ONE, Antananarivo – March, 5rd 2014

Biodiversity scenarios under the effect of climate change and future deforestation in Madagascar

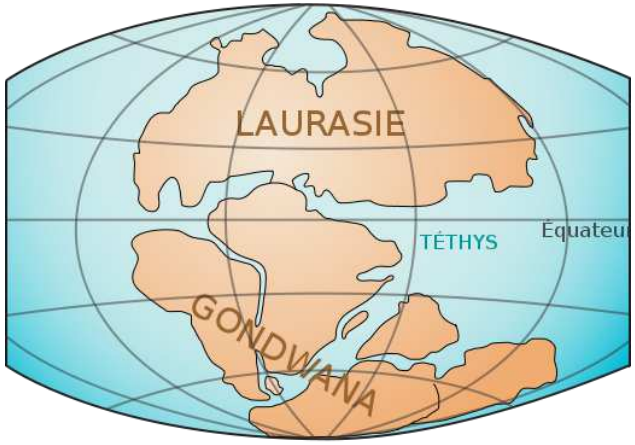
Ghislain Vieilledent Tom Allnutt Clovis Grinand
Miguel Pedrono Jean-Roger Rakotoarijaona Dimby Razafimpahanana

1. Introduction
   - Madagascar biodiversity
   - Threats to biodiversity
   - Objectives
2. Tasks
   - Biodiversity map
   - Biodiversity under climate change
   - Deforestation models
3. Project partners
4. Deliverables

1. Introduction
   - Madagascar biodiversity
   - Threats to biodiversity
   - Objectives
2. Tasks
   - Biodiversity map
   - Biodiversity under climate change
   - Deforestation models
3. Project partners
4. Deliverables

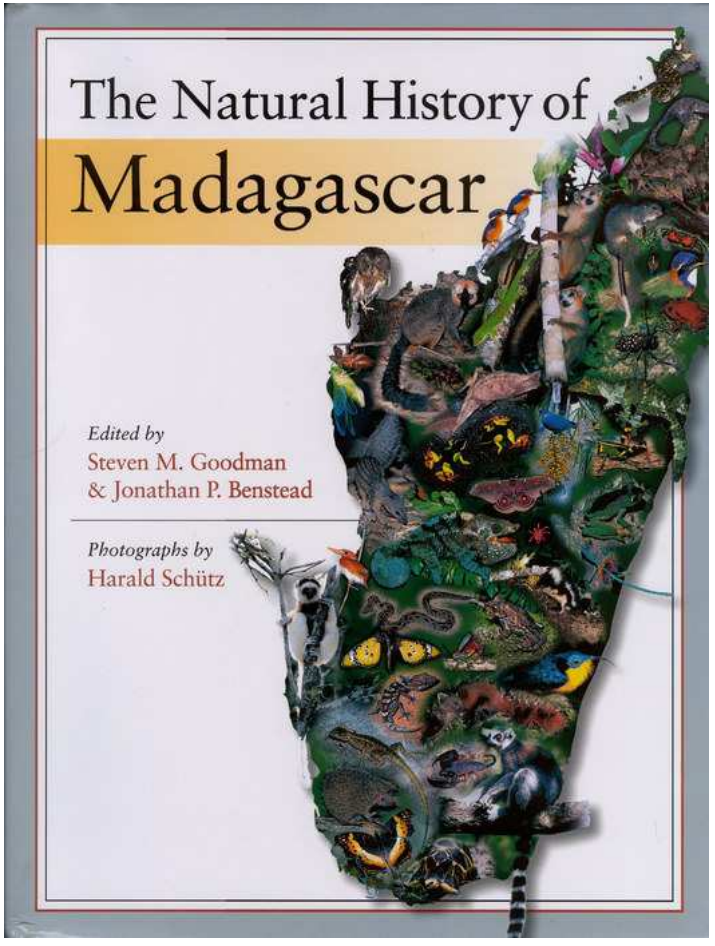
1. Introduction
   - Madagascar biodiversity
   - Threats to biodiversity
   - Objectives
2. Tasks
   - Biodiversity map
   - Biodiversity under climate change
   - Deforestation models
3. Project partners
4. Deliverables

