title: Systematic Planning in the Pantanal Biosphere Reserve using the DSS Marxan with zones (Marxan-Z_{ee})

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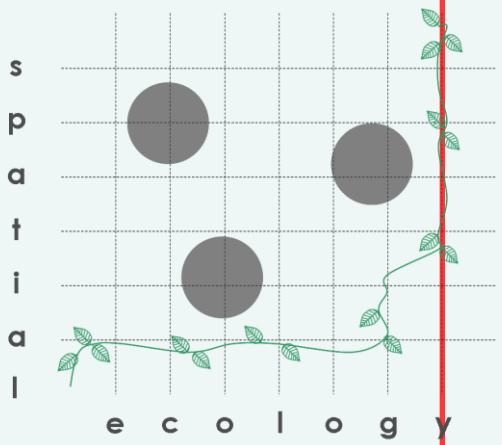

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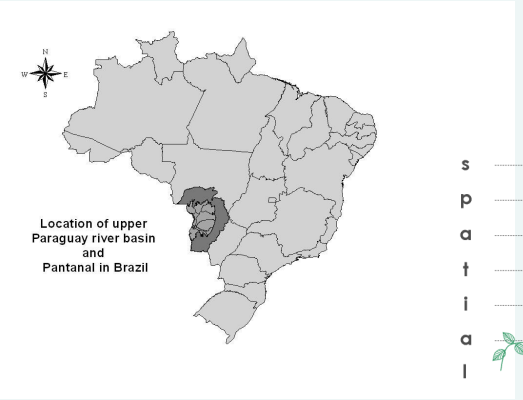
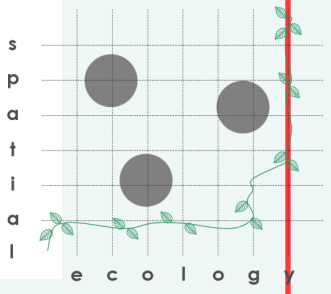
Introduction

- The Unesco Biosphere Reserve (BR) system is composed of 529 sites in 105 countries.

- They were conceived to be models of “sustainable societies” and case-studies for sustainable development (Batisse 1990).

- The Pantanal BR is one of 4 Br/BR and covers a territory of around 25 million hectares in the Upper Paraguay river in South America.



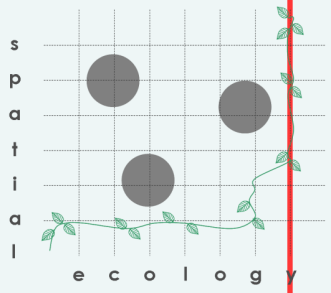


BR - Objectives

- Use BR to protect and conserve natural and cultural diversity.

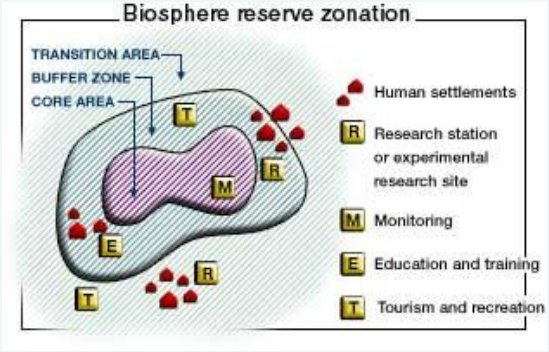
protection of natural diversity while maintaining the cultural heritage of traditional communities

- Utilize BR as models for sustainable development.
- Use them as logistic support for research, monitoring, educational and training.
- To fully implement the concepts of BR, through the harmonization of the above functions

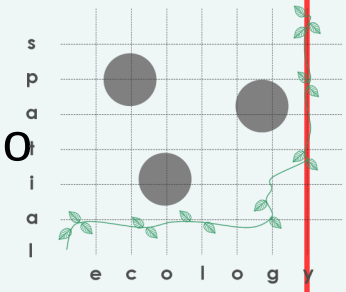


Problem definition

- The designation of BRs follows an ad hoc nested zonation scheme with no quantitative targets or indicators. The system have a core, a buffer and a transition zone.

