National Protected Area Systems Analysis

Case Study: Gra Gra Lagoon National Park

Problem statement: How does Gra Gra Lagoon National Park fit in the National Protected Areas System and how does it relate to adjacent conservation features?

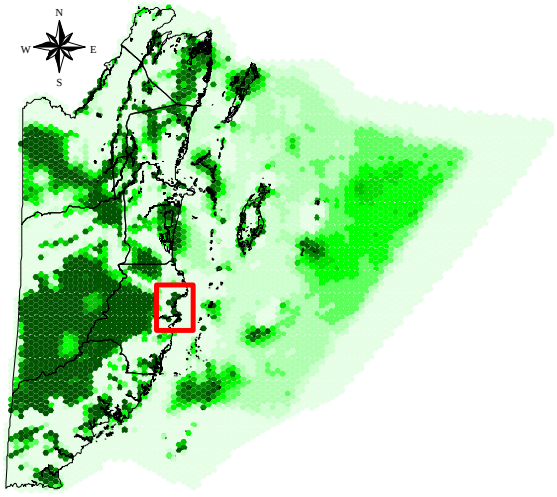

Figure 1. MARXAN analysis of conservation targets in Belize (seeded version)

The MARXAN analysis for the whole country of Belize presents a very complex picture. This picture (see figure 1 to the left) gives a quick overview of the national priorities. In order to analyze individual protected areas/regions, it is better to zoom in and analyze only those hexagons that interest us for the moment.

In this case the case of Gra Gra Lagoon National Park and environs (red square) will be analyzed.

For this purpose we will first compare the two different MARXAN outputs[1]: <*locked _02*> (figure 2 below left) and <*seeded_02*> (figure 3 below right). In this case both outcomes are very similar. The main difference being that the

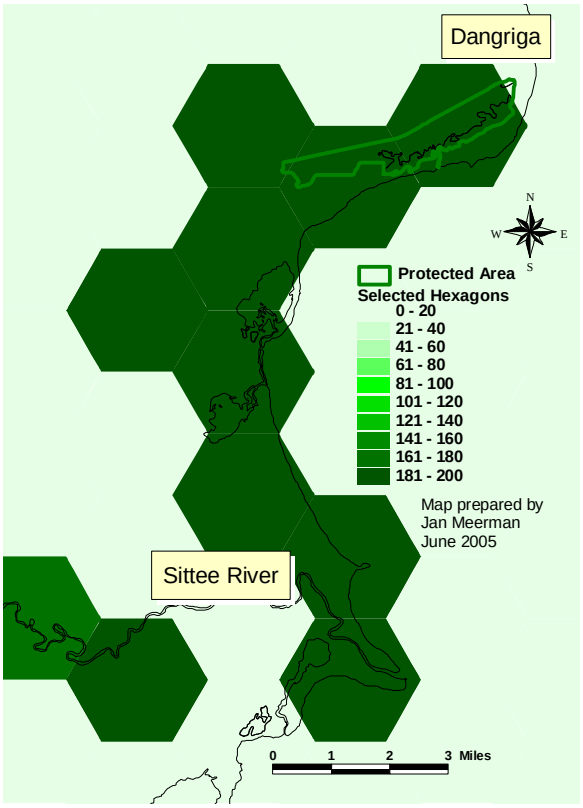

Figure 2. Gra Gra Lagoon NP locked in.

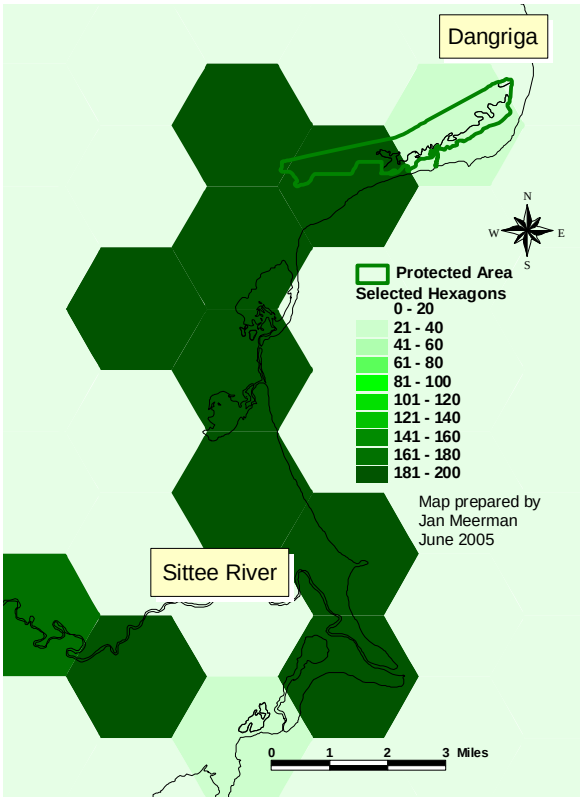

Figure 3. Gra Gra Lagoon NP seeded.

