An overview of biodiversity conservation in Mauritius










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Outline

Introducing Mauritius: Basic facts about terrestrial biodiversity

Conservation challenges in Mauritius – laboratory of extinction ☹ ?

Conservation successes in Mauritius – laboratory of conservation ☺ ?

Selected case studies of plant conservation and ecological restoration

Remaining challenges, lessons and conclusions

Mauritius

- ~ 7.6 MY old
- Volcanic island
- ~900 km East of Madagascar
- Maximum altitude 828m
- 1865 Km^2

- Discovered by the Portuguese in early 16th Century
- Colonised: 1638 Dutch - 1722 French - 1810 British

Mauritius (Masacrenes islands)

articles

Biodiversity hotspots for conservation priorities

Norman Myers*, Russell A. Mittermeier†, Cristina G. Mittermeier†, Gustavo A. B. da Fonseca‡ & Jennifer Kent§

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§ *35 Dorchester Close, Headington, Oxford OX3 8SS, UK*

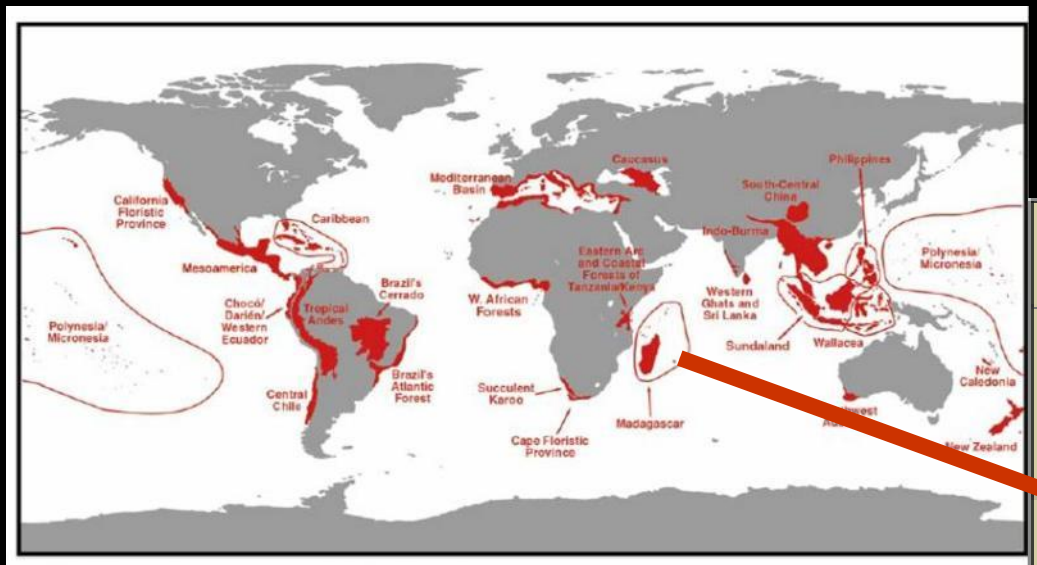


Figure 1 The 25 hotspots. The hotspot expanses comprise 30–3% of the red areas.

Mauritius Biodiversity overview

Table 6.1 Native and endemic terrestrial species diversity in selected groups in Mauritius (Mau) and Rodrigues (Rod), with respective total number of extinctions. Percentages are given in brackets

	Total Native		Total Endemic		Total Extinct		Endemic Extinct	
	Mau	Rod	Mau	Rod	Mau	Rod	Mau	Rod
Angiosperms[1]	691	150	273 (39.5%)	47 (31.3%)	61 (8.8%)	17 (11.3%)	30 (11.0%)	10 (21.3%)
Mammals[2]	5	2	1* (20.0%)	0	2 (40.0%)	1 (50.0%)	0	0
Land birds[2,3]	28	14	19 (67.9%)	13 (92.9%)	16 (57.1%)	11 (78.6%)	12 (63.2%)	11 (84.6%)
Reptiles[2**]	17	8	16 (94.1%)	8 (100.0%)	5 (29.4%)	8 (100.0%)	5 (31.3%)	8 (100.0%)
Butterflies[4]	30	10	5 (16.7%)	0	4 (13.3%)	1 (10.0%)	1 (20.0%)	0
Snails[5]	125	30	81 (64.8%)	16 (53.3%)	43 (34.4%)	7 (23.3%)	36 (44.4)%	5 (31.3%)

[1] Baider *et al*. 2010; [2] Cheke and Hume 2008, [3] Hume 2011; [4] Williams 2007; [5] Griffiths and Florens 2006;
* Goodman *et al*. 2008
** one species of gecko survives on Rodrigues but it was first recorded after 1884 and is believed to be cryptogenic

Florens 2013. In Sodhi *et al.* (eds) Conservation Biology: Voices from the tropics.