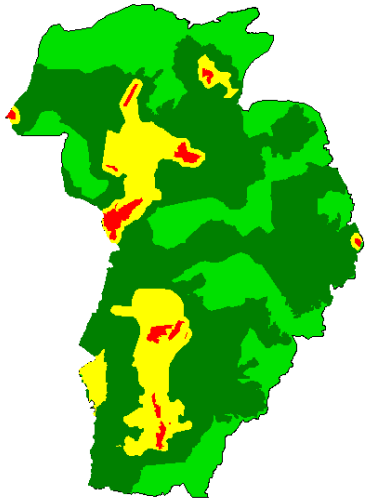


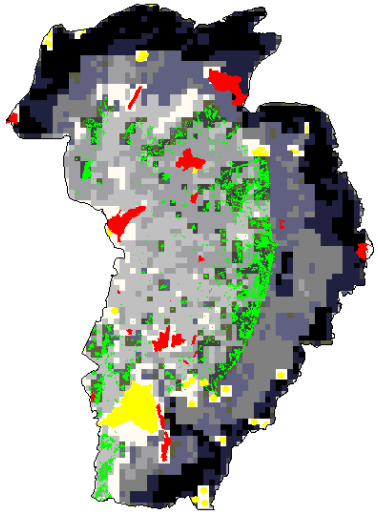
- UNESCO directive by 2013 all Biosphere Reserves will have to review their zonation schemes (Madrid action plan-UNESCO2008)
- UNESCO directive for the new zonation is that all zones must contribute to the BR objectives
- But there is no single word about systematic planning and no Methods to provide accountability



Pantanal Biosphere Reserve *ad hoc* zones

- Red – Nuclei = Existing PA
- Yellow – Buffer = Indigenous + Extensive ranching
- Green – Transition (dark) & not assigned (light)
- Grey – Acquisition Cost = darker > cost





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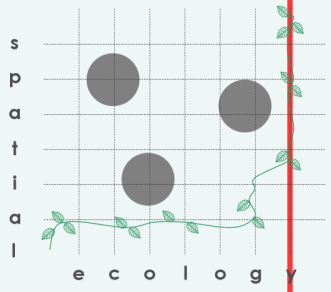
Methods

- Marxan-z_{ee} is based on an adaptation of the set-covering problem used in Marxan software (Ball & Possingham 2000). The software is able to optimize the compromises between land suitability and availability under a multi-objective and variable cost context (Watts et all, in prep).

Minimize the configuration cost of all zones + Boundary compatibility cost + Feature and zone representation shortfall penalty

Framework

- 293 biodiversity, cultural, economic features targets
- 117 red listed species distributions modelled in MAXENT
- 37 cost layers
- Scenarios and sensitivity to zone juxtaposition (compatibility)