"seeded" version has the north-eastern lobe of the Gra Gra Lagoon National Park less frequently selected. Using the <*abundance_targets*> shapefile[2] it is possible to determine that the Gra Gra Lagoon National Park is covered by two 10 km² hexagons: #1947 and #4894 (see figure 4 below).

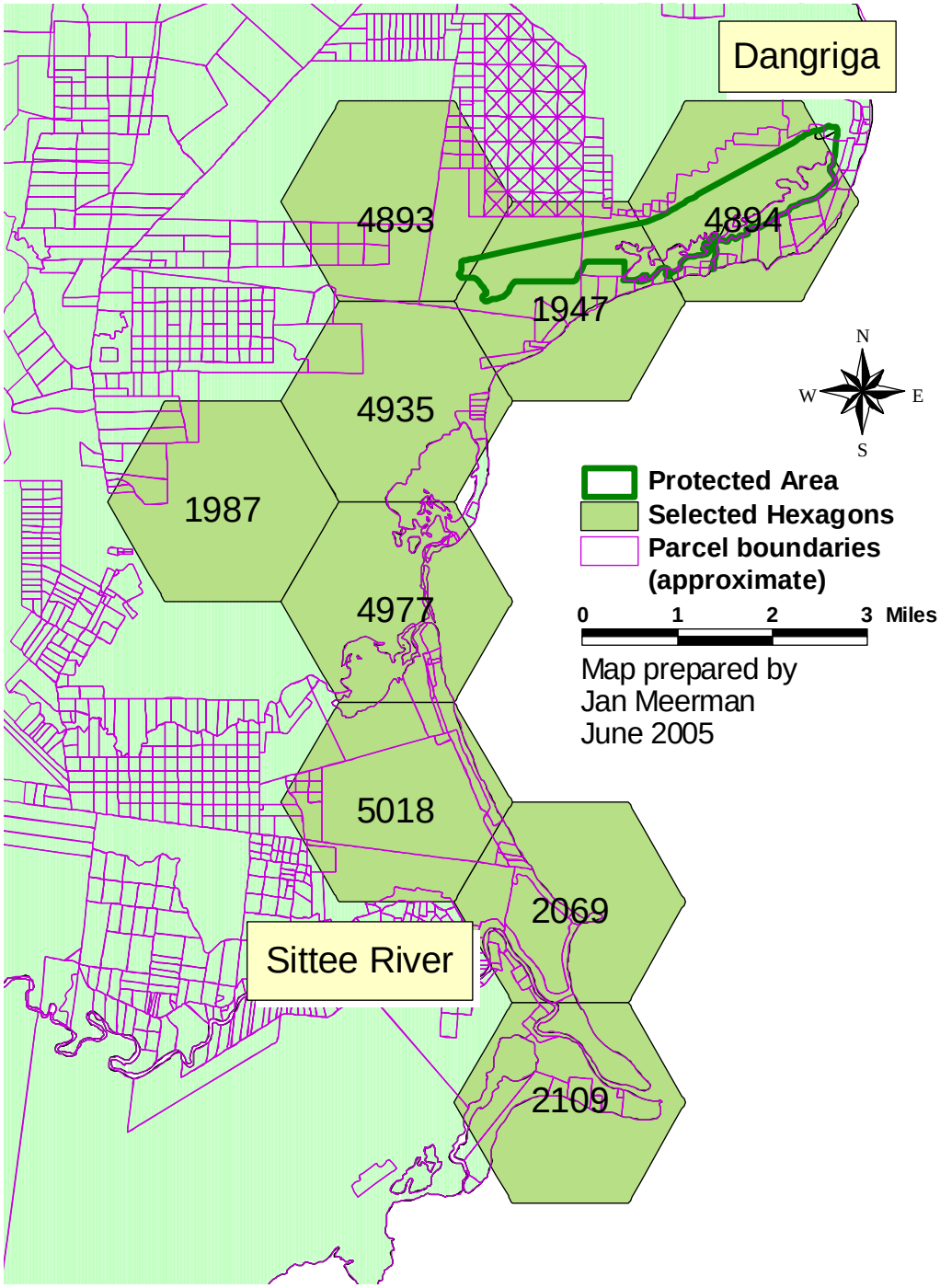

Figure 4. Selected Hexagons with overlay of property boundaries

[1] ArcView files on resource CD
[2] ArcView file on the resource CD

Based on the comparison between the two MARXAN analyses, the first question that surfaces is "Why does the "seeded" version not strongly select the north-eastern lobe (hexagon #4894) of the National Park?"