Biodiversity – Angiosperms

691 species (39.5 % endemism)






Biodiversity - Birds

42 species (33% endemism)

Biodiversity- Reptiles

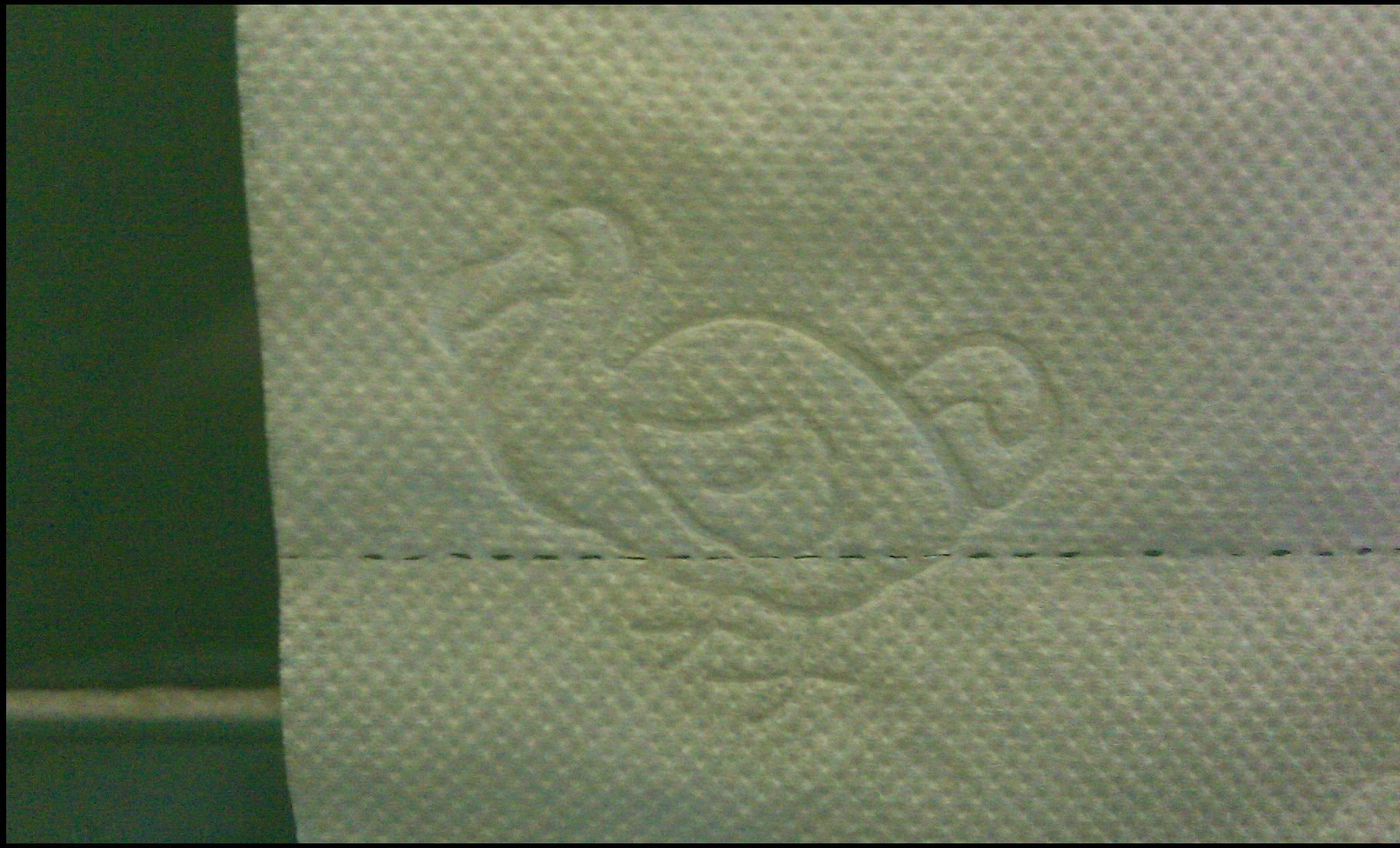
20 species (80% endemism)