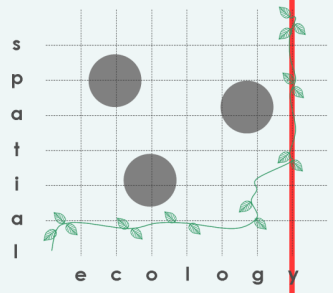


Features targeted by objective & zone contribution

Features	Unit	Overall target	Biosphere Reserve objective	Zone contribution (Available)	Zone contribution (Transition)	Zone contribution (Buffer)	Zone contribution (Core)	Zone target (Available)	Zone target (Transition)	Zone target (Buffer)	Zone target (Core)
Density Cayman	L - M - H	0.3	biod-sust	-----	0.6 or 1.0	0.75	1.0	-----	-----	-----	-----
Density Capybara	L - M - H	0.3	biod-sust	-----	0.6 or 1.0	0.75	1.0	-----	-----	-----	-----
Density Marsh deer	L - M - H	0.3	biod-sust	-----	0.6 or 1.0	0.75	1.0	-----	-----	-----	-----
Density Pampas deer	L - M - H	0.3	biod-sust	-----	0.6 or 1.0	0.75	1.0	-----	-----	-----	-----
Distance to river	6 classes	0.2	biod-sust	-----	1.0	1.0	1.0	-----	-----	-----	-----
Distance to road	18 classes	0.2	sust-cult	-----	1.0	1.0	1.0	-----	-----	-----	-----
Freshwater domain	40 classes	0.2	biod-sust	-----	0.5 or 0.7	1.0	0.25 or 1.0	-----	-----	-----	-----
Soil types	16 classes	0.2-0.3	biod-sust	-----	0.5	1.0	1.0	0.1	0.32	0.2	0.18
Vegetation	38 classes	0.2-0.3	biod-sust	-----	0.7	0.7	0.0 or 1.0	0.1	0.32	0.2	0.18
Vegetation subclasses	13 classes	0.2-0.7	biod-cult	-----	0.7 or 1.0	0.7 or 1.0	0.0 or 1.0	0.1	0.32	0.2	0.18
Watersheds	20 units	0.2	biod-cult	-----	0.5	0.9	1.0	0.1	0.32	0.2	0.18
Indigenous Land	26 reserves	0 or 1	cult -biod	-----	0.5	1.0	1.0	0.0	0.0	1.0	0.0
Protected Areas	19 reserves	0 or 1	biod	-----	0.0	0.5	1.0	0.0	0.0	0.0	1.0
Deforestation	Pres/Abs	0	sust.	-----	-----	-----	-----	0.5	0.5	0.0	0.0
Cattle density	4 classes	0.3	cult-sust	1.0	1.0	1.0-0.75 0.75-0.0	0.0	0.7	0.7	0.0	0.0
Species models	117 species	0.3 to 1	biod.	-----	0.5, 0.6 or 0.75	0.6, 0.75 or 1.0	1.0	-----	-----	-----	-----

Cost Layers

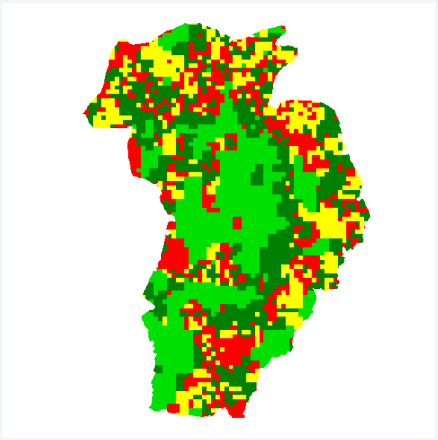
Cost layer Features	B R Objective	Unit	Zone 1 Available	Zone 2 Transition	Zone 3 Buffer	Zone 4 Core
Cattle density	cult-biod	4 classes	0	0	0	100
Deforestation	biod	pres/abs	0	0	80	100
Distance to river	sust	6 intervals	0	80	50	0
Distance to roads	sust	18 intervals	0	0	50	10
Erodability	biod	4 classes	0	20	100	100
Fire risk	biod	13 classes	0	10	50	70
Fragility	sust	6 classes	0	0	50	100
Soil types	sust	16 types	0	0-100	0-100	0-100
Vegetation subclasses	cult-sust	13 types	0	0-100	0-100	0-100
Acquisition costs	cult-sust	continuous	0	20	50	1000