The two principal ecosystems of the Gra Gra Lagoon NP within hexagon #4894 are: Caribbean mangrove forest; basin mangrove and Brackish/saline lake (see figure 5 and table 1). A quick look at the gap analysis[3] shows that neither of these ecosystems is sufficiently represented within the current PA system, so this in itself can not be the reason for its de-selection.

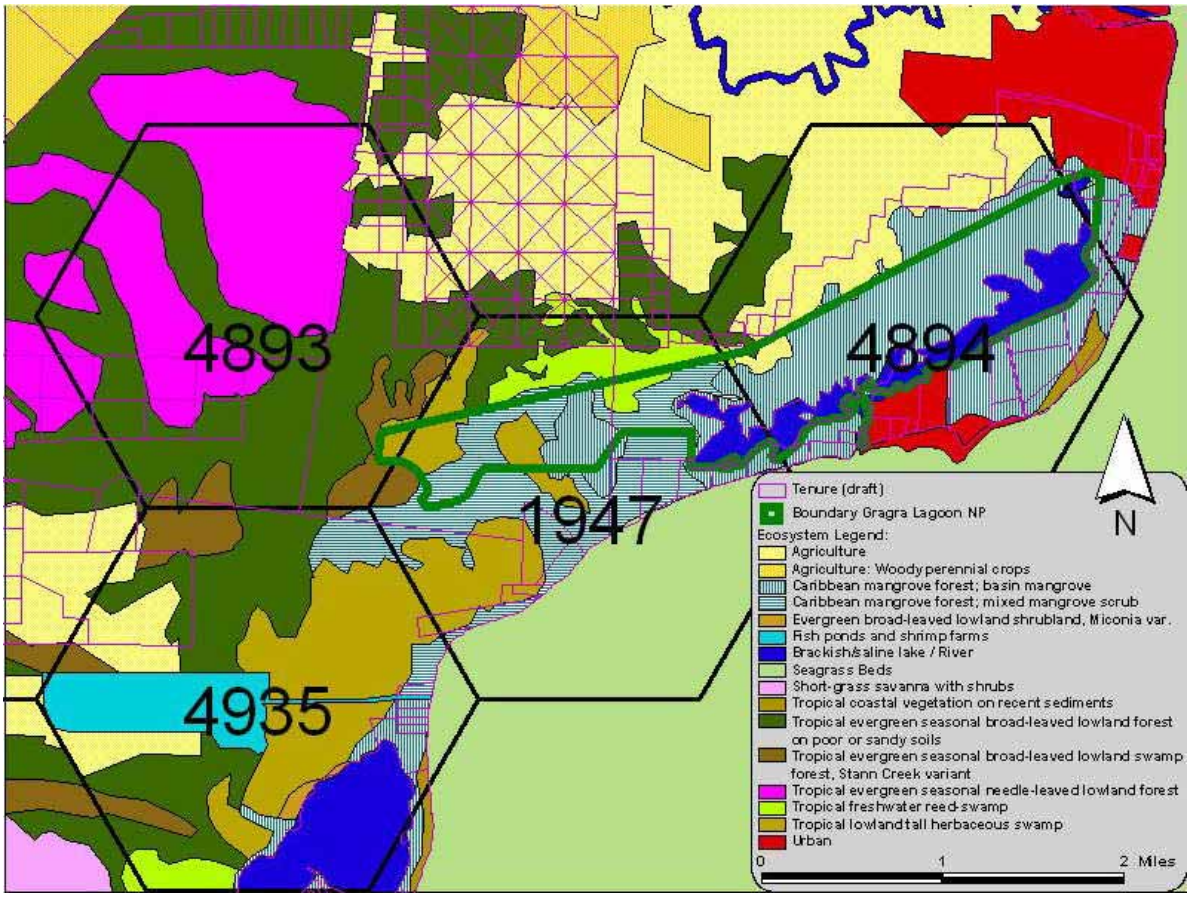

Figure 5. Ecosystems map of Gra Gra Lagoon National Park with selected hexagon overlay

The more likely reason for the de-selection lies in the main function of MARXAN which is that it selects conservation areas based on lowest "cost". In other words, to meet set conservation feature targets, where are these met most easily and cost effective? The overlay of private properties shapefile[4] <*tenure_draft*> in figures 4 and 5 clearly show the Gra Gra Lagoon NP being hemmed in by private properties. This fact alone will result in high "costs" for the maintenance of this PA and thus, MARXAN tries to place the conservation feature elsewhere.

