Geographic strategies for conservation in Brazil: Studies cases with mammals

Carlos Eduardo de Viveiros Grelle
Departamento de Ecologia, UFRJ
(email: grellece@biologia.ufrj.br)

Science december 2010

RESEARCH ARTICLE

The Impact of Conservation on the Status of the World's Vertebrates

Michael Hoffmann,[1,2]* Craig Hilton-Taylor,[3] Ariadne Angulo,[4,5] Monika Böhm,[6] Thomas M. Brooks,[7,8,9] Stuart H. M. Butchart,[10] Kent E. Carpenter,[2,5,11] Janice Chanson,[5,12]

by two to three orders of magnitude (*3*), with substantial detrimental societal and economic consequences (*4*). In response to this crisis, 193 parties to the Convention on Biological Diversity (CBD; adopted 1992) agreed "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional, and national level as a contribution to poverty alleviation and to the benefit of all life on Earth" (*5*). That the target has not been met was borne out

- Protected areas as a goal.
-
- How many protected areas?

- Protected areas and networks.

- Two paradigms have been used in strategies for protected areas:

1. Theory of Island Biogeography.

2. Landscape Ecology: functional connectivity.

Size of protected areas. Is there a minimum size?

The answer can be obtained from Minimum Viable Populations.

Biodiversity and Conservation 13: 2519–2536, 2004.

Effectiveness of a reserve network for the conservation of the endemic marsupial *Micoureus travassosi* in Atlantic Forest remnants in southeastern Brazil

DANIEL BRITO[1,3,*] and CARLOS EDUARDO DE VIVEIROS GRELLE[2,4]

Biodivers Conserv (2008) 17:3255–3268
DOI 10.1007/s10531-008-9427-z

ORIGINAL PAPER

Is the Atlantic Forest protected area network efficient in maintaining viable populations of *Brachyteles hypoxanthus*?

Daniel Brito · Carlos Eduardo V. Grelle · Jean Philippe Boubli

Mongabay.com Open Access Journal - Tropical Conservation Science Vol. 3 (1):63-77. 2010

Research Article

Identifying Important Forest Patches for the Long-term Persistence of the Endangered Golden-Headed Lion Tamarin (*Leontopithecus chrysomelas*)

Zeigler, Sara L.[1*], William F. Fagan[2], Ruth DeFries[3], and Becky E. Raboy[4,5]

[1]Department of Geography, University of Maryland, College Park MD USA. Email corresponding author* <szeigler@umd.edu>
[2] Department of Biology, University of Maryland, College Park MD USA. Email <bfagan@umd.edu>
[3] Department of Ecology, Evolution and Environmental Biology, Columbia University, New York, NY USA. Email <rd2402@columbia.edu>
[4] Smithsonian Conservation Biology Institute, Washington DC USA. Email <raboyb@si.edu>
[5] Instituto de Estudos Socioambientais do Sul da Bahia, Ilhéus, Bahia, Brazil.

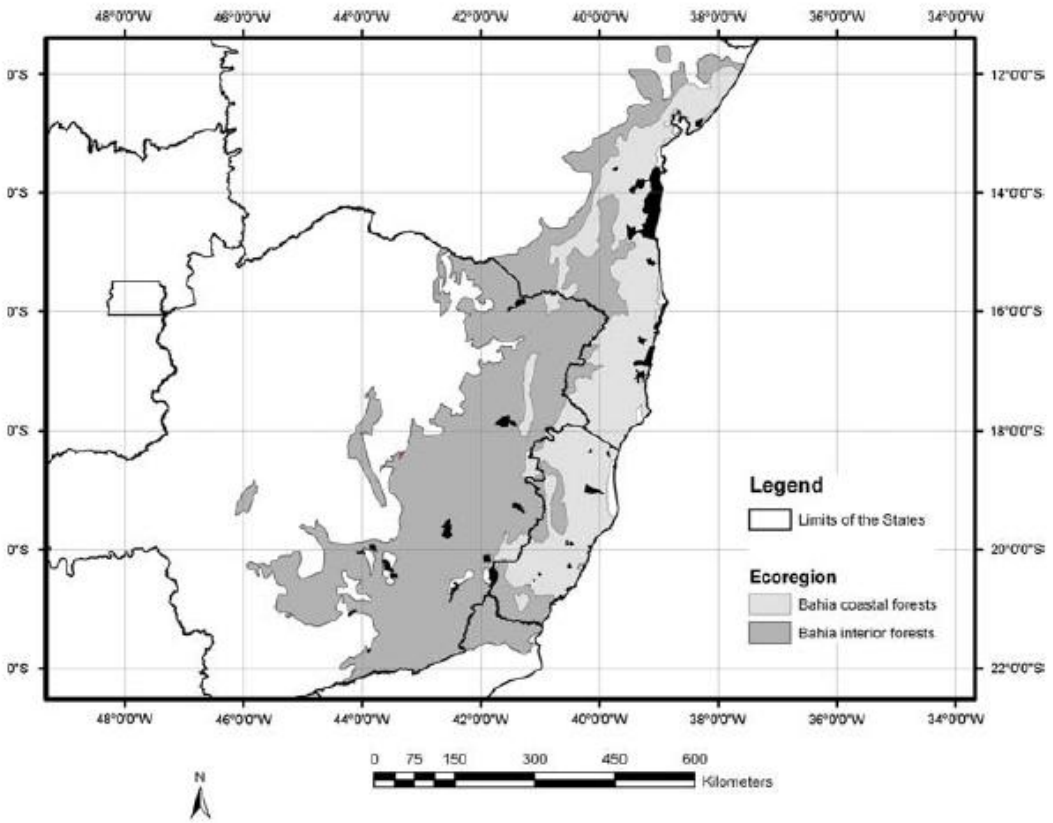


Fig. 1 Protected areas (black polygons) encompassed within the geographic range of the northern muriqui *B. hypoxanthus* in the Atlantic Forest

Brito, Grelle & Boubli (2008)

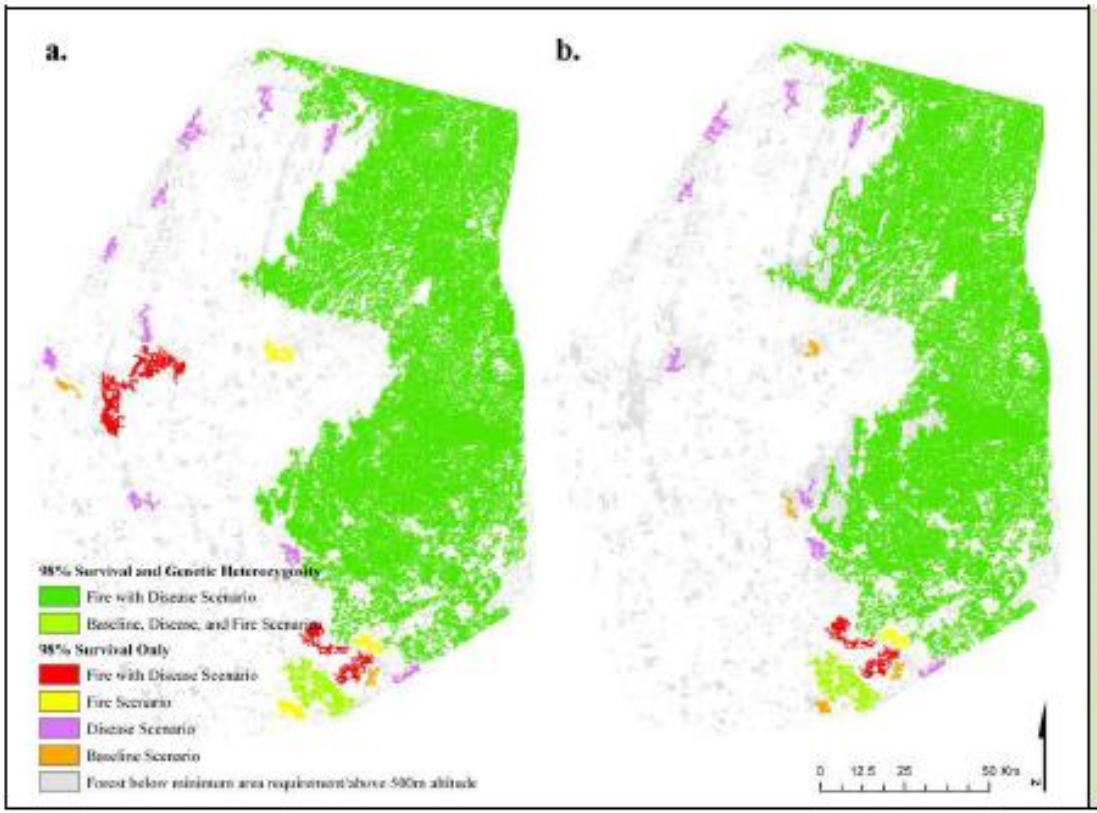
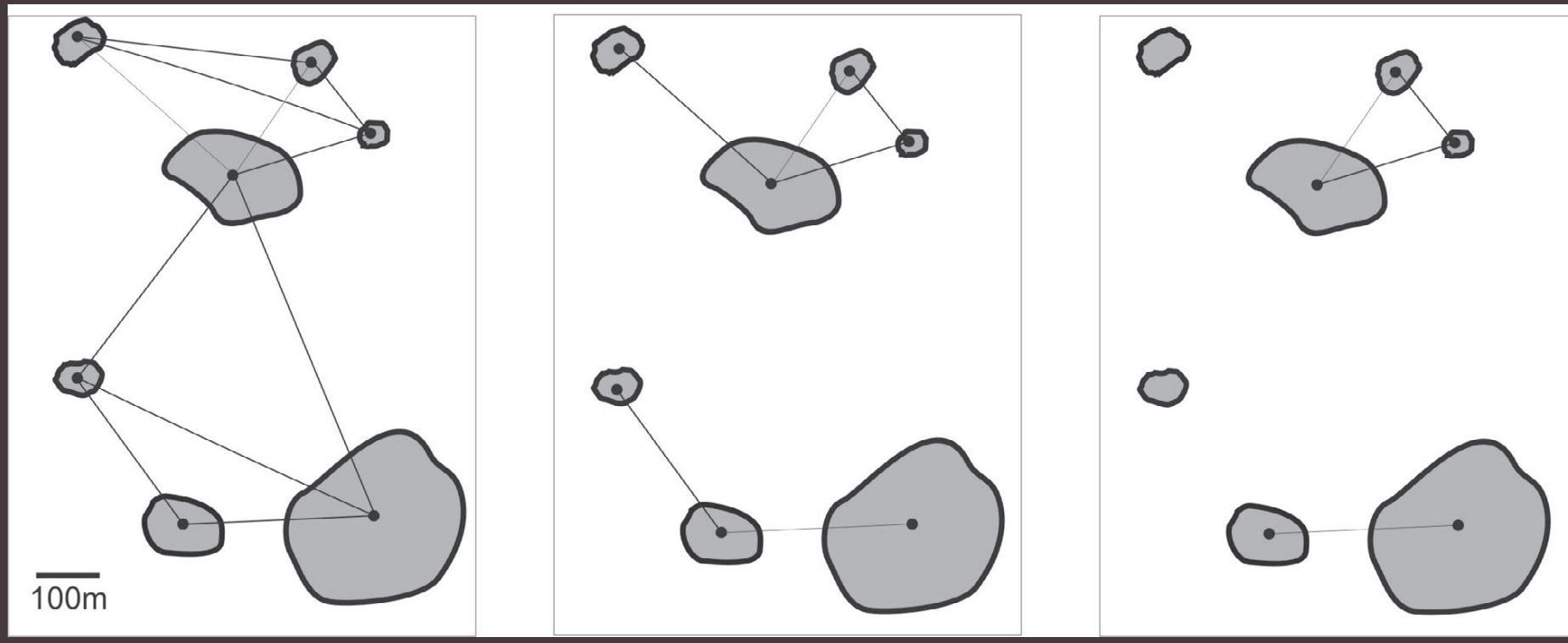