An unparralleled biodiversity



TRIAS
Il y a 200 millions d'années

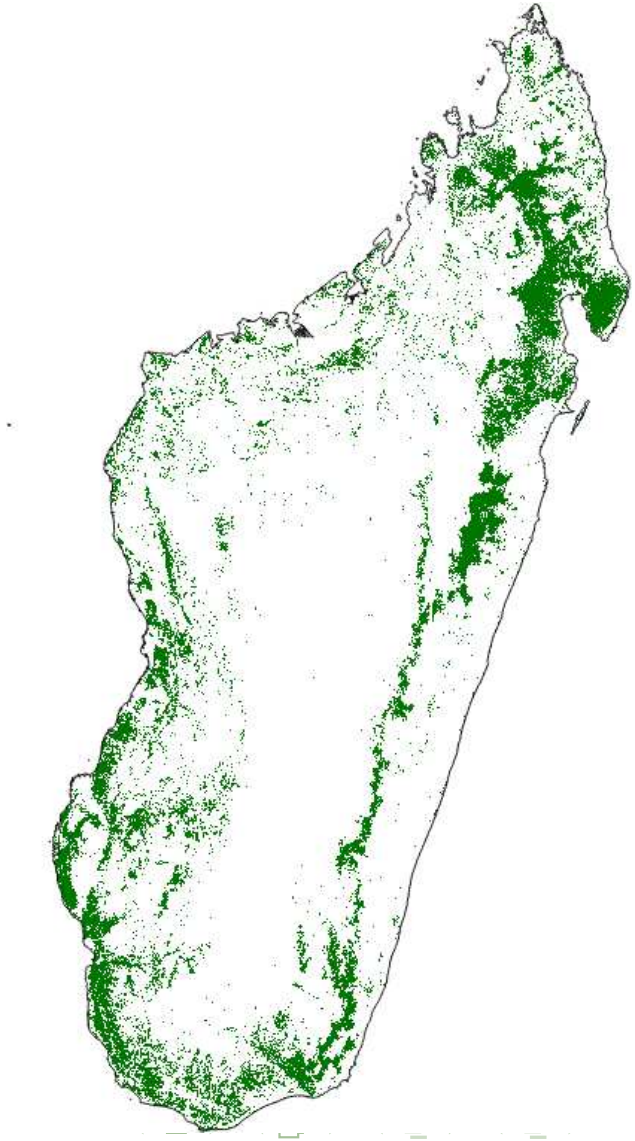
- Madagascar: top 3 of the countries with mega-diversity
- Vascular plants: 12000 species, endemism=85%
- Trees: endemism=96%
- Invertebrates: 5800 species, endemism=86%



Concentrated in forests

Tropical forests

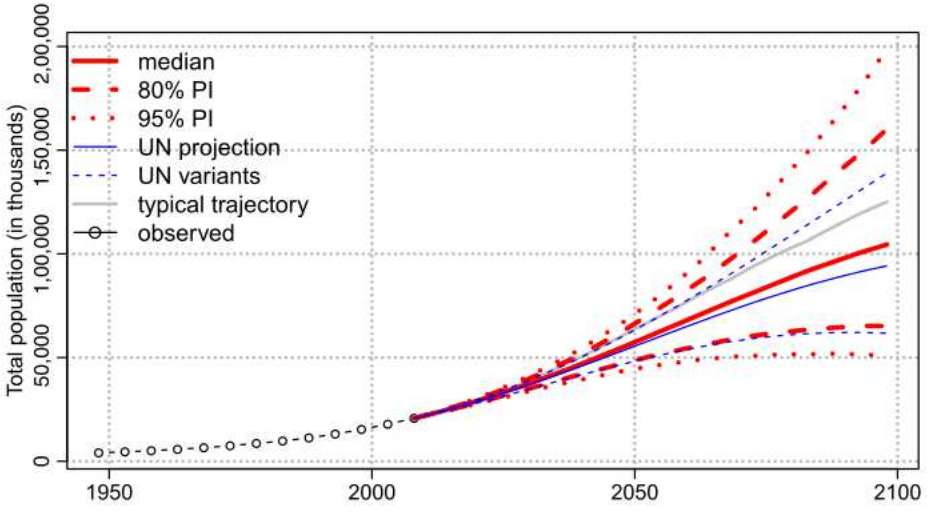
>50% of the terrestrial species

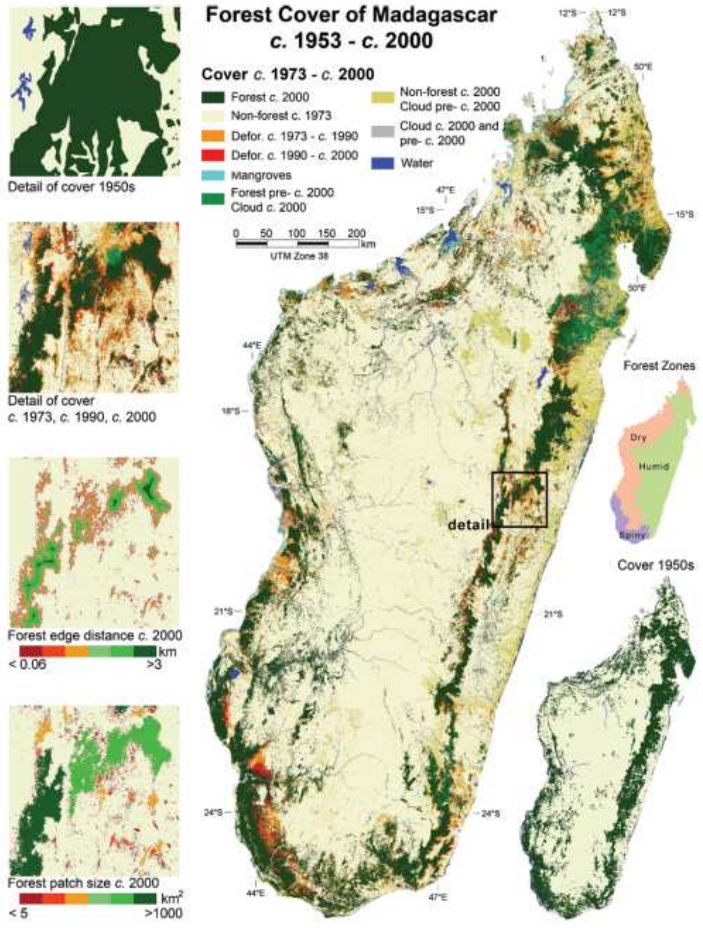


1. Introduction
   - Madagascar biodiversity
   - Threats to biodiversity
   - Objectives
2. Tasks
   - Biodiversity map
   - Biodiversity under climate change
   - Deforestation models
3. Project partners
4. Deliverables