Biodiversity – Ecosystems

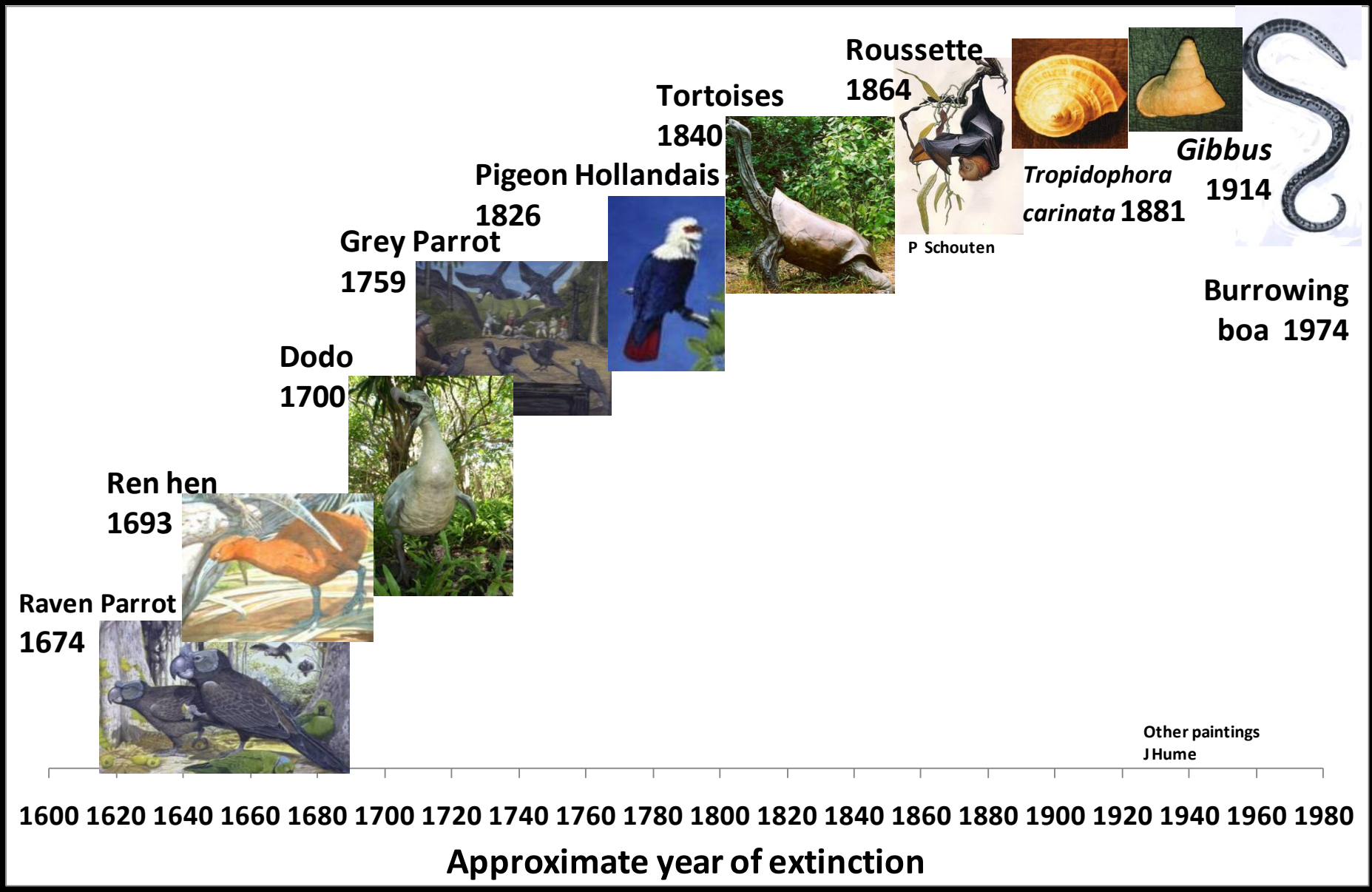
A wealth of different ecosystems from dry coastal vegetation to wet tropical and mossy forests, marshes etc

Dodo: Symbol of human-caused extinction

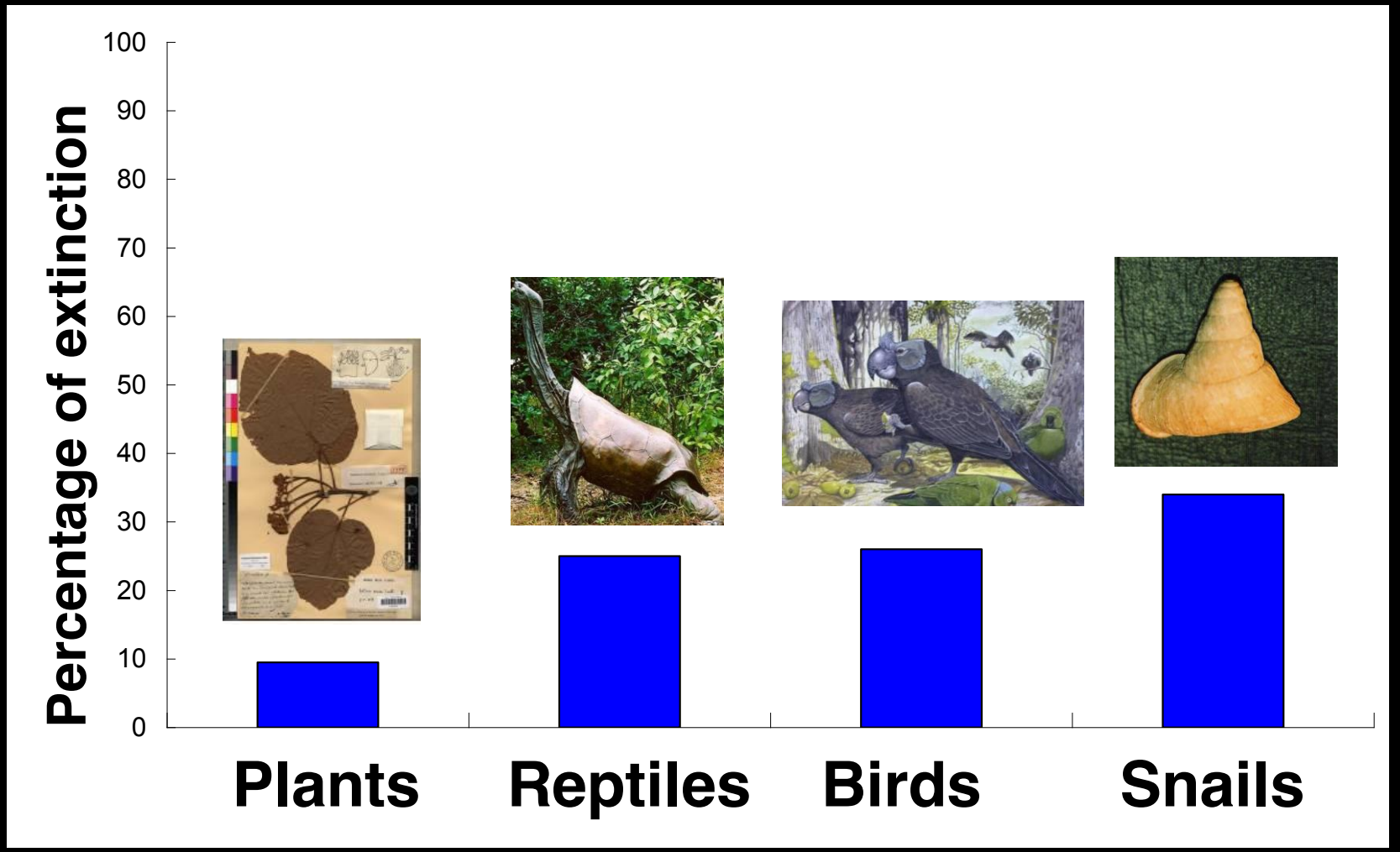
(Still close to our hearts…)



