C. 2000, Feasibility Study of the Proposed Northern Belize Biological Corridors Project, Herrera et al, 2002. Phase II of the characterization study: Belize National Report of the Participation Planning Process. See Biological Corridor Routes Map.
Special Habitats Note: Based on Meerman & Sabido, 2001. Central American Ecosystems Map: Belize. See Ecosystems Map

Protected Area Scoring System – Sheet 2

Landuse characteristics

Ownership	*Choose only one*		
	National Lands or Waters (in the case of National Protected Areas)	5	
	Title (In the case of Private Protected Areas)	5	
	Long term lease	3	
	Short term lease	NA	
Information base	*Choose only one*[1]		
	Extensive species inventory carried out	8	
	Certain groups of organisms researched	4	
	No data available	0	
Management	*Choose only one*[1]		
	Efficiently patrolled	8	
	Occasionally patrolled	4	
	No management	0	
Land use Activities	*More than one choice is possible*		
	Scientific Research	8	
	Strict Conservation (e.g. no-take zone)	4	
	Tourism/recreational	4	
	Active ecosystem restoration activities	4	
	Managed extraction of Timber/Non-Timber products	2	
	Managed fisheries		
	Agro-forestry	2	
	Development activities that detract from the conservation value of the property	-5	
	Hunting/fishing allowed (unmanaged)	-5	
Infrastructure	*More than one choice is possible*		
	Road Access	2	
	Trails	2	
	Structures for management purposes	5	
Total Landuse Characteristics			
Total of Bio-physical Characteristics (Previous Page)			
Total of Landuse and Biophysical Characteristics combined			

[1] Some ranking is possible based on intensity or level of importance. E.g. if you feel that, yes species inventories have been carried out, it is more than a bit, but hardly extensive, choose a 6. Same for management.

Note the scoring is subject to vetting by an independent committee.

Belize Biological Corridor Routes
(Herrera et al, 2002)