Deforestation and demography

- 10 to 15% of original forest
- Deforestation rate: $\sim 1\% \cdot yr^{-1}$
- 1950–2000: 10% of species committed to extinction

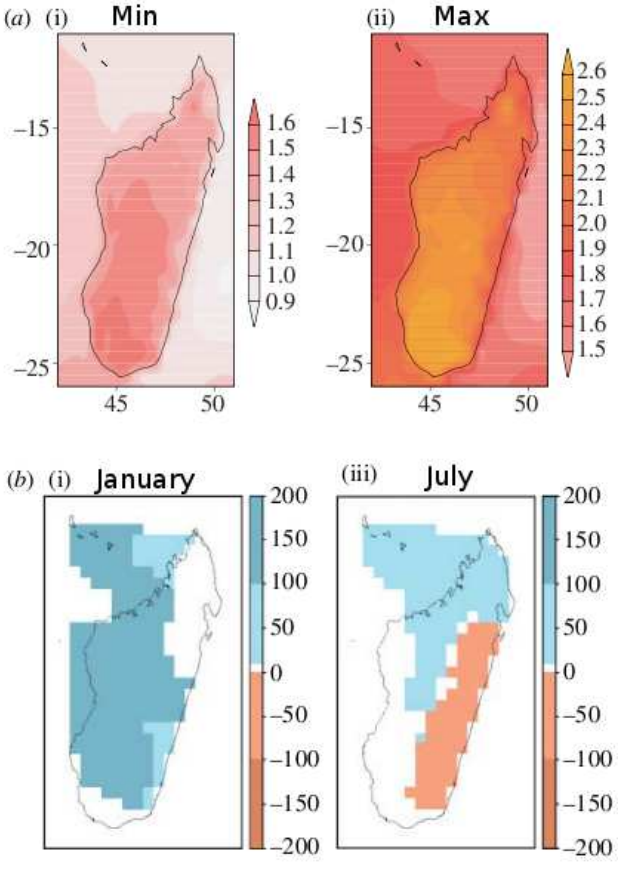




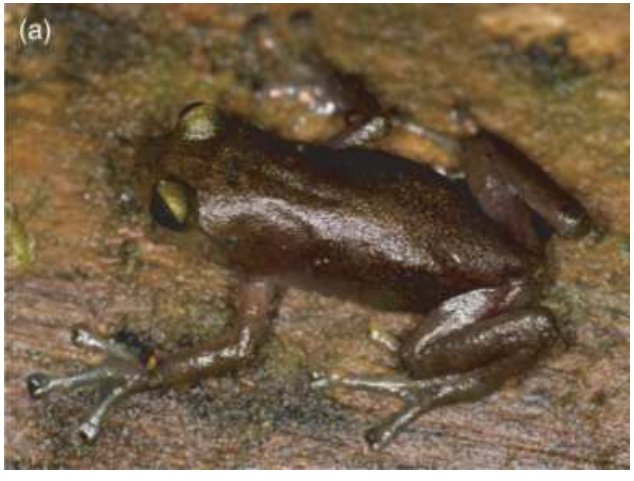
- Demographic rate: $>3\% \cdot yr^{-1}$
- Doubling-time: 25 years

Predicted climate change

- Mean temperature increase: +1.1 to +2.7°C
- Wetter summer (up to +200 mm.yr^{-1})
- Drier winter in the SE (down to -100 mm.yr^{-1}) and wetter winter elsewhere (up to +100 mm.yr^{-1})