Fig. 3. Key forest patches meeting the minimum area requirements that could support a population of golden-headed lion tamarins at medium density with a 98% probability of survival for 100 years and 98% of its original genetic heterozygosity at baseline with no catastrophes and with a risk of disease, fire, and disease with fire. A. depicts key patches considering all forest cover within the patch while B. depicts key patches after all forest above 500m was removed from patches.

Zeigler *et al.* (2010)

Graph Theory can be used for study of functional connectivity.



Forero-Medina & Vieira 2007

- In the graph theoretical model (Urban & Keitt 2001), there must be links between nodes. Every node must be reachable from some other node in order to represent a graph, otherwise a graph unconnected may consist of several subgraphs.

Urban, D.L. & Keitt, T.H. (2001) Landscape connectivity: A Graph-theoretic perspective. *Ecology* -

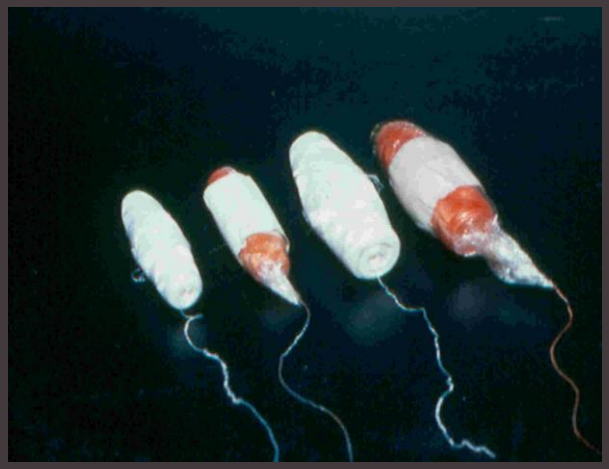
Stockholm Resilience Centre
Research for Governance of Social-Ecological Systems

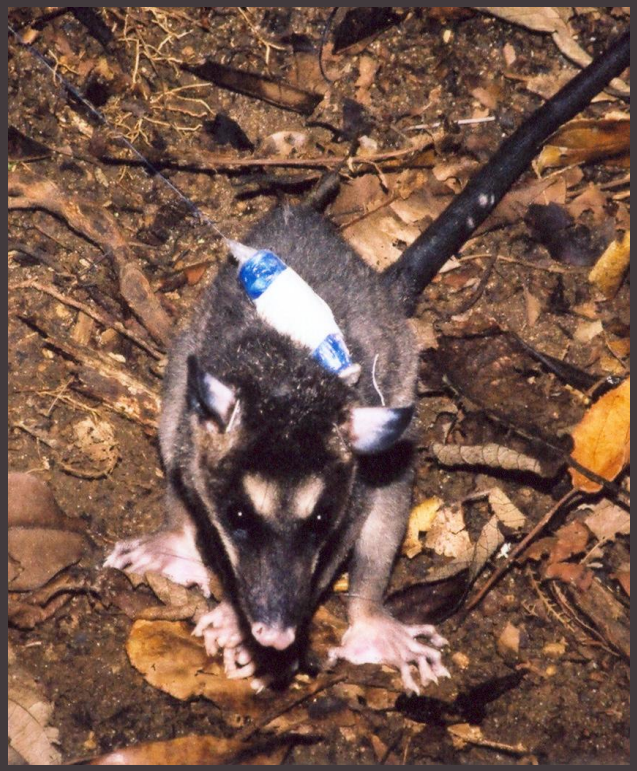
Bodin, O¨ ., M. Tengo¨ , A. Norman, J. Lundberg, and T. Elmqvist. 2006. The value of small size: loss of forest patches and ecological thresholds in southern Madagascar. Ecological Applications 16:440–451.

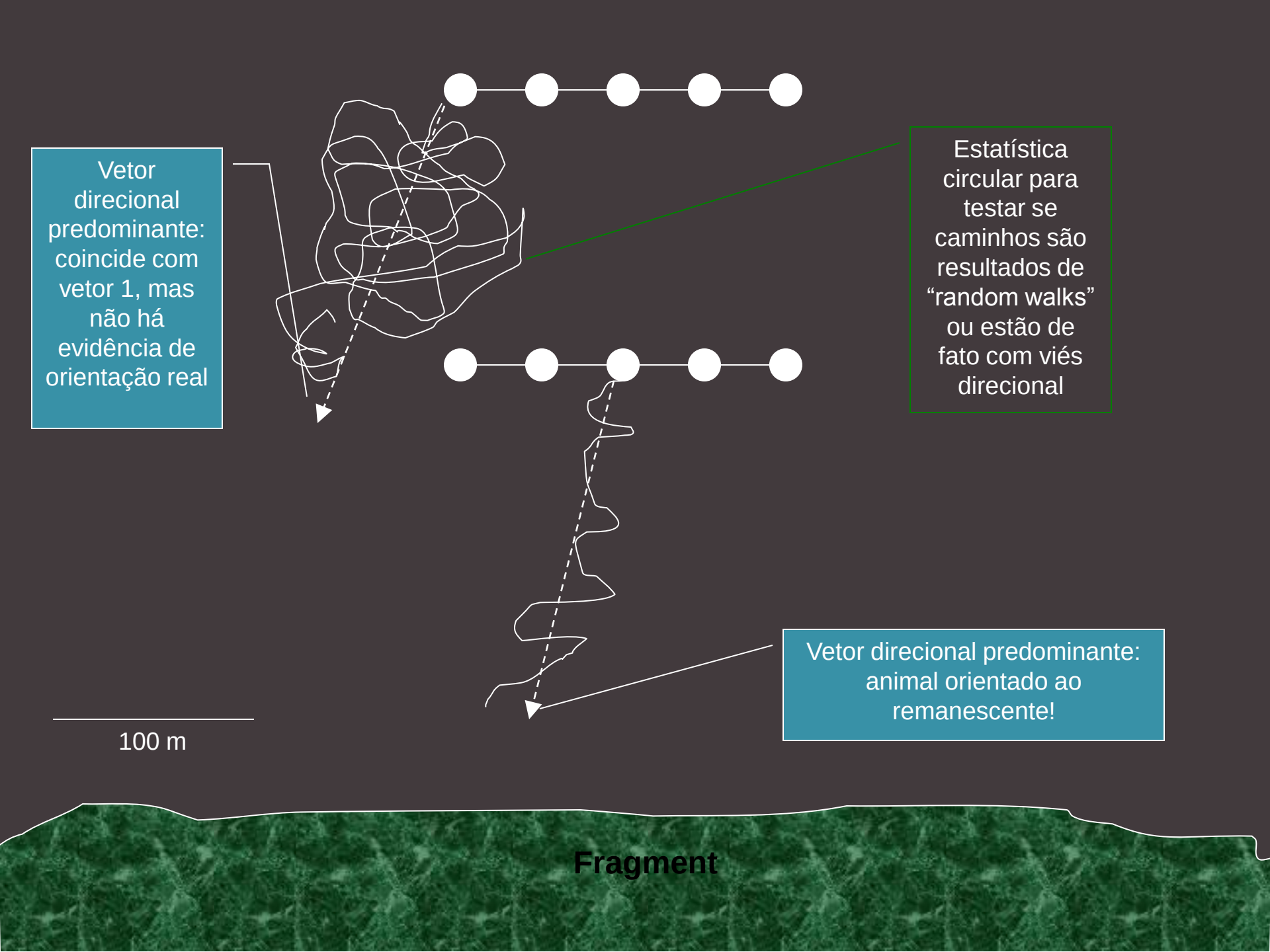
Örjan Bodin PhD in Natural Resource Management