Many extinctions: lost of functions (frugivores, browsers…)



Extinctions rates

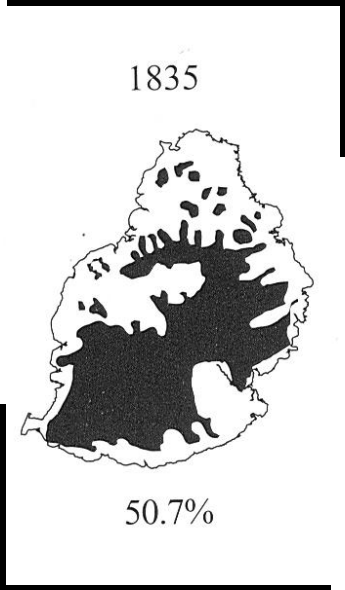


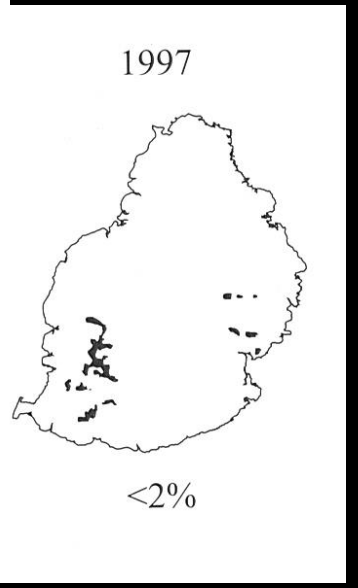
From bad to worst....

Habitat destruction (Major cause of extinctions)

Habitat fragmentation

- Minimum viable populations?
- 'Ghost of past deforestation'





Ahead of the world in terms of habitat destruction and fragmentation

Source: Vaughan and Wiehe 1937; Page and D'Argent 1997)

Predictions rather grim

Ecosystem degradation has been and is predicted to continue to be most rapid in developing or relatively low income countries (Laurance 2001 *TREE*)

Research Update TRENDS in Ecology & Evolution Vol.16 No.10 October 2001

Future shock: forecasting a grim fate for the Earth

William F. Laurance

In recent years, much attention has focused on the potential environmental effects of global climate change, but other anthropogenic impacts might be even more important. A new study by Tilman *et al.* highlights the threat posed to natural ecosystems worldwide by increasing agricultural development. Over the next 50 years, model projections suggest that rates of habitat destruction, water consumption and emission of agricultural pollutants will increase drastically. Such changes will be greatest in developing nations, which sustain a disproportionately large fraction of the Earth's biological diversity.

What sort of world will our children inherit? A recent article by Tilman *et al.*[1]

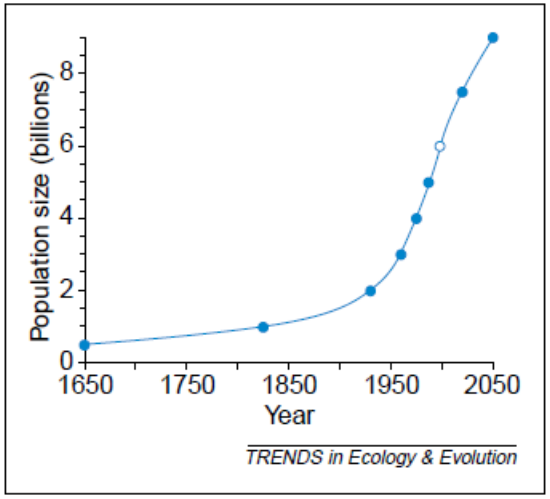


Fig. 1. Rapid growth of the human population from 1650 to 2050 (data taken from Ref. 2). The curve was fitted by a cubic spline function. The current population is indicated by the open circle.

ecosystems so rapidly that some biologists refer to the present era as the 'Homogeocene'[10]. These myriad changes are driving a mass-extinction event that could ultimately rival the most catastrophic episodes in the geological history of the Earth[11,12].