Predicted climate change



Andriamasimanana 2013, Vieilledent 2013, Raxworthy 2008

Predicted climate change

SDM approach

Biological Conservation 166 (2013) 11–22

Contents lists available at SciVerse ScienceDirect

Biological Conservation

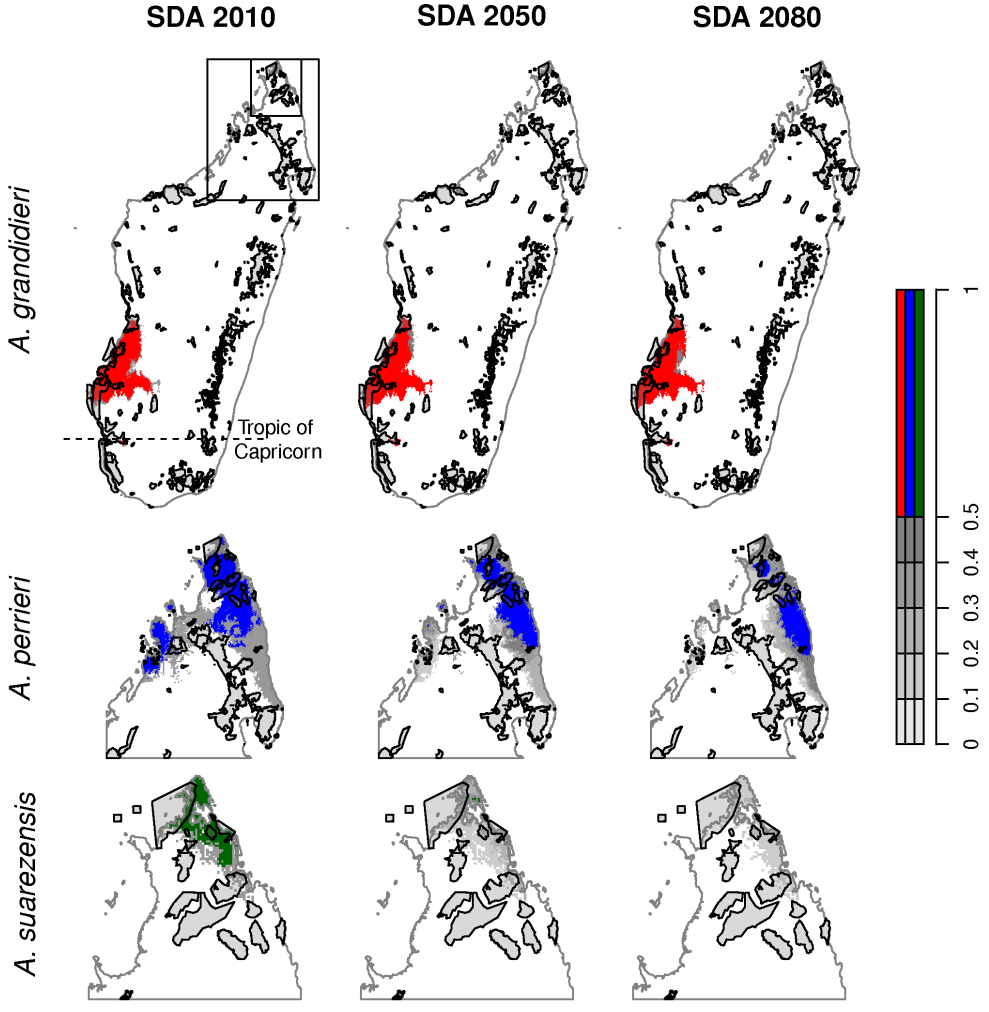
journal homepage: www.elsevier.com/locate/biocon

Vulnerability of baobab species to climate change and effectiveness of the protected area network in Madagascar: Towards new conservation priorities

Ghislain Vieilledent [a,b,*], Cyrille Cornu [b,c], Aida Cuní Sanchez [d], Jean-Michel Leong Pock-Tsy [b], Pascal Danthu [a,b]

[a] Cirad, UPR BSEF, Montpellier, France
[b] Cirad, DP Forêt et Biodiversité, Antananarivo, Madagascar
[c] Cirad, UMR TETIS, Montpellier, France
[d] University of York, York Institute of Tropical Ecosystem Dynamics, Environment Department, Heslington, YO10 5DD York, United Kingdom

Predicted climate change

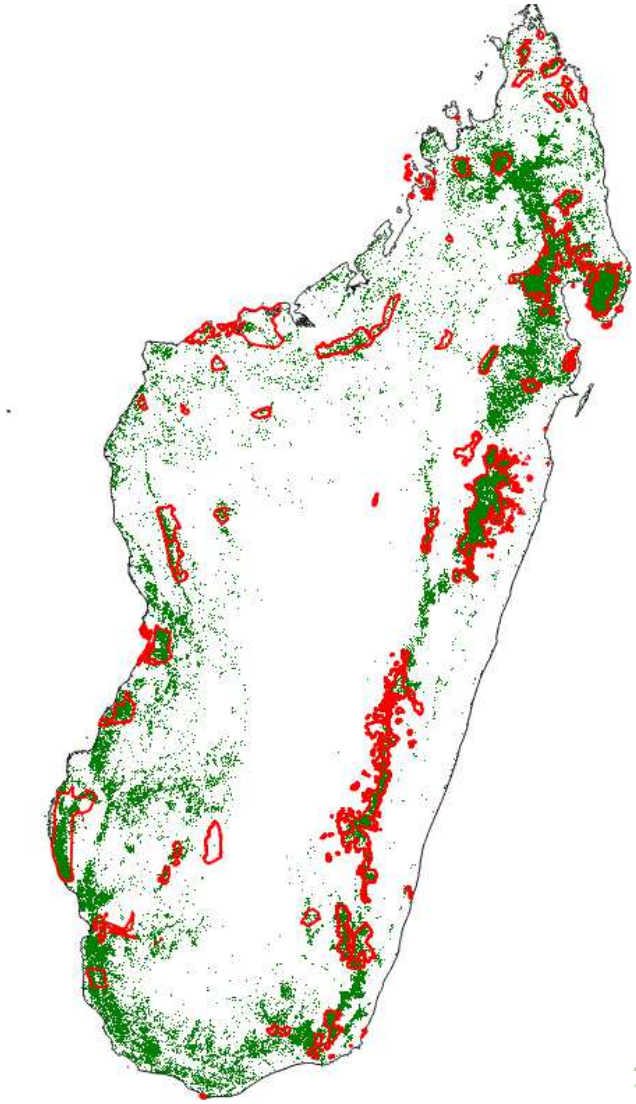


1. Introduction
   - Madagascar biodiversity
   - Threats to biodiversity
   - Objectives
2. Tasks
   - Biodiversity map
   - Biodiversity under climate change
   - Deforestation models
3. Project partners
4. Deliverables