Theme leader Knowledge management, learning and social networks
Email: orjan.bodin 'a' stockholmresilience.su.se
Phone + 46 703 410 121 / +46 8 674 76 71

Spool and line method to find perceptual range of Atlantic forest marsupials.






Vetor direcional predominante: coincide com vetor 1, mas não há evidência de orientação real
Estatística circular para testar se caminhos são resultados de “random walks” ou estão de fato com viés direcional
Vetor direcional predominante: animal orientado ao remanescente!
100 m
Fragment

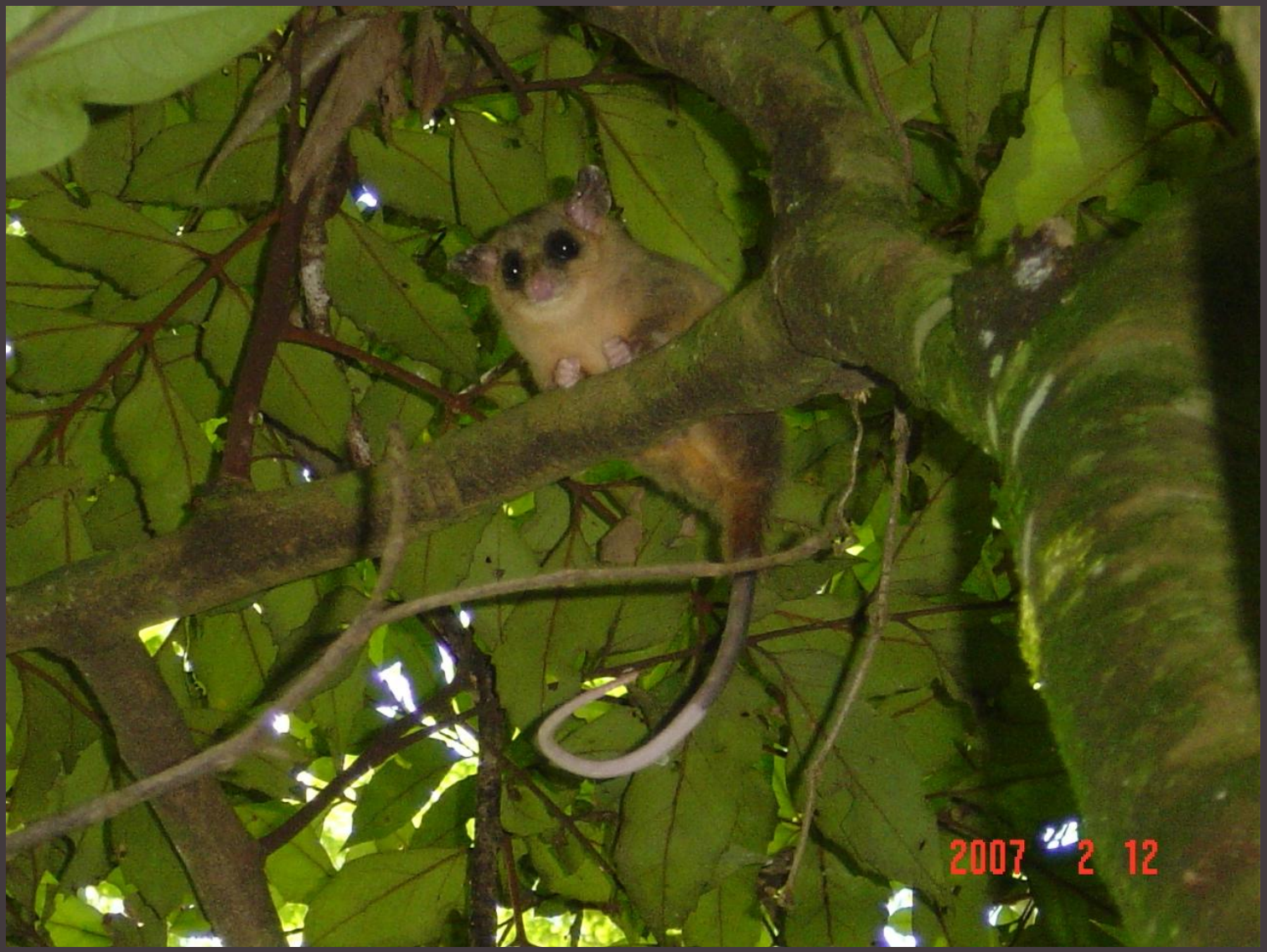
Journal of Tropical Ecology (2009) **25**:53–62.
doi:10.1017/S0266467408005543 Printed in the United Kingdom

Perception of a fragmented landscape by neotropical marsupials: effects of body mass and environmental variables

Germán Forero-Medina[1] and Marcus Vinícius Vieira

Laboratório de Vertebrados, Departamento de Ecologia, Instituto de Biologia – CCS, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, CEP: 21941-590
(*Accepted 16 October 2008*)

Does connectivity increase the population viability? An analysis with a New World marsupial.


2007 2 12

Study performed with data from Rio de Janeiro State (inside of Atlantic forest):

1) Protected areas (strictly use and sustainable use)

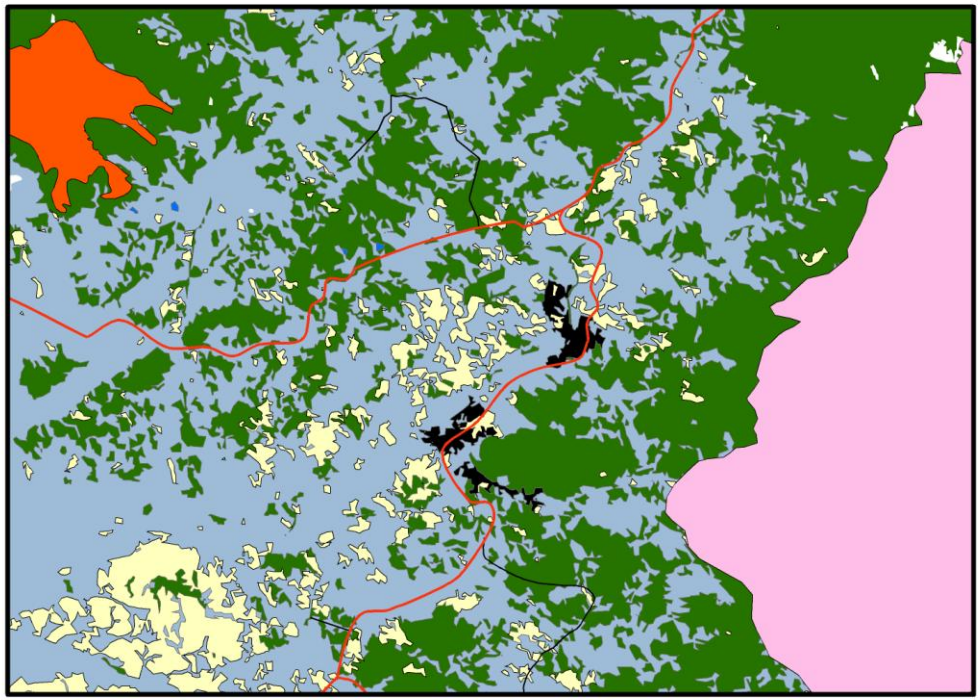
2) Map with fragments and land-use

3) Potential connectivity of *Micoureus paraguayanus* between protected areas (each pair) was studied structural variable (distance between PAs and the kind of matrix), and perceptual range. Analyses were performed using the sofware *JMatrixNet* (www.ecology.su.se/JMatrixNet)

- Viable populations of *M. paraguayanus*: 3.600ha (Brito & Grelle 2004), and 38% of PAs at the Rio de Janeiro State has size below this threshold.

- *M paraguayanus* occurs at florest in different sucessional stages (Grelle 2003), and inside the florest can move 1 km per night (Moraes-Junior 2003).

- At fragmented landscape can move 100m in matrix with grass (inside farms) (Forero, 2007), and 300m in more complex matrix, Pteridium aquilinum, with trees of early sucessional stages and grass.