Based on the cost factor alone, it may appear that the eastern lobe of the Gra Gra Lagoon National Park is not a high priority on a national scale. This notion is supported by the place

[3] See that document
[4] ArcView file on resource CD

of Gra Gra Lagoon National Park in the site scoring system[5] (middle regions). While it thus appears that there is a lower priority on a national scale for the conservation of the north eastern lobe, this actually creates opportunities for the management of the protected area as a whole. It's proximity to developed areas creates a opportunity or even a need for heavier use (tourism activities, education) and thus warrant different management for this zone of the park. Meanwhile, more critical sections of the park are to be managed more for its strict biodiversity qualities.

While hexagon 4894 was less frequently selected, hexagon #1947 was strongly selected as were a number of adjacent hexagons all the way south to False Sittee Point near Sittee River. The fact that these hexagons were selected in both MARXAN analysis types indicates gaps in the conservation feature coverage on a national scale.

The <abundance_targets> spreadsheet[6] and shapefile[7] reveal that in the ten adjoining 10 km² hexagons, the following twenty conservation features can be found:

1. Tropical evergreen seasonal broad-leaved lowland forest on poor or sandy soils
2. Tropical evergreen seasonal needle-leaved lowland forest
3. Tropical evergreen seasonal broad-leaved lowland swamp forest, Stann Creek variant
4. Caribbean mangrove forest; mixed mangrove scrub
5. Caribbean mangrove forest; coastal fringe mangrove
6. Caribbean mangrove forest; basin mangrove
7. Evergreen broad-leaved lowland shrubland, Miconia variant
8. River
9. Brackish/saline lake
10. Short-grass savanna with scattered needle-leaved trees
11. Short-grass savanna with shrubs
12. Eleocharis marsh.
13. Tropical coastal vegetation on recent sediments
14. Tropical freshwater reed-swamp
15. Tropical lowland tall herbaceous swamp
16. Low_land_value: Areas with low agricultural land value
17. Estap_protected Areas identified for protection by ESTAP
18. Marine Zone Central
19. Inner Platform with sea grass
20. Great blue Heron

The details for each of the above conservation features including their set targets can be found in tables 1 & 2. When studying these tables it becomes clear that several of the above conservation features are rare with three of them particularly rare:

1. Tropical evergreen seasonal broad-leaved lowland swamp forest, Stann Creek variant
2. Tropical coastal vegetation on recent sediments (This is the "littoral forest". 83 ha of which are located within these few polygons which is 5% of the national total surface of 1591 ha)
3. Tropical freshwater reed-swamp

[5] See that document
[6] Excel file on resource CD
[7] ArcView file on resource CD

Another obvious common factor is the low agricultural value of the majority of the conservation features involved.

Based on the MARXAN analysis, there are ample reasons to extend management activities from Gra Gra Lagoon south all the way to False Sittee Point near Sittee River. The parcel boundaries information as presented in figure 4 are incomplete but it is clear that the actual coast itself is already in private hands virtually ruling out formal conservation management activities. This is particularly the case for the very rare and threatened littoral forest (tropical coastal vegetation on recent sediments). This emphasizes the point that not all conservation targets can be addressed through orthodox protected areas. However, private development activities in this area, could take the obvious presence of conservation features on their properties into account in their development plans. Preferably all activities here should be made subject to an environmental impact assessment (and enforcement of their outcomes).

Only for parts of hexagons #4893, #4935, there are opportunities for traditional conservation activities and additional fieldwork combined with title research should establish whether it is possible to expand the extend of the Gra Gra Lagoon National Park and add critical wetlands and swamp forest types to the portfolio of this protected area.

These swamps and wetlands form actually part of the headwaters of the Gra Gra Lagoons and inclusion of those would give greater integrity to the coastal wetland system as a management unit.

Conclusions

A thorough analysis of the MARXAN conservation feature analysis of the area between Dangriga and Sittee River comes up with the following points:

- There are a number of conservation features in this area that are not currently “protected”
- Several of these conservation features in this area are located on private property and can not be declared “protected” in the traditional sense. Instead, creative ways are to be sought to incorporate these conservation features in the management of these private properties and to maintain a desirable context in the wider landscape. The Environmental Impact mechanism can be an important tool in this.
- There is room to expand the Gra Gra Lagoon National Park to the west and include critical swamps and wetlands thus increasing integrity of the wetland system as a whole.
- The north eastern lobe of the Gra Gra Lagoon National Park is better suited for development of conservation related activities such as education, research and tourism than for strict conservation. A zoning of the Gra Gra Lagoon National Park should include this section as a multiple use zone, while the south western sections of the park should be zoned for more strict conservation.