Objectives

Biodiversity conservation

- Anticipating climate change and deforestation
- Conservation planning
  - Adapting the protected area network
  - Biodiversity safeguards for REDD+ projects



1 Introduction
- Madagascar biodiversity
- Threats to biodiversity
- Objectives

2 Tasks
- Biodiversity map
- Biodiversity under climate change
- Deforestation models

3 Project partners

4 Deliverables

1. Introduction
   - Madagascar biodiversity
   - Threats to biodiversity
   - Objectives
2. Tasks
   - Biodiversity map
   - Biodiversity under climate change
   - Deforestation models
3. Project partners
4. Deliverables

Biodiversity map

LETTER

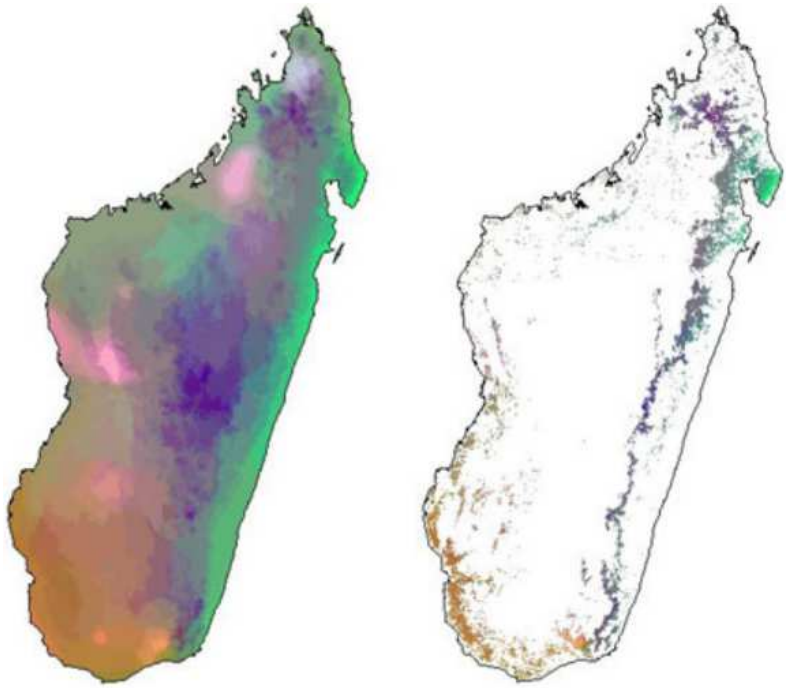
A method for quantifying biodiversity loss and its application to a 50-year record of deforestation across Madagascar

Thomas F. Allnutt[1,2], Simon Ferrier[3,4], Glenn Manion[3], George V. N. Powell[1], Taylor H. Ricketts[1], Brian L. Fisher[5], Grady J. Harper[6], Michael E. Irwin[7], Claire Kremen[2], Jean-Noël Labat[8], David C. Lees[9], Timothy A. Pearce[10], & France Rakotondrainibe[8]

Allnut et al. 2008 Conservation Letters

Biodiversity map

Bray–Curtis dissimilarity d_{ij} between pairs of locations i and j as a function of n environmental variables, x_1 to x_n



Biological dissimilarity across Madagascar prior to habitat loss (left), in 2000 (right)

Biodiversity map

Dataset	Sp. count	Pres. records	% forest dep.	Source
Ants	116	1112	98	B. Fisher
Butterflies	297	8803	70	C. Kremen, D. Lees
Ferns	474	3376	79	F. Rakotondrainibe
Ficus	24	205	NA	Missouri Botanical Garden
Land Snails	588	1616	84	T. Pearce
Legumes	373	6449	NA	J-N. Labat, D. DuPuy
Palms	159	738	98	H. Beentje, J. Dransfield
Plants	165	2627	100	G. Schatz
Solanaceae	28	80	NA	Missouri Botanical Garden
Therevid flies	19	110	84	G. Kampmeier, M. Irwin
Total	**2243**		**88**	

Biodiversity data

Additional data

Group	Source	Type
Trees	AT REDD-ONE Madagascar	Mada
Various	Vahatra	Mada
Lemurs	ONE	Mada
Various	REBIOMA	Mada / Open data
Birds	eBird	Open data
Various	GBIF	Open data
Ants	AntWeb	Open data
Trees	Tropicos	Open data

Field data

Id	Inv	N
1	CAZ/COFAV (CI)	117
2	FORECA Ivohibe (ESSA)	378
3	FORECA Tapia (ESSA)	385
4	Honky (BlueVenture)	79
5	IEFN-0 (DGF)	795
6	JariAla (DGF/USAID)	519
7	Kirindy (ONE/DGF)	15
8	Makira (WCS)	131
9	PHCF (WWF/GoodPlanet)	92
10	PK32 (WWF/Cirad)	14
	TOTAL	2525