0 795 1.590 3.180 4.770 6.360 Meters

Legend

Roads

- non-pavemented
- pavemented

Protected areas

- Bacia do Rio São João Area of Environment Protection
- Paraiso Ecological State

Land use

- agro-pasture
- water corpses
- florest and fragments
- urban areas
- pasture

Figure 3. Connectivity of the landscape between two protected areas (Paraíso Ecological Station at left corner and Bacia do Rio São João Area of Environmental Protection at right corner) at Brazilian Atlantic forest, showing nodes and graphs. In this case, there is no connectivity between these protected areas.

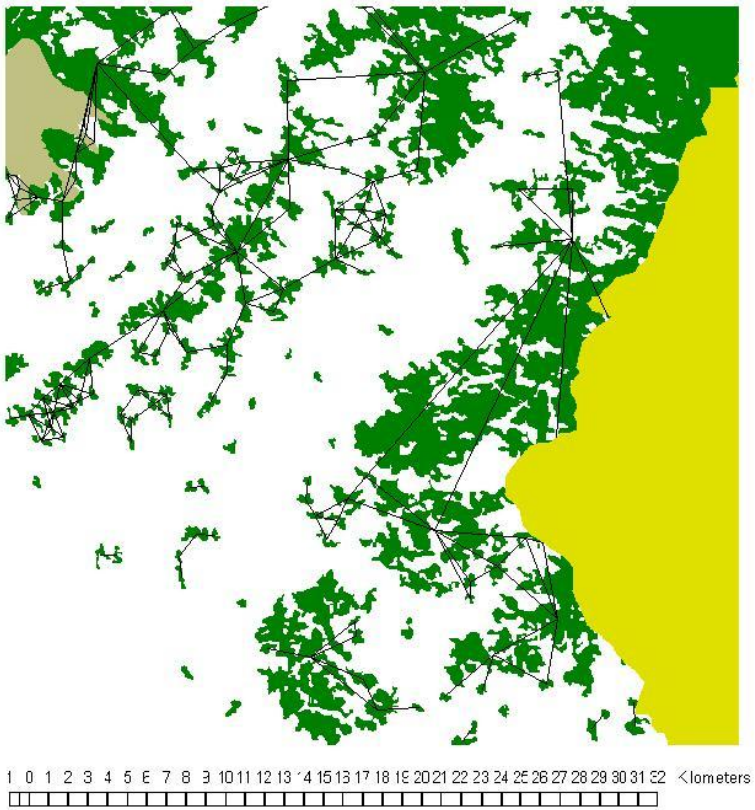


Table 2. Protected areas of Rio de Janeiro State (Brazil), their size and the status of connection and viability of the network that includes them. Protected areas in bold were not used in Brito & Grelle (2004).

Protected Areas	**Area (ha)**	**Connected**	**Viable[c]**
Chacrinha State Park[a]	13	NO	NO
Grajaú State Park[a]	55	YES	YES
Pau-Brasil Area of Environmental Protection[b]	1.2[d]	NO	NO
Cicuta Area of Ecological Interest[b]	131	NO	NO
Mario Xavier National[b]	500	YES	YES
Maricá Area of Environmental Protection[b]	500	NO	NO
Serra da Concordia State Park[a]	804	NO	NO
Serra da Tiririca State Park[a]	1800	NO	NO
Araras Biological Reserve[a]	2068	YES	YES
Jacarandá Area of Environmental Protection[b]	2700	YES	YES
Guaratiba Biological Reserve[a]	2800	YES	YES
União Biological Reserve[a]	3126	YES	YES
Tijuca National Park[a]	3200	YES	YES
Praia do Sul Biological Reserve[a]	3600	YES	YES
Paraíso Ecological Station[a]	4920	YES	YES
Poço das Antas Biological Reserve[a]	5000	YES	YES
Ilha Grande State Park[a]	5594	YES	YES
Sapiatiba Area of Environmental Protection[b]	6000	NO	NO
Bacia dos Frades Area of Environmental Protection[b]	7500	YES	YES
Guaxindiba Ecological Station[a]	3260	NO	NO

- In conclusion: Before 62% of PAs had sufficient size (3600ha) for maintenance of viable populations. Now, under a perspective o connectivity between PAs increase for 81%.

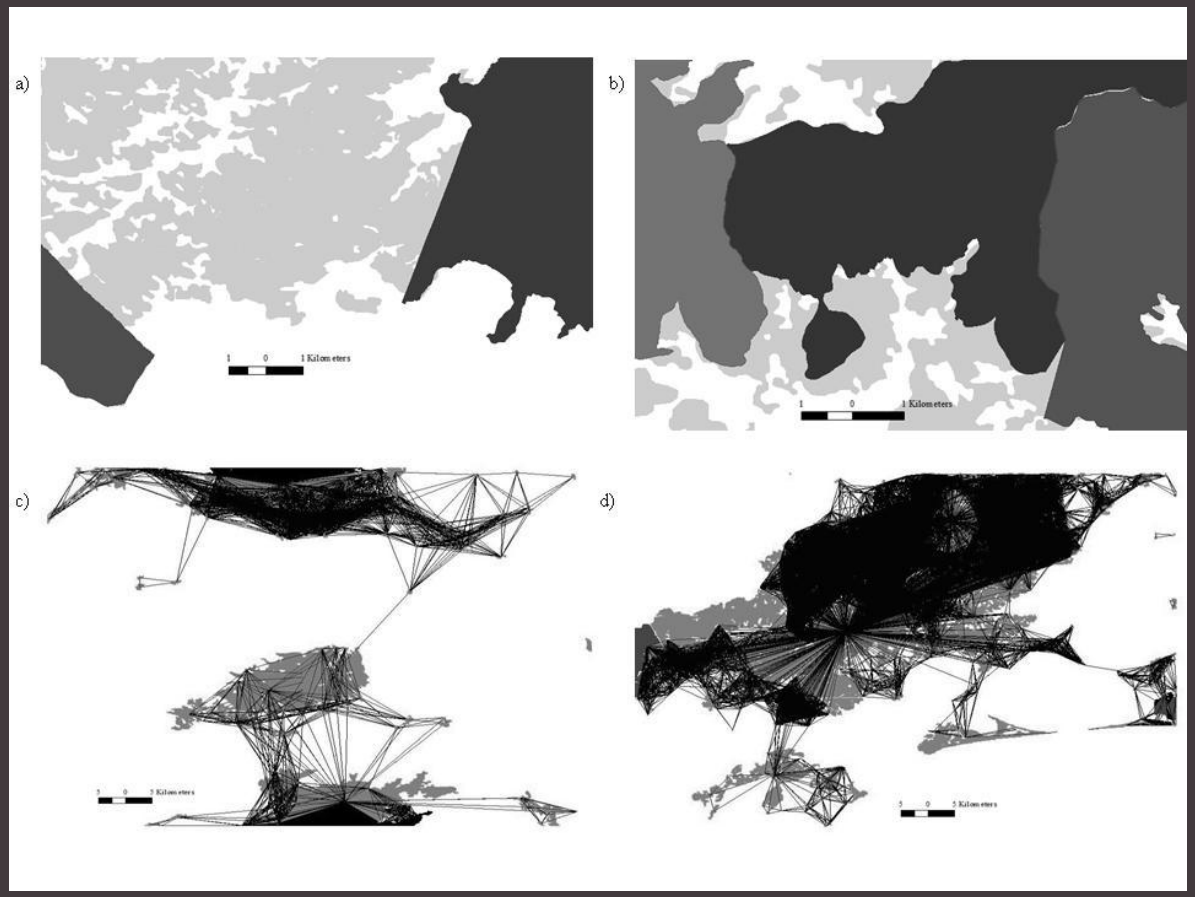
Network Analyses for Protected Areas: A Study on Landscape Connectivity Threshold in Southeastern Brazil

- Connectivity between each pair of Protected Areas.

- Our goal was find the shortest inter-patch distance necessary for any species of terrestrial animal traverse between pairs of strictly protected areas. Euclidean and Cost-distance models were used to compare the number of connections for each protected areas.