Forecasting the future

The dramatic rise in population and in affluence means that demand for food will increase sharply over the next 50 years. According to Tilman *et al.*, meeting this demand will require an effort that is comparable to the Green Revolution, during which low-yield, labor-intensive farming systems in developing countries were replaced by Western

Overexploitation: Edible palms

As early as 1638 some native species started to become rare in some areas, like the palmiste blanc in Port Louis

A ban on harvesting of “palmettos” was declared by Hugo in 1670

but not enforced…

Alien species*

Plants (23 serious invader species)

Psidium cattleianum

Lantana camara

Animals

Feral pig

Macaque….

Perspectives in Plant Ecology, Evolution and Systematics 12 (2010) 107–129

Contents lists available at ScienceDirect

Perspectives in Plant Ecology, Evolution and Systematics

journal homepage: www.elsevier.de/ppees

Review

Conservation of oceanic island floras: Present and future global challenges

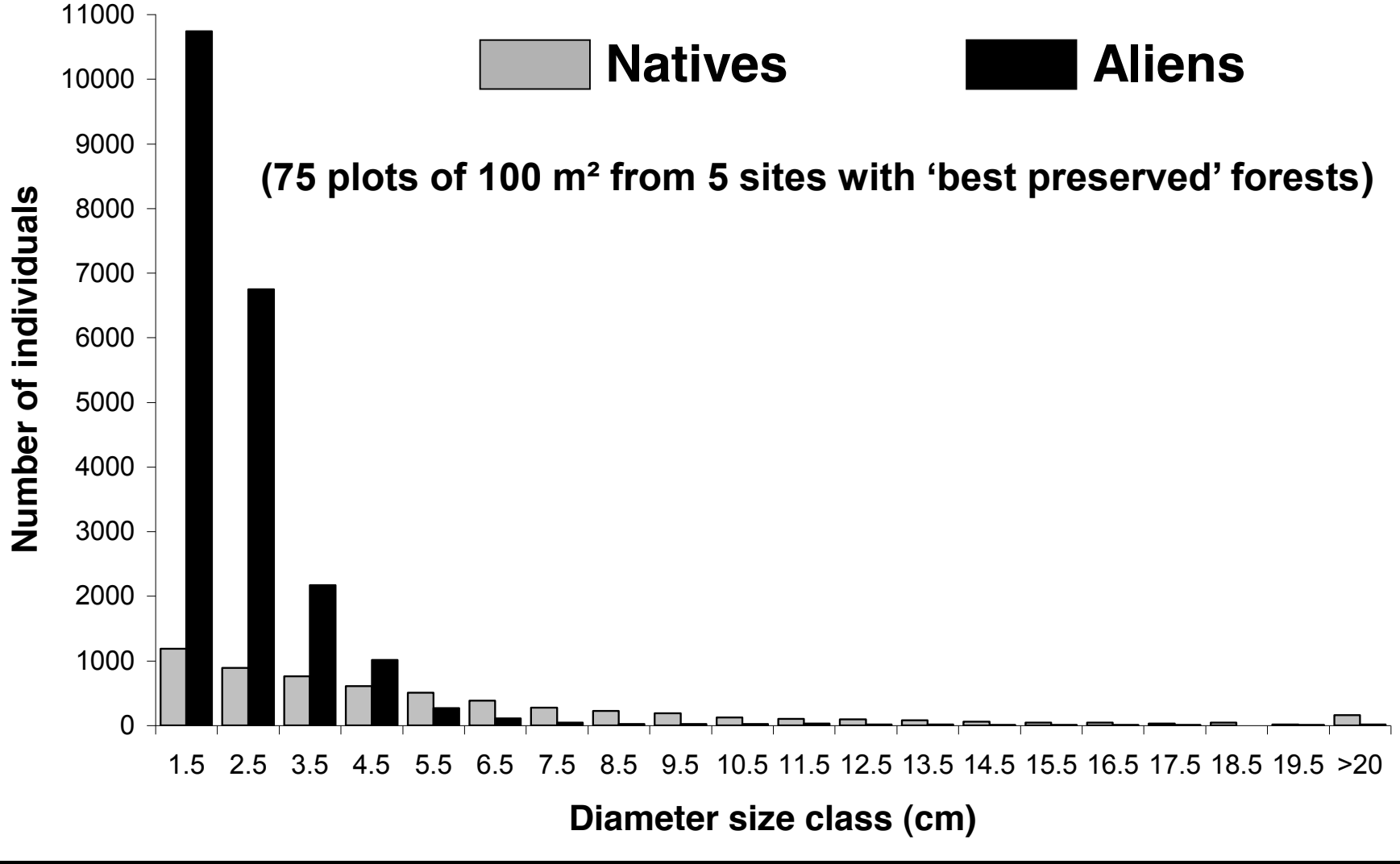
Juli Caujapé-Castells [a,*], Alan Tye [b], Daniel J. Crawford [c], Arnoldo Santos-Guerra [d], Ann Sakai [e], Katy Beaver [f], Wolfram Lobin [g], F.B. Vincent Florens [h,i], Mónica Moura [j], Roberto Jardim [k], Isildo Gómes [l], Christoph Kueffer [m]