1 Introduction
- Madagascar biodiversity
- Threats to biodiversity
- Objectives

2 Tasks
- Biodiversity map
- Biodiversity under climate change
- Deforestation models

3 Project partners

4 Deliverables

Biodiversity under climate change

GDM approach

Diversity and Distributions, (Diversity Distrib.) (2007) 13, 252–264

BIODIVERSITY RESEARCH

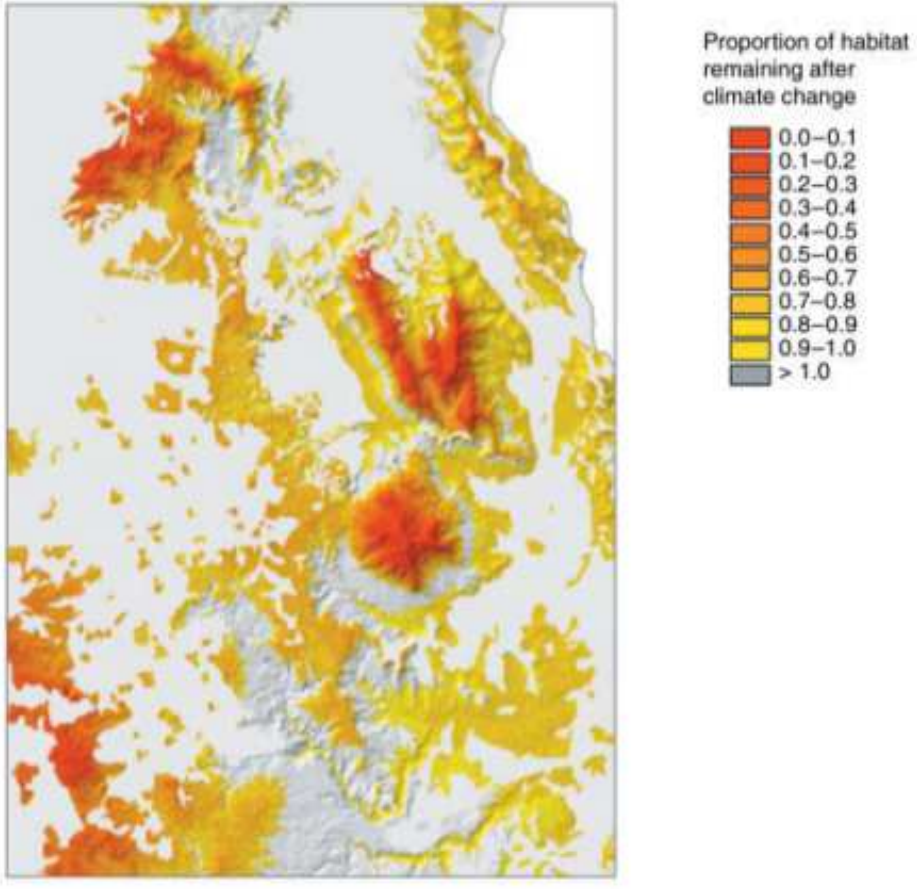
Using generalized dissimilarity modelling to analyse and predict patterns of beta diversity in regional biodiversity assessment

Simon Ferrier[1]*, Glenn Manion[1], Jane Elith[2] and Karen Richardson[3]

Ferrier et al. 2007 Diversity and Distribution

Biodiversity under climate change

GDM approach



Identifying refugea area for biodiversity under climate change

Biodiversity under climate change

SDM approach

Biological Conservation 166 (2013) 11–22

Contents lists available at SciVerse ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Vulnerability of baobab species to climate change and effectiveness of the protected area network in Madagascar: Towards new conservation priorities

Ghislain Vieilledent [a,b,*], Cyrille Cornu [b,c], Aida Cuní Sanchez [d], Jean-Michel Leong Pock-Tsy [b], Pascal Danthu [a,b]

[a] Cirad, UPR BSEF, Montpellier, France
[b] Cirad, DP Forêt et Biodiversité, Antananarivo, Madagascar
[c] Cirad, UMR TETIS, Montpellier, France
[d] University of York, York Institute of Tropical Ecosystem Dynamics, Environment Department, Heslington, YO10 5DD York, United Kingdom