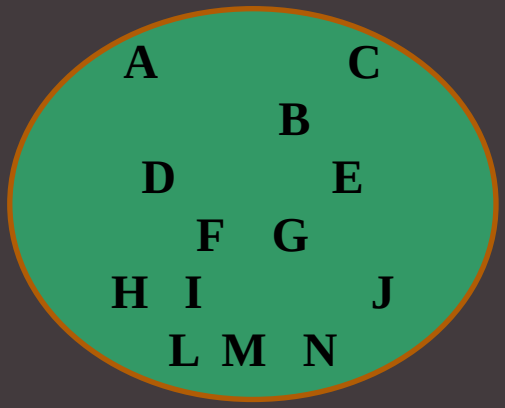
- **We found a threshold of 6.8 km to connectivity between each pair of PAs.**

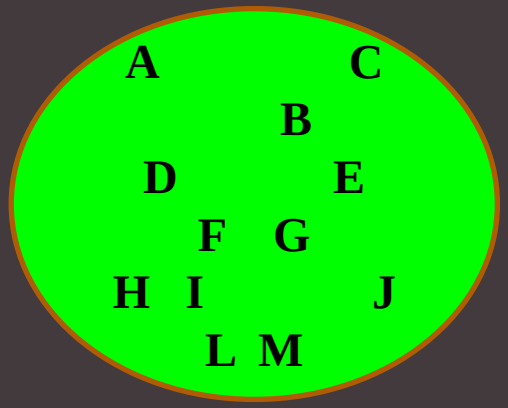
c) The largest inter-patch distance in the shortest pathway was 6.8 km for this pair in euclidean model

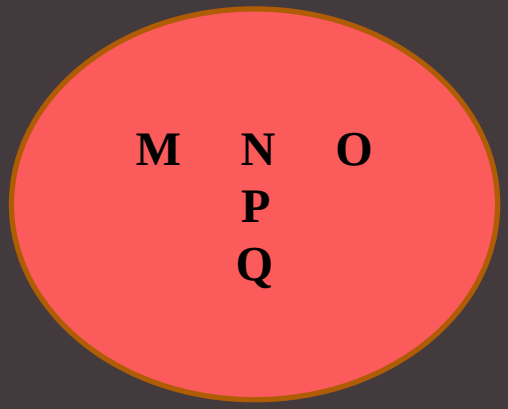


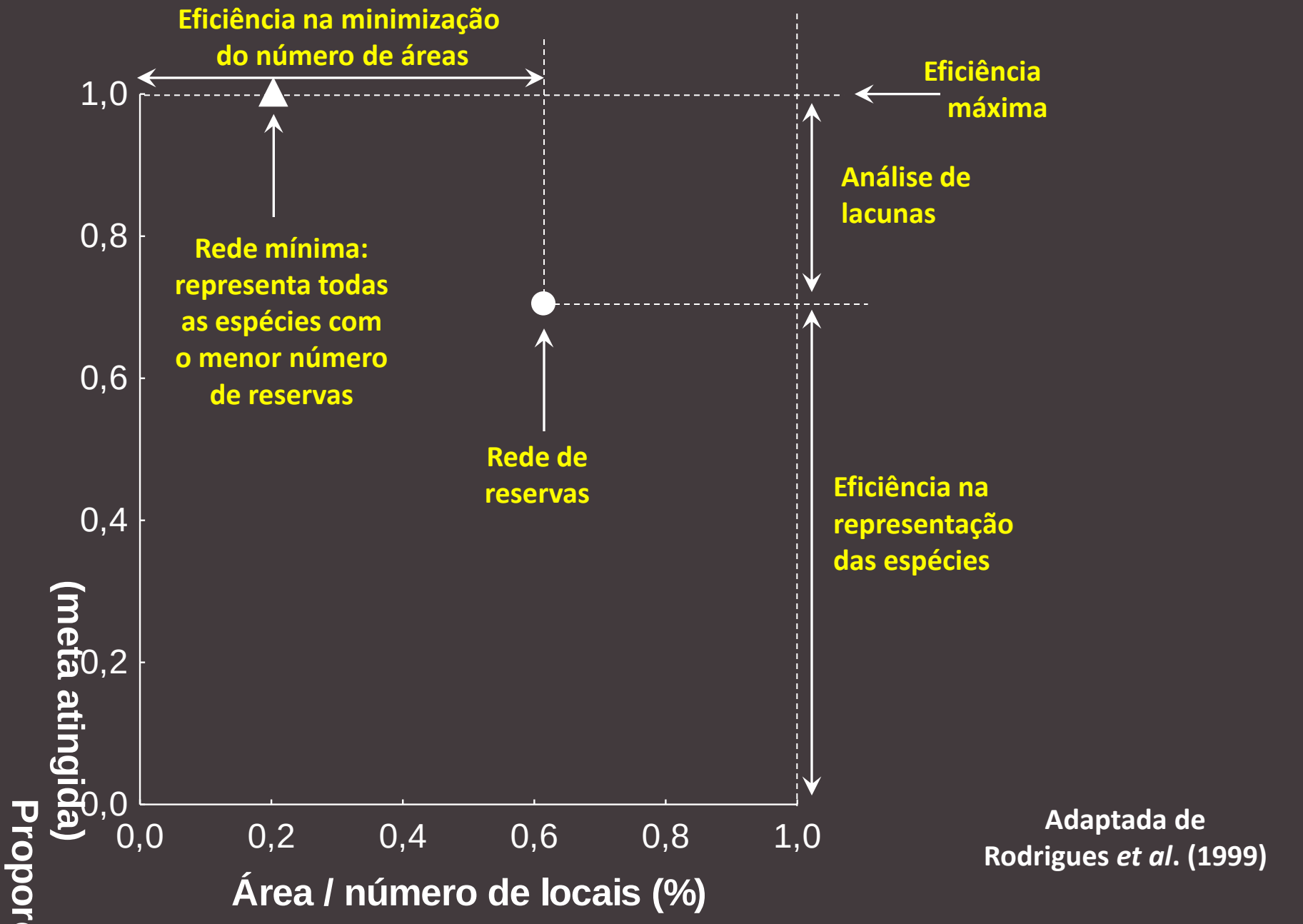
Is there approachs in other scales?

Yes, reserve selection using complementary approach.


A C
B
D E
F G
H I J
L M N


A C
B
D E
F G
H I J
L M


M N O
P
Q



Adaptada de Rodrigues *et al*. (1999)

Biodivers Conserv (2009) 18:957–968
DOI 10.1007/s10531-008-9513-2

ORIGINAL PAPER

Reserve selection and persistence: complementing the existing Atlantic Forest reserve system

Míriam Plaza Pinto · Carlos Eduardo Viveiros Grelle

A grid with a quarter-degree cell resolution was superimposed on the map of the Atlantic Forest biome in Brazil. We excluded all cells that contained ⁄50% of Atlantic Forest; this left a total of 1,884 cells

There are 20 especies of endemic primates at Atlantic forest (Grelle 2000, Silva-Júnior 2001, Oliveira & Langguth 2006) and we compiled more than 600 localities

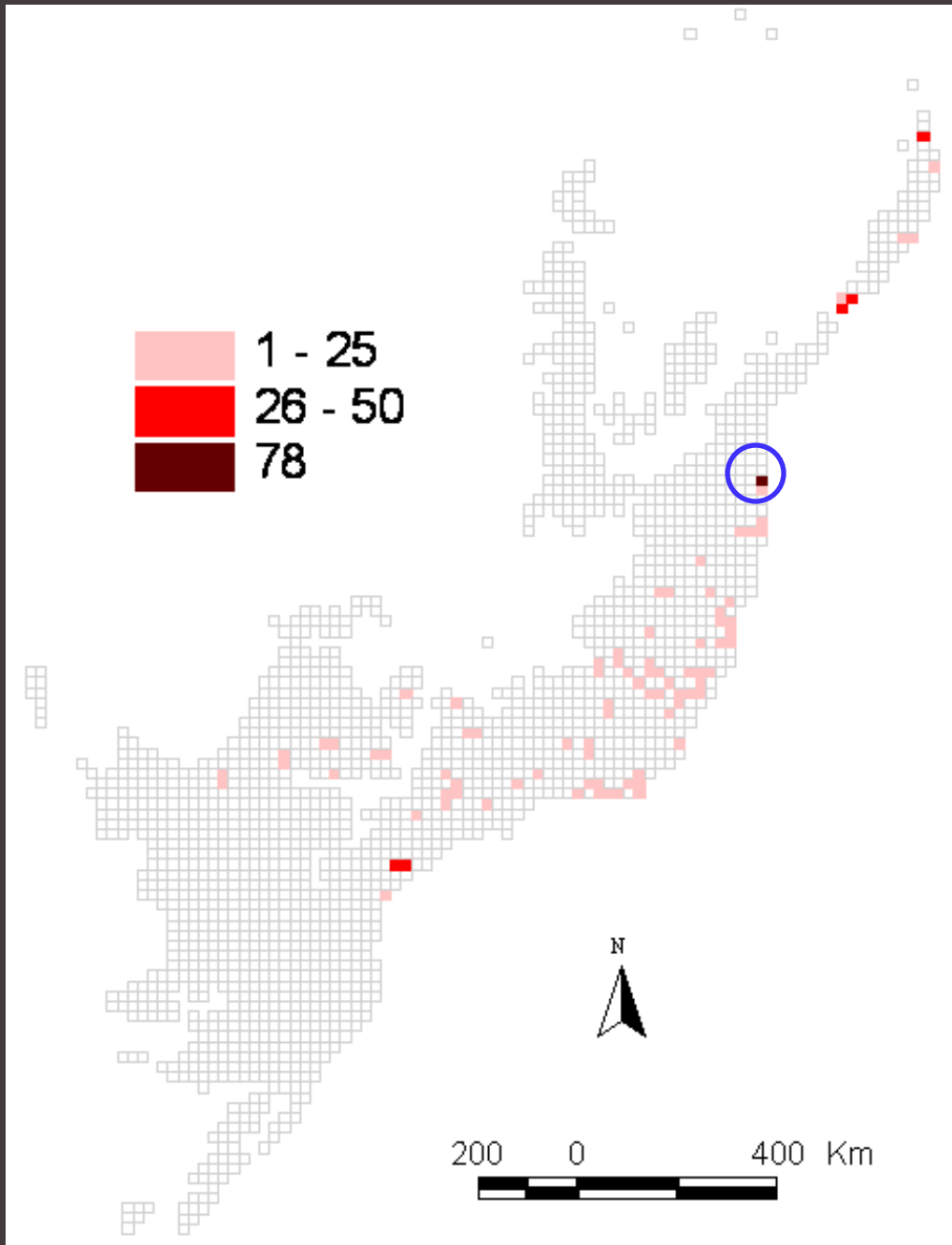
Simulated annealing - SITES (Andelman *et al*. 1999)

Approach with localities and low commision error.