* Worst threat on most oceanic islands (Caujape-Castells *et al* 2010 *PPEES)*

Rate of invasion by alien plants of native forests

Extreme invasion by alien plants

Understorey heavily dominated by alien plants



Alien plant invasion progress over 20 years

> 2.5 cm dbh	Sites	**Lorence & Sussman 1980's**	**This study**	
% alien plants	Brise Fer	20.8	27.5	↑
	Bel Ombre	34.8	60.7	↑
Native species richness	Brise Fer	49	42 ± 7.4	n.s.
	Bel Ombre	56	55 ± 7.7	n.s.
Native density (1000 m^2)	Brise Fer	76.2	58 ± 9.1	↓
	Bel Ombre	71.5	63 ± 11.2	↓

Acute conservation challenges…

Many species on the brink, including CWR

Pandanus pseudomontanus

Rarest screwpine in the world

Dombeya mauritiana

1 survivor in the wild

Hyophorbe amaricaulis

Rarest species worldwide

Conservation Management Areas

All invasive alien plants weeded

Fenced to exclude alien pigs (*Sus scrofa*) and Java deer (*Rusa timorensis*)

Effect of weeding on woody plants

Results: Individual and population level (*Sideroxylon grandiflorum* – Tambalacoque)

Reproductive output (*S. grandiflorum* – 'Dodo tree')

Invasion strongly reduces reproductive output

Flowering is more abundant in areas without alien plants*

($U_{122,78}$ = 3520.5; P = 0.002)

Fruting is in average 37 times higher in managed areas*

($U_{140,135}$ = 6662.5; P< 0.001)

* Baider & Florens (2006) In Laurance & Peres *Emerging threats to tropical forests*. Chicago Univ Press

Growth and mortality of *Sideroxylon grandiflorum*

Higher growth rate in managed (weeded) sites

Site	N	Mean growth rate/year (cm ± 95%CI)
Non-weeded	125	0.046 ± 0.046
Weeded	155	0.112 ± 0.042

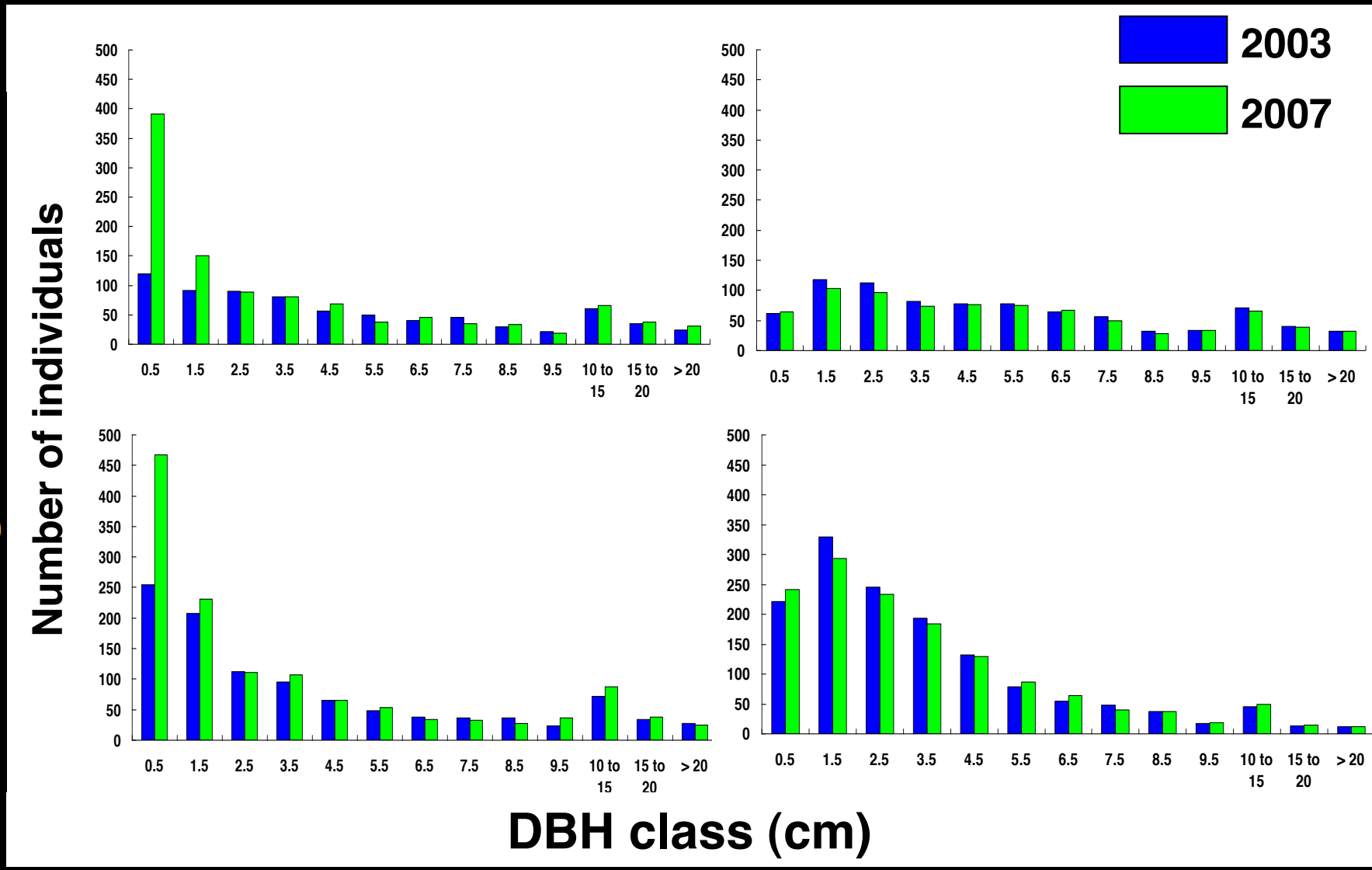
Higher mortality rate on invaded forests