1 Introduction
- Madagascar biodiversity
- Threats to biodiversity
- Objectives

2 Tasks
- Biodiversity map
- Biodiversity under climate change
- Deforestation models

3 Project partners

4 Deliverables

Deforestation models

Ecology and Evolution

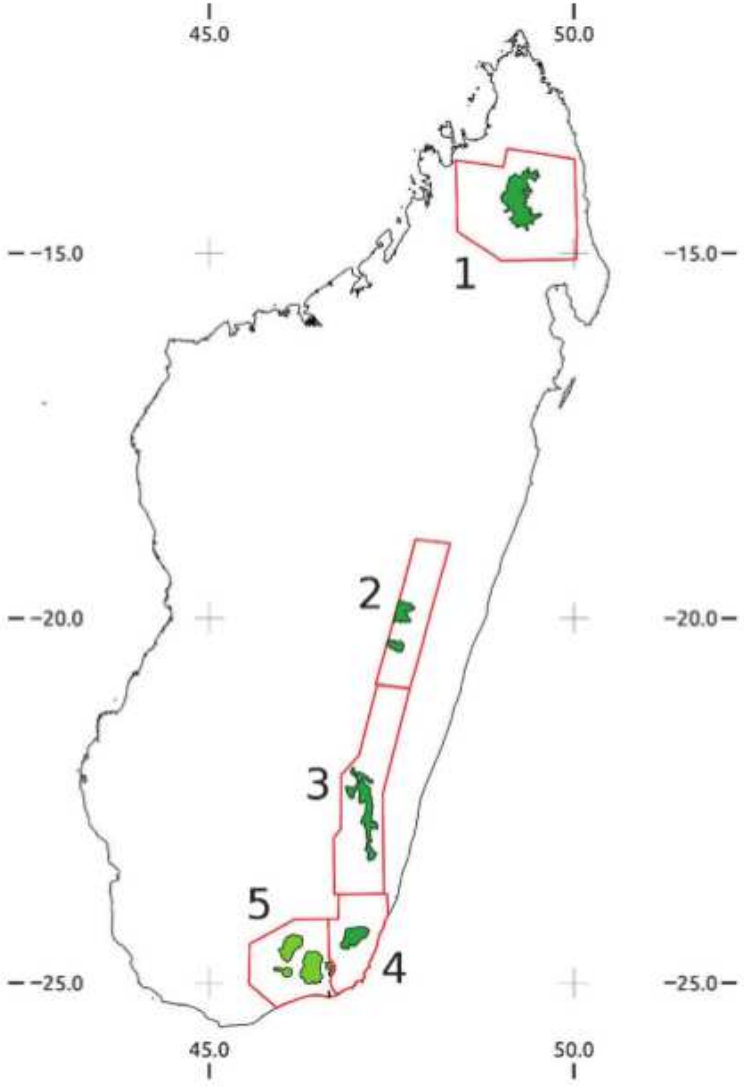
Open Access

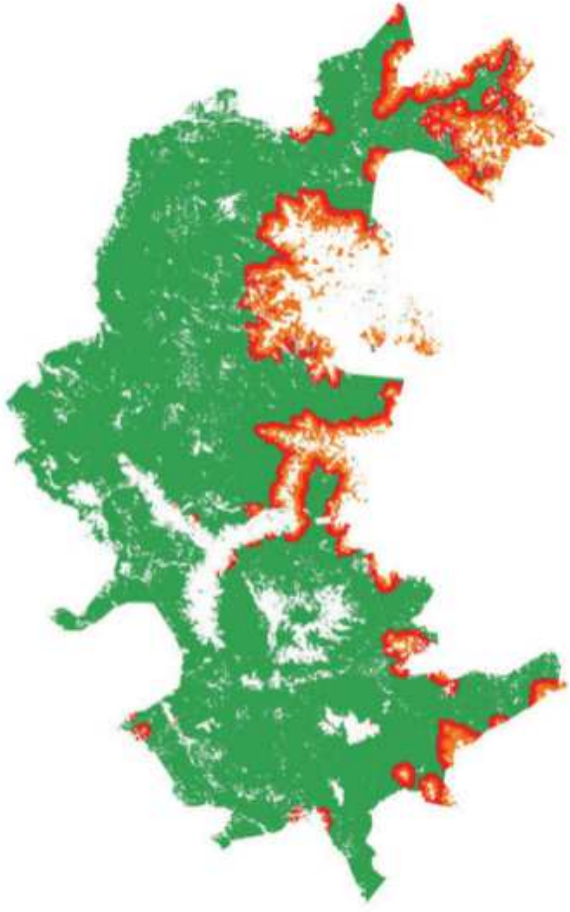
Forecasting deforestation and carbon emissions in tropical developing countries facing demographic expansion: a case study in Madagascar

Ghislain Vieilledent[1,2], Clovis Grinand[3] & Romuald Vaudry[3]

[1]Cirad – UPR BSEF, F34398 Montpellier, Cedex 5, France
[2]Cirad-Madagascar – DP Forêt et Biodiversité, BP 853, Ambatobe, 101-Antananarivo, Madagascar
[3]GoodPlanet – Fondation GoodPlanet, Domaine de Longchamp, 1 carrefour de Longchamp F-75116 Paris, France

Deforestation models





Deforestation models

Difficulty

- One model for Madagascar
- Taking into account the regional specificity

Biological Conservation 164 (2013) 62–72

Contents lists available at SciVerse ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Deforestation in an African biodiversity hotspot: Extent, variation and the effectiveness of protected areas

Jonathan M.H. Green [a,b,*], Cecilia Larrosa [c,d], Neil D. Burgess [d,e,f], Andrew Balmford [b], Alison Johnston [g], Boniface P. Mbilinyi [h], Philip J. Platts [i], Lauren Coad [d,j,k]

GAM + effets aléatoires spatiaux

1 Introduction
- Madagascar biodiversity
- Threats to biodiversity
- Objectives

2 Tasks
- Biodiversity map
- Biodiversity under climate change
- Deforestation models

3 Project partners

4 Deliverables

Project partners

Id	Name	Institution	Tasks
1	Ghislain Vieilledent	**Cirad** UMR BSEF	Coordination
2	Tom Allnut	**WCS**	Biodiversity map and GDM
3	Clovis Grinand	**ETC Terra**	Deforestation model
4	Miguel Pedrono	**Cirad** UMR AGIR	Conservation planning
5	Jean-Roger Rakotoarijaona	**ONE** Madagascar	Coordination with stakeholders
6	Dimby Razafimpahanana	**WCS**	Biodiversity data