- Approach A—Considering no pre-existing reserves (put at zero—no cell was included a priori in the network);
- Approach B—Grid cells with more than 5,000 ha of existing reserves were accounted for in the network;
- Approach C—Grid cells with more than 11,500 ha of existing reserves were accounted for in the network.

- We chose 11,500 ha area because it is the minimum area needed for viable populations for the larger primate species, and 5,000 ha area trying to incorporate some reality related to actually reserves sizes

First approach A – 9 cells



Approach B

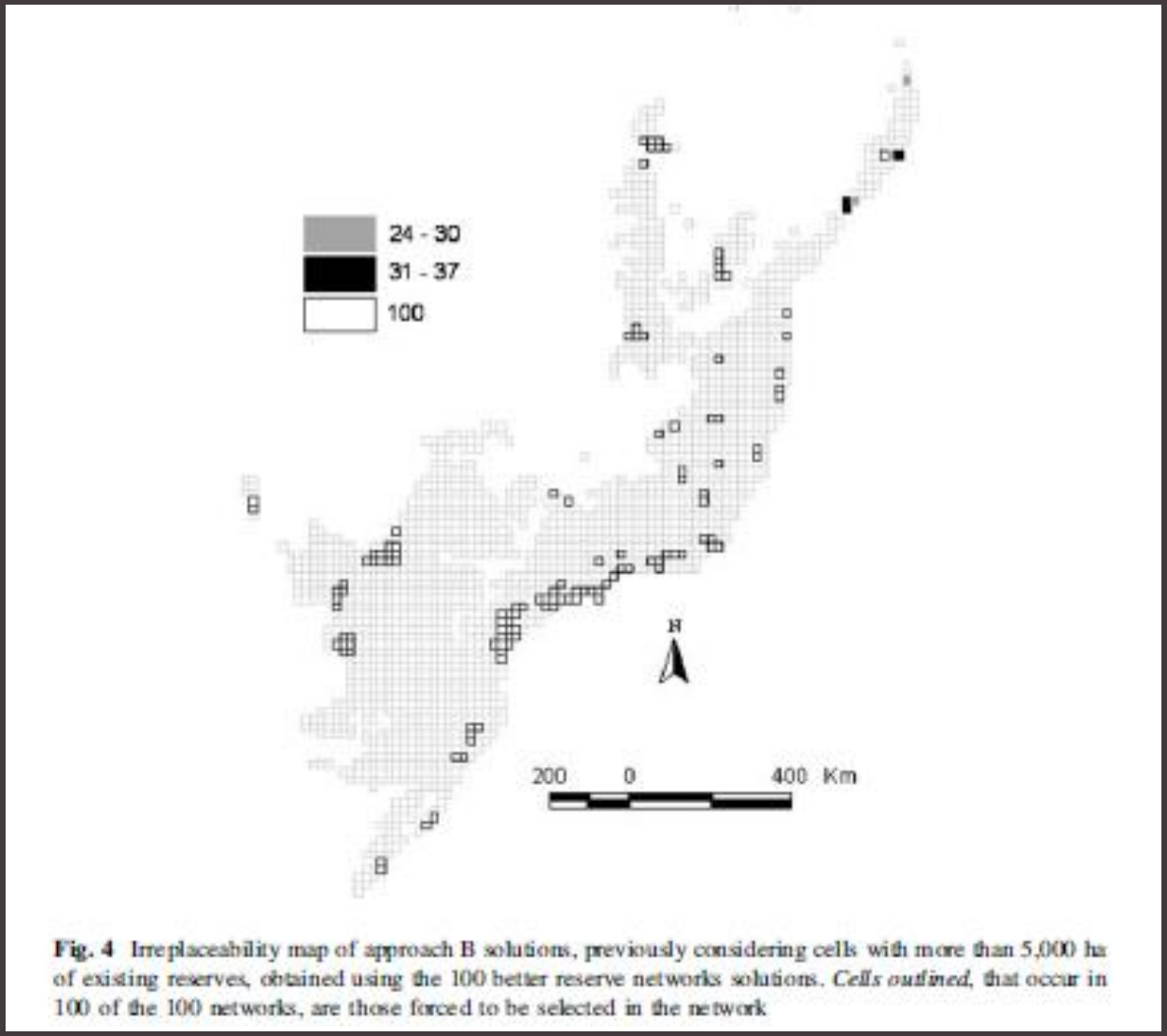


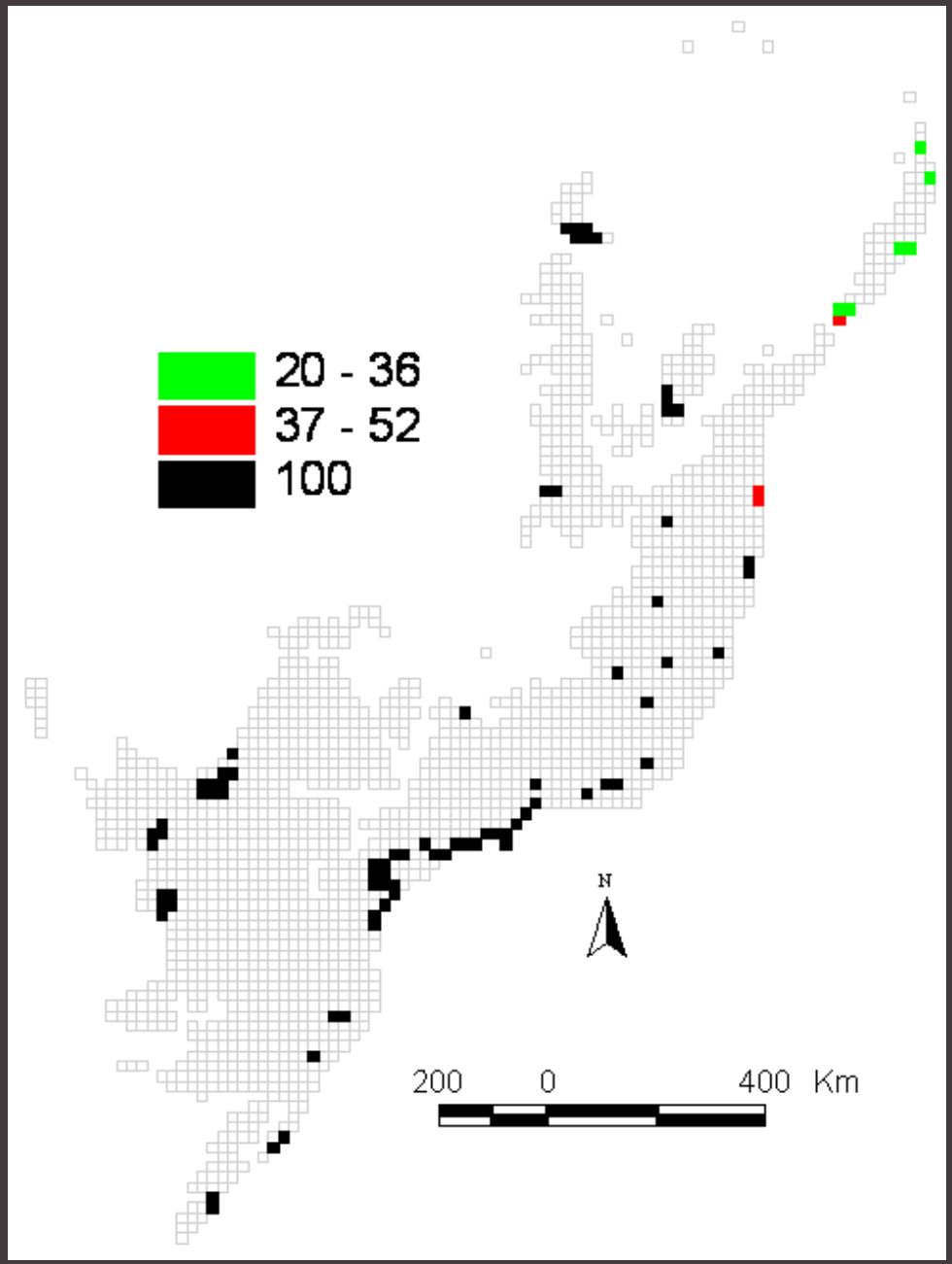
Fig. 4 Irreplaceability map of approach B solutions, previously considering cells with more than 5,000 ha of existing reserves, obtained using the 100 better reserve networks solutions. *Cells outlined*, that occur in 100 of the 100 networks, are those forced to be selected in the network