Site	N	†	Mean mortality/year
Non-weeded	140	13	2.7%
Weeded	160	1	0.16%

Mean growth rate of all woody native species

	Non weeded				Weeded			
	Number	Average (dbh, mm)	-95%	95%	Number	Average (dbh, mm)	-95%	95%
Brise Fer	795	0.10	0.08	0.12	686	**0.58**	0.45	0.72
Mare Longue	1353	0.08	0.06	0.11	995	**0.44**	0.35	0.53

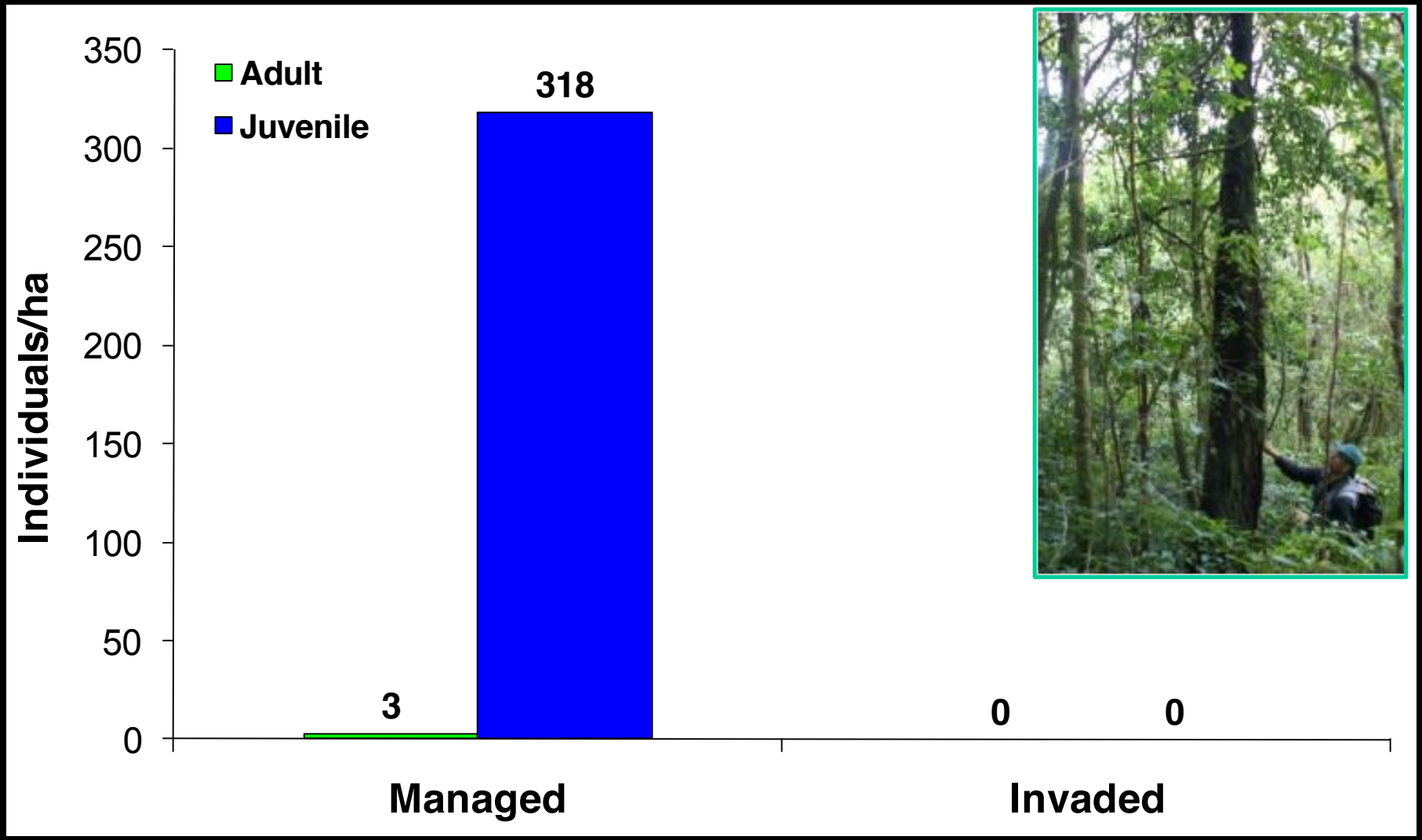
Community changes over 4 years



Invasion effect on native *Cyathea* spp. (tree ferns)