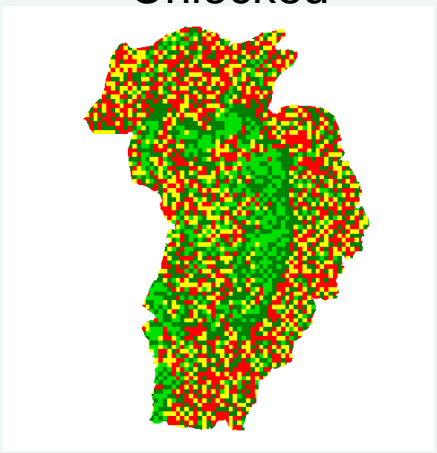


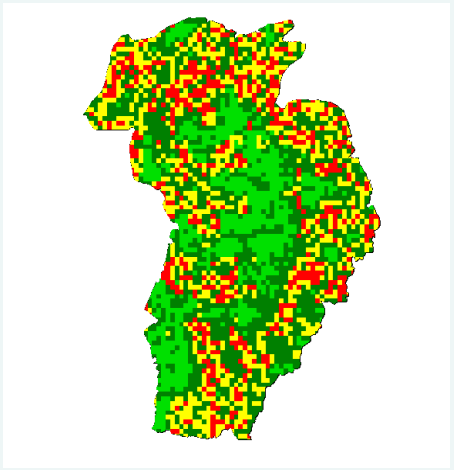
Results - Zone compatibility sensitivity analysis

(Best solution 100 runs 3 scenarios)