Furthermore this case study shows that the MARXAN analysis is helpful in defining the issues but needs further analysis on a site-specific level.

Table 1. Conservation features (ecosystems) found in each of the 10 selected hexagons (4 digit numbers), with indicated the % target rationale

UNIT_ID			1947	1987	2069	2109	4893	4894	4935	4977	5018	Acres[8]	Hectares	Slope	Rare	Count	Env-serv	Timber	Fisheries	Endemics	Last-wild	Low Ag	Wetland	Total	%Target
VALUE_329	IA2a(1)(b)S	Tropical evergreen seasonal broad-leaved lowland forest on poor or sandy soils	66[9]	98	0	0	468	48	236	25	95	63,272	25,606		20			20			10			50	**50**
VALUE_332	IA2a(2)(b)	Tropical evergreen seasonal needle-leaved lowland forest	0	85	0	0	329	0	0	0	0	44,283	17,921		20			20			10			50	**50**
VALUE_342	IA2g(1)(a)-SC	Tropical evergreen seasonal broad-leaved lowland swamp forest, Stann Creek variant	12	270	121	39	59	0	64	165	123	4,704	1,904		50	10						10		70	**70**
VALUE_348	IA5a(1)(c)	Caribbean mangrove forest; mixed mangrove scrub	241	0	0	67	0	0	40	79	9	66,436	26,886		20							10	10	40	**40**
VALUE_349	IA5a(1)(d)	Caribbean mangrove forest; coastal fringe mangrove	0	0	53	146	0	0	0	0	0	60,917	24,652		20		20					10	10	60	**60**
VALUE_351	IA5a(1)(f)	Caribbean mangrove forest; basin mangrove	75	0	0	31	0	373	39	68	0	27,881	11,283		30							10	10	50	**50**
VALUE_355	IIIA1b(a)MI	Evergreen broad-leaved lowland shrubland, Miconia variant	0	0	0	0	0	0	7	0	0	51,470	20,829		20							10		30	**30**
VALUE_362	SA1a	River	0	0	32	54	0	0	0	0	0	21,822	8,831		40							10	10	60	**60**
VALUE_364	SA1b(5)	Brackish/saline lake	24	0	0	54	0	98	112	155	11	65,673	26,577		20							10	10	40	**40**
VALUE_375	VA2a(1)(2)	Short-grass savanna with scattered needle-leaved trees	0	0	0	9	0	0	0	0	0	218,741	88,522					20		10		10		40	**40**
VALUE_376	VA2b(2)	Short-grass savanna with shrubs	0	477	36	1	0	0	0	88	299	251,561	101,803							10		10		20	**20**
VALUE_378	VD1a(1)	Eleocharis marsh. Note: not as rare as indicated. Partly included as patches in other ecosystems	0	0	36	0	0	0	0	0	280	1,416	573		30							10	10	50	**50**
VALUE_391	VIB3a	Tropical coastal vegetation on recent sediments	0	0	0	27	0	13	3	40	0	3,932	1,591		50		10							60	**60**
VALUE_392	VIIB1a	Tropical freshwater reed-swamp	70	5	56	0	0	2	97	126	242	3,267	1,322		50	10							10	70	**70**
VALUE_393	VIIB4	Tropical lowland tall herbaceous swamp	147	0	23	21	12	0	166	0	0	92,827	37,566		20								10	30	**30**

[8] Acres and Hectares here present the total national figure for this ecosystem

[9] This figure represents the number of hectares of this ecosystem present within this 10 km² hexagon (=1000 ha)

Table 2. Continued: Conservation features (other than ecosystems) found in each of the 10 selected hexagons (4 digit numbers), with indicated the % target rationale

UNIT_ID		1947	1987	2069	2109	4893	4894	4935	4977	5018	Env serv	Hist/ Cultural	Scenic	Marine WG	Biodiv	Endang	Endemic	Reprod site	Target%
VALUE 415	Low_land_value: Areas with low agricultural land value	580	967	226	335	213	329	832	512	706	10				10				**20**
VALUE 421	Estap_protected Areas identified for protection by ESTAP	1	0	208	366	474	0	204	359	697	10	20			10				**40**
VALUE 434	Marine Zone Central	364	0	623	552	0	170	28	235	40				20					**20**
VALUE 440	Inner Platform with seagrass	364	0	623	552	0	170	28	235	40				20					**20**
VALUE 507	GreatBlueHeron	0	0	0	1	0	0	0	0	0								50	**50**