Approach C – 11500 ha

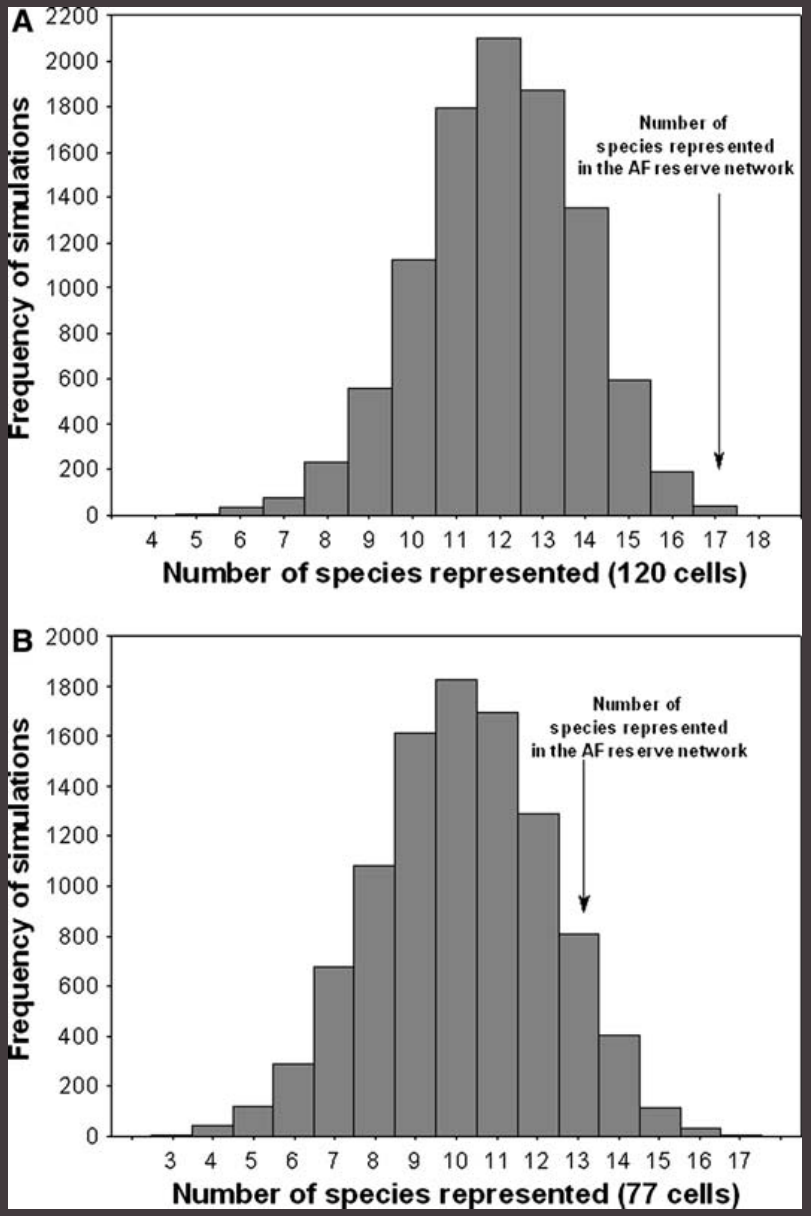
77 fixed cells (PAs)

68% of species represented

We need at least 3 cells!!!!



10,000 random networks

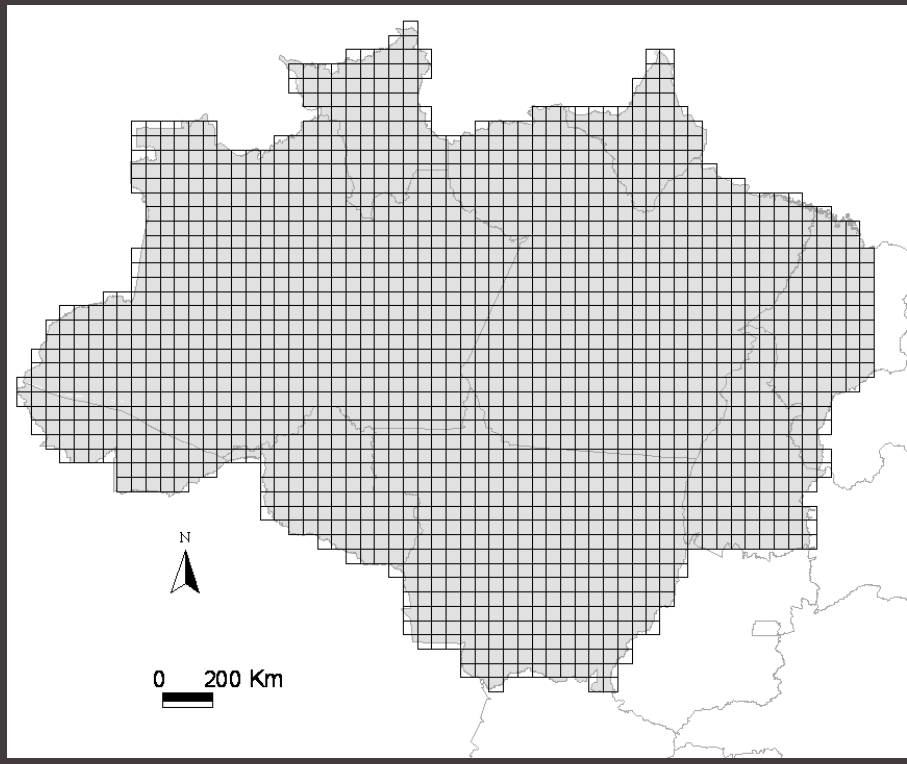


Reserve selection and Amazonian primates

- **How representative are protected areas to amazonian primates?**
- **Dataset: specimens housed at MPEG and literature.**
- **Dr. José de Sousa e Silva Júnior (Cazuza) – MPEG**

1687 cells of 0.5º x 0.5º

Protected areas: only strictly use



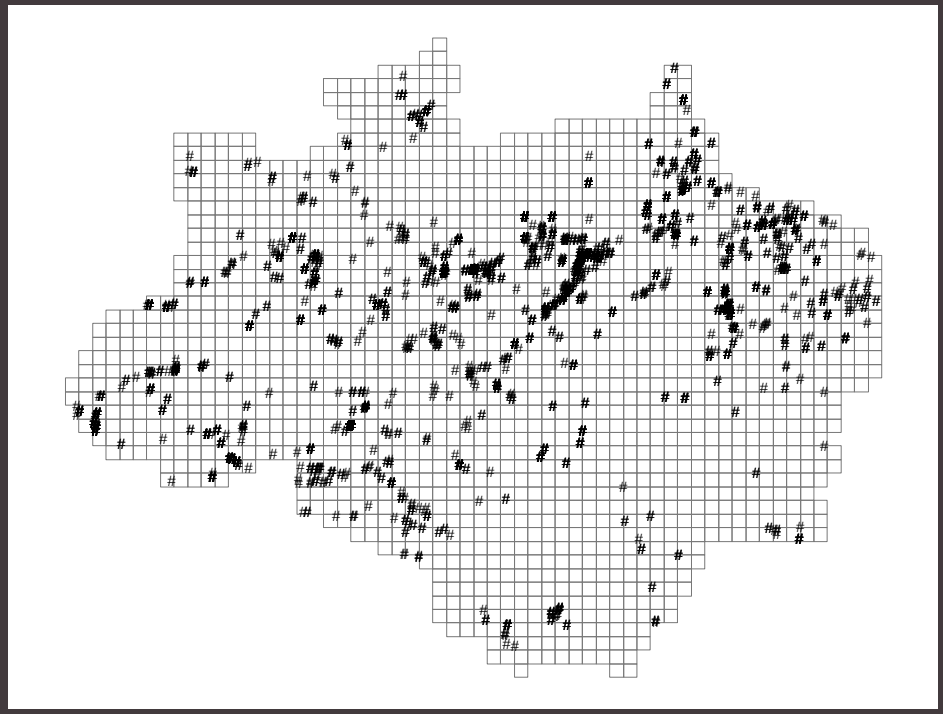
Approach A—Considering no pre-existing reserves (put at zero—no cell was included a priori in the network);
Approach B—Grid cells with more than 10,000 ha;
Approach C—Grid cells with more than 12,500 ha;
Approach D – Grid cells with more than 15,000ha.