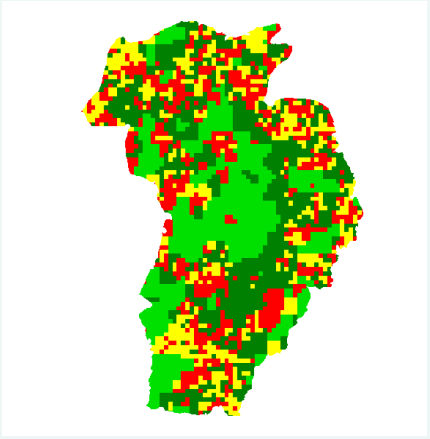
Unlocked

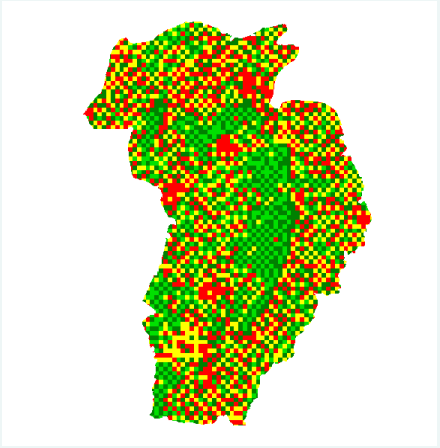


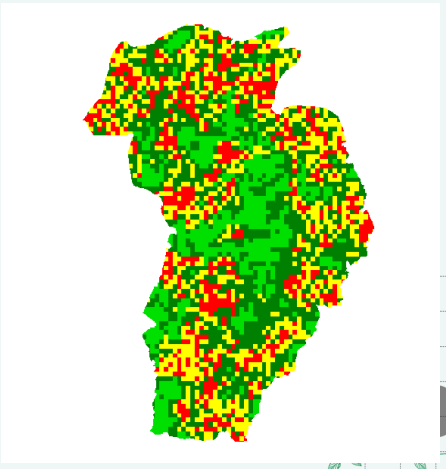




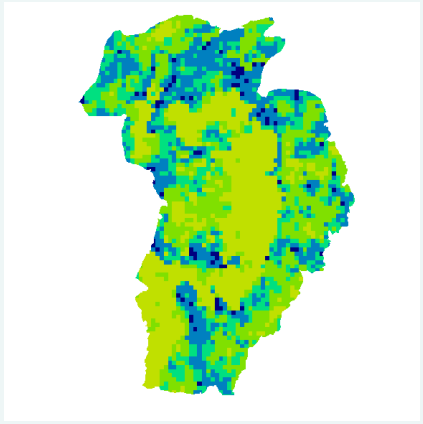
Locked



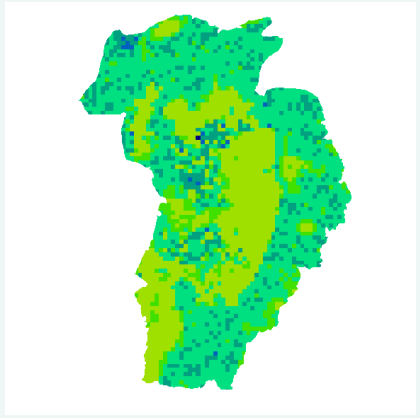




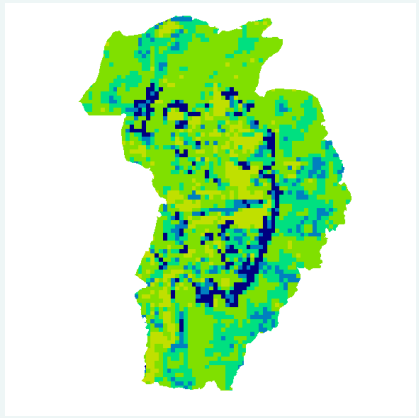
Selection frequency = irreplaceability by zone



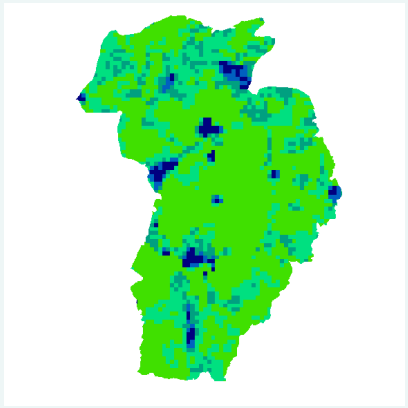
(a) CORE

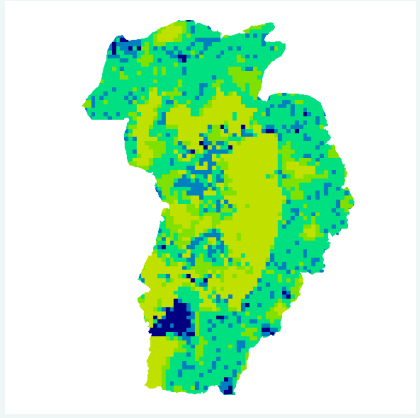


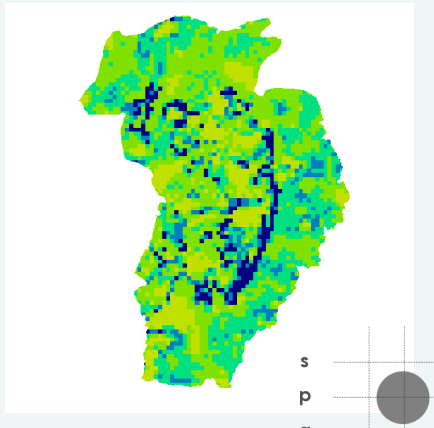
(b) BUFFER



(c) TRANSITION







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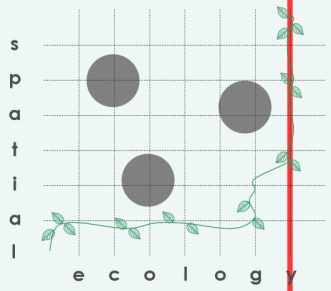
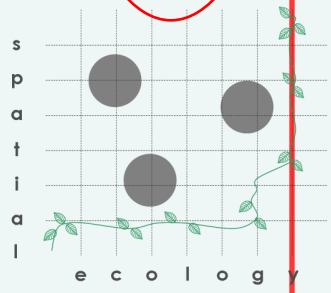
Agreement between scenarios (Kappa Statistics)

Scenario	Scenario	Agreement - Core	Agreement - Buffer	Agreement - Transition
1 (u)	2 (l)	low	low	very low
3 (u)	4 (l)	very low	very low	very low
5 (u)	6 (l)	low	low	very low
1 (u)	3 (u)	very low	very low	very low
1 (u)	5 (u)	low	very low	very low
3 (u)	5 (u)	very low	very low	very low
2 (l)	4 (l)	very low	very low	very low
2 (l)	6 (l)	low	very low	very low
4 (l)	6 (l)	very low	very low	very low