1 Introduction
- Madagascar biodiversity
- Threats to biodiversity
- Objectives

2 Tasks
- Biodiversity map
- Biodiversity under climate change
- Deforestation models

3 Project partners

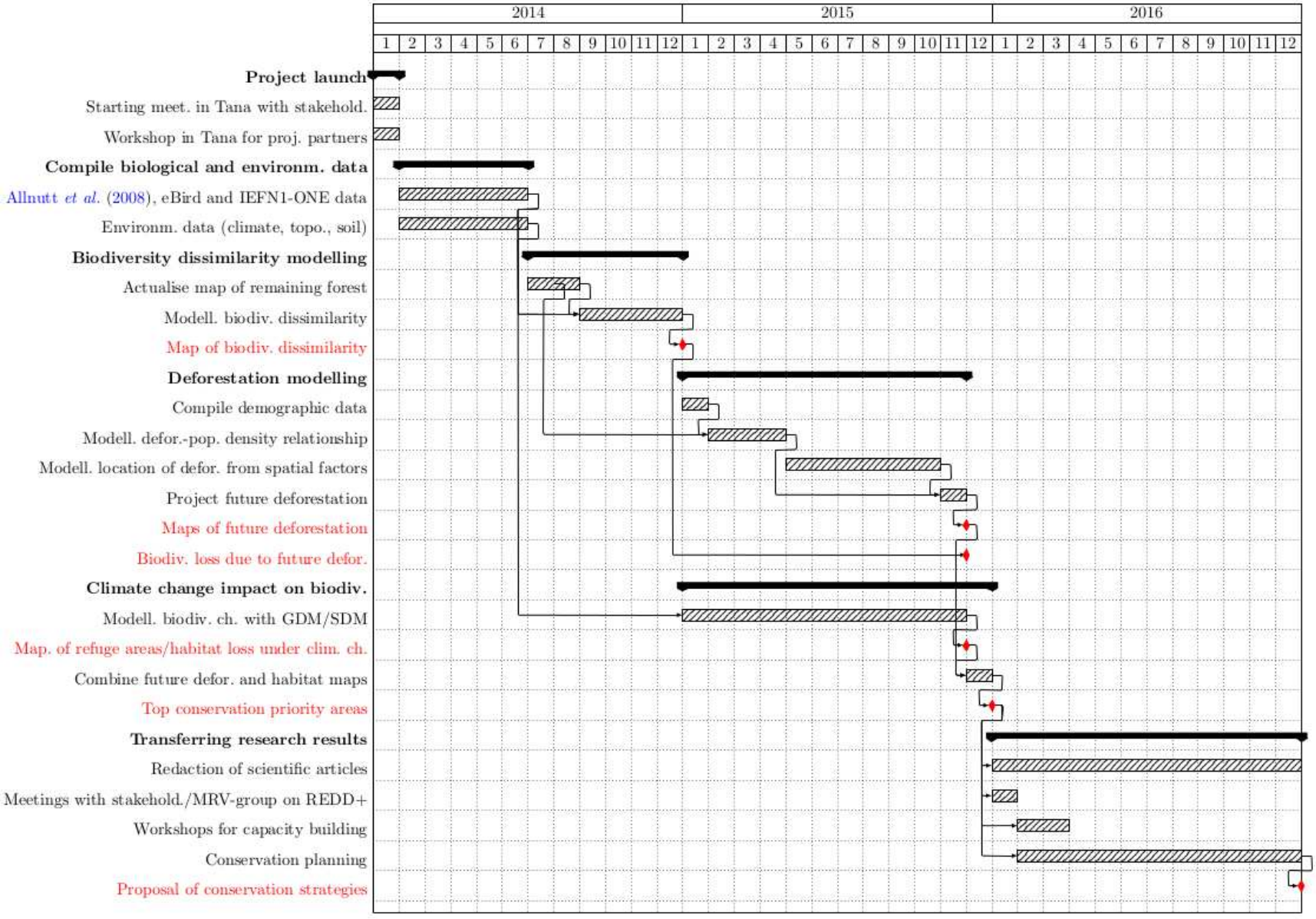
4 Deliverables

Deliverables

Id	Deliverables
1	Biodiversity map
2	Maps of future deforestation ($\sim$2050)
3	Maps of future biodiversity under climate change (refugea areas, areas with high risk of biodiversity loss)
4	Maps showing the overlap between future refugea areas for biodiversity and areas with high risk of deforestation

1. Introduction
   - Madagascar biodiversity
   - Threats to biodiversity
   - Objectives
2. Tasks
   - Biodiversity map
   - Biodiversity under climate change
   - Deforestation models
3. Project partners
4. Deliverables

Timetable


2014
2015
2016
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
Project launch
Starting meet. in Tana with stakehold.
Workshop in Tana for proj. partners
Compile biological and environm. data
Allnutt et al. (2008), eBird and IEFN1-ONE data
Environm. data (climate, topo., soil)
Biodiversity dissimilarity modelling
Actualise map of remaining forest
Modell. biodiv. dissimilarity
Map of biodiv. dissimilarity
Deforestation modelling
Compile demographic data
Modell. defor.-pop. density relationship
Modell. location of defor. from spatial factors
Project future deforestation
Maps of future deforestation
Biodiv. loss due to future defor.
Climate change impact on biodiv.
Modell. biodiv. ch. with GDM/SDM
Map. of refuge areas/habitat loss under clim. ch.
Combine future defor. and habitat maps
Top conservation priority areas
Transferring research results
Redaction of scientific articles
Meetings with stakehold./MRV-group on REDD+
Workshops for capacity building
Conservation planning
Proposal of conservation strategies

. . . Thank you for attention . . .