1690 localities

85 species

15 genus

Range of localities per species: 1 to 217



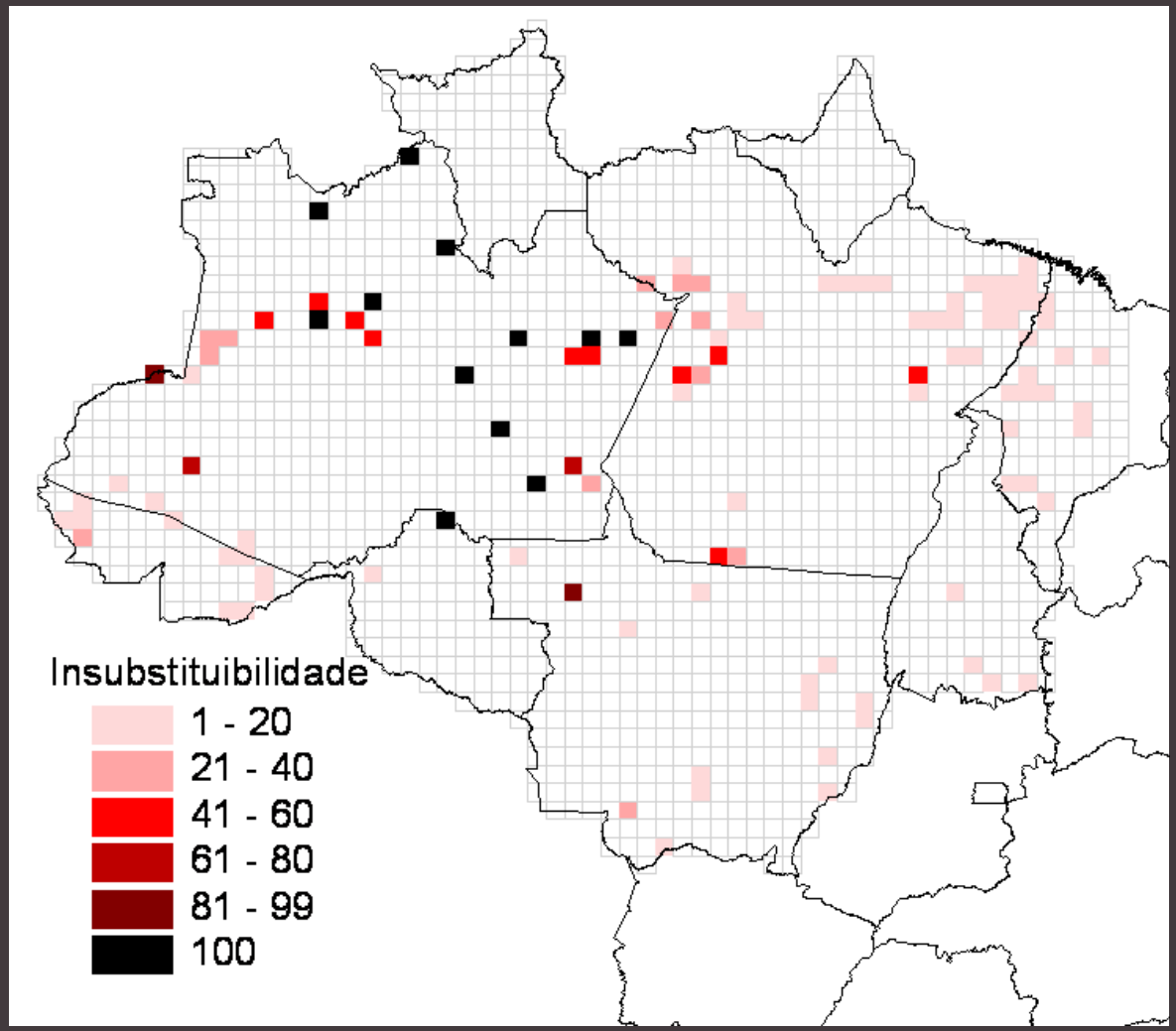
Approach A – without PAs

Network with 29 cells

12 cells - irreplaceability

11 no AM

1 em RO



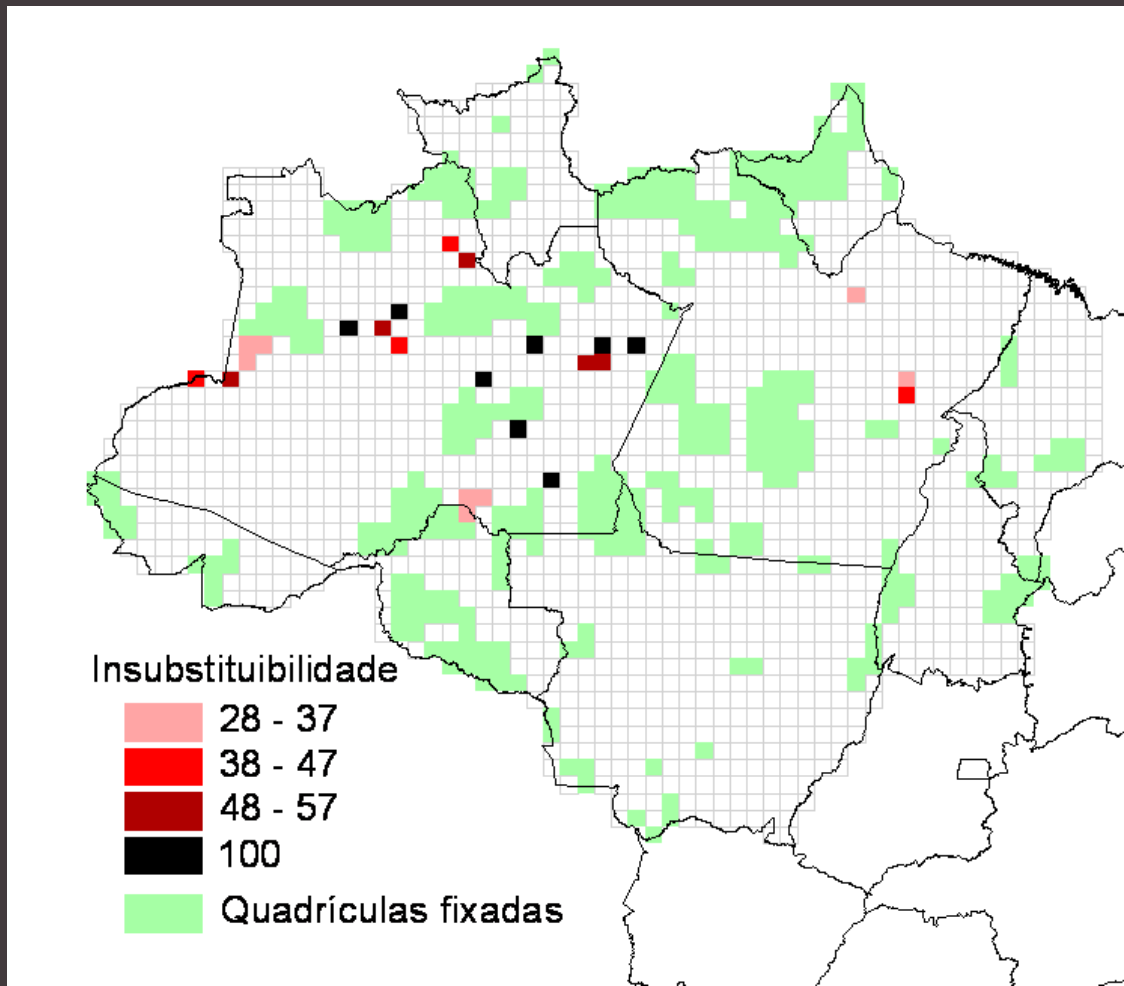
Approaches B, C e D – same results

Approach D

Network with 356 cells

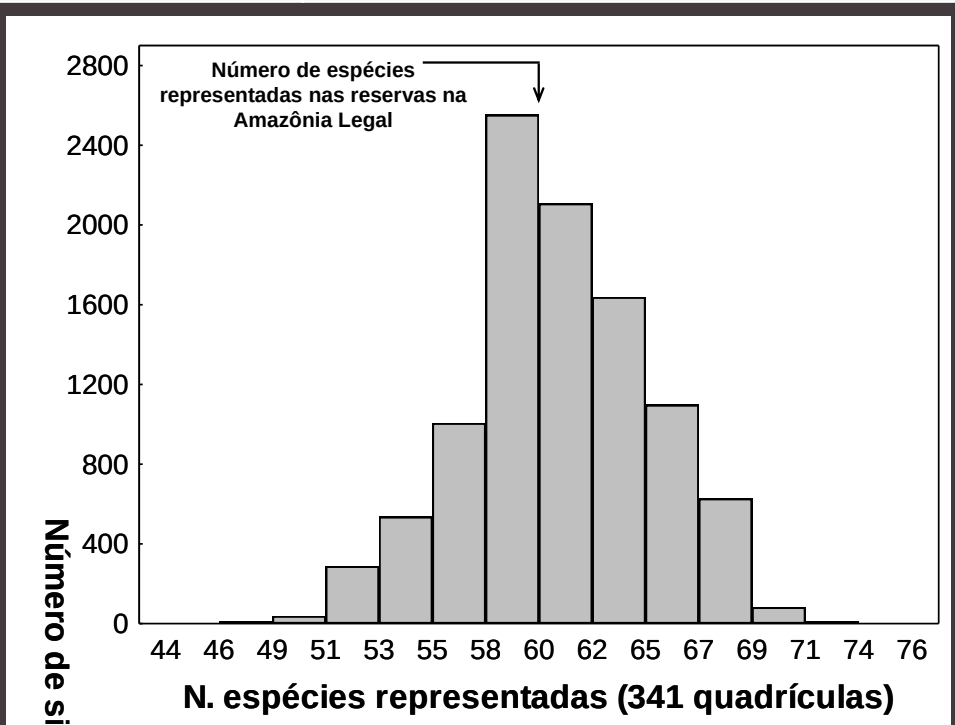
341 are PAs (fixed and green in the figure)

We need more 15.



The actual is not different of a random network (results from 10,000 random networks).

Abordagem	Nº quadrículas	+ de 60 espécies representadas em	*P*
B	364	6.518	0,6518
C	350	5.967	0,5967
D	341	5.566	0,5566



What is the next steps?

Landscape Ecology and Island Biogeography must be blended, and functional connectivity should be add in analysis of reserve selection.