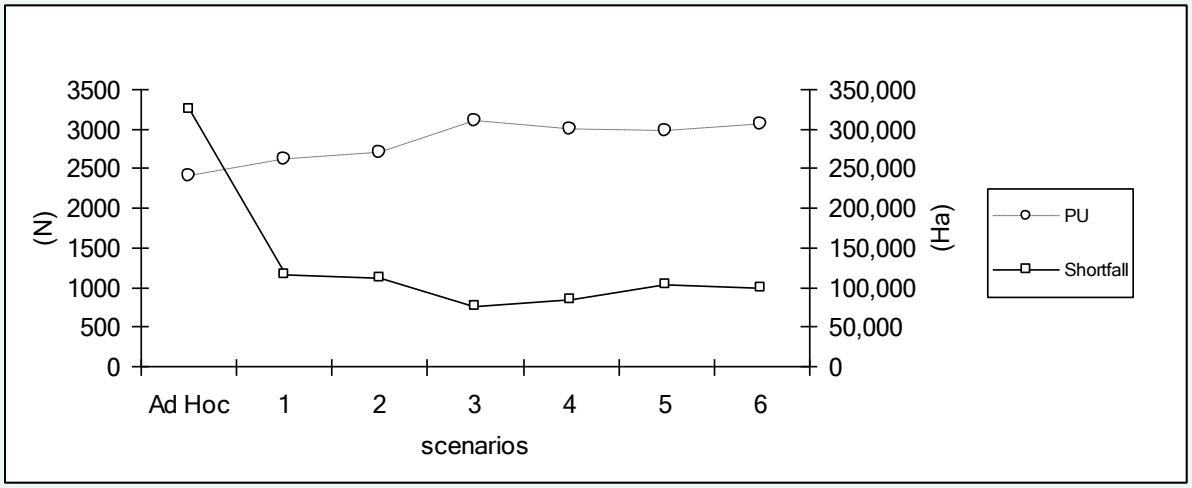


Results

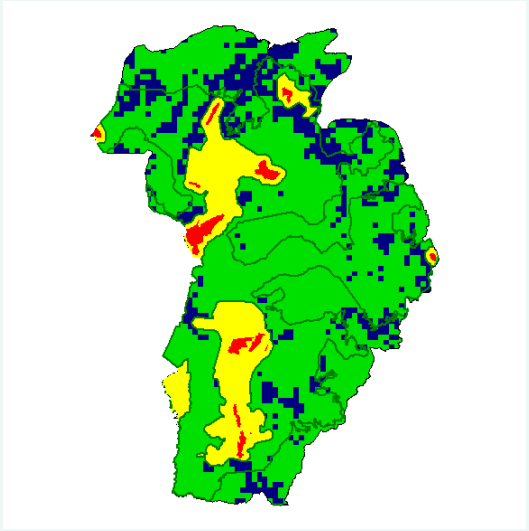
scenario	Reserve status	No. of PU in all scenarios	proportion of total PU	PU in transition zone	%	No. PU in buffer zone	%	No. PU in core zone	%	Target shortfall in Hectares
Ad hoc	Locked	2403	0.64	1807	0.48	689	0.18	57	0.02	324,685.3
1	Unlocked	2615	0.70	1137	0.31	672	0.18	805	0.22	116,323.2
2	Locked	2704	0.73	1119	0.30	727	0.20	858	0.23	111,515.1
3	Unlocked	3104	0.83	1182	0.32	808	0.22	1114	0.30	76,113.2
4	Locked	2988	0.80	1177	0.32	866	0.23	944	0.25	83,370.0
5	Unlocked	2981	0.80	1440	0.39	929	0.25	612	0.16	104,008.6
6	Locked	3051	0.82	1413	0.38	963	0.26	675	0.18	99,659.3
Average		2907	0.78	1244	0.33	827	0.22	834	0.22	98,498.2
Stdv		199	0.05	142	0.04	113	0.03	182	0.05	15,803.9



Conclusion



(a) scenario 5



(b) scenario 6