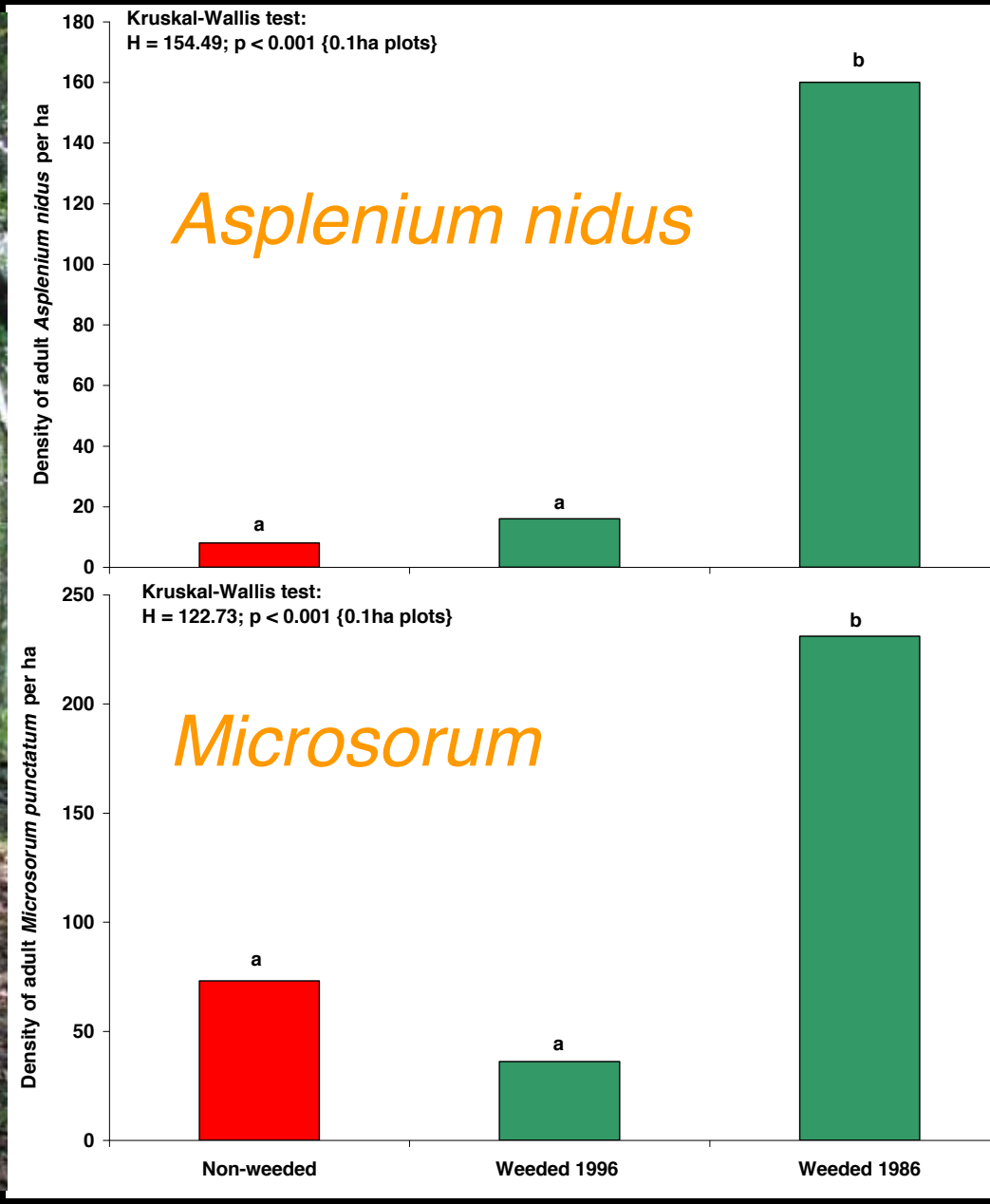
Comparison between 1 ha invaded and 1 ha weeded

(Thormann, Baider & Florens unpubl data)




Large epiphytic ferns
(Bindewald, Baider & Florens unpubl)

Population recovery within 24 years



Biol Invasions (2011) 13:2641–2646
DOI 10.1007/s10530-011-9980-3

INVASION NOTE

Control of invasive alien weeds averts imminent plant extinction

Cláudia Baider · F. B. Vincent Florens

Biodivers Conserv (2010) 19:3835–3848
DOI 10.1007/s10531-010-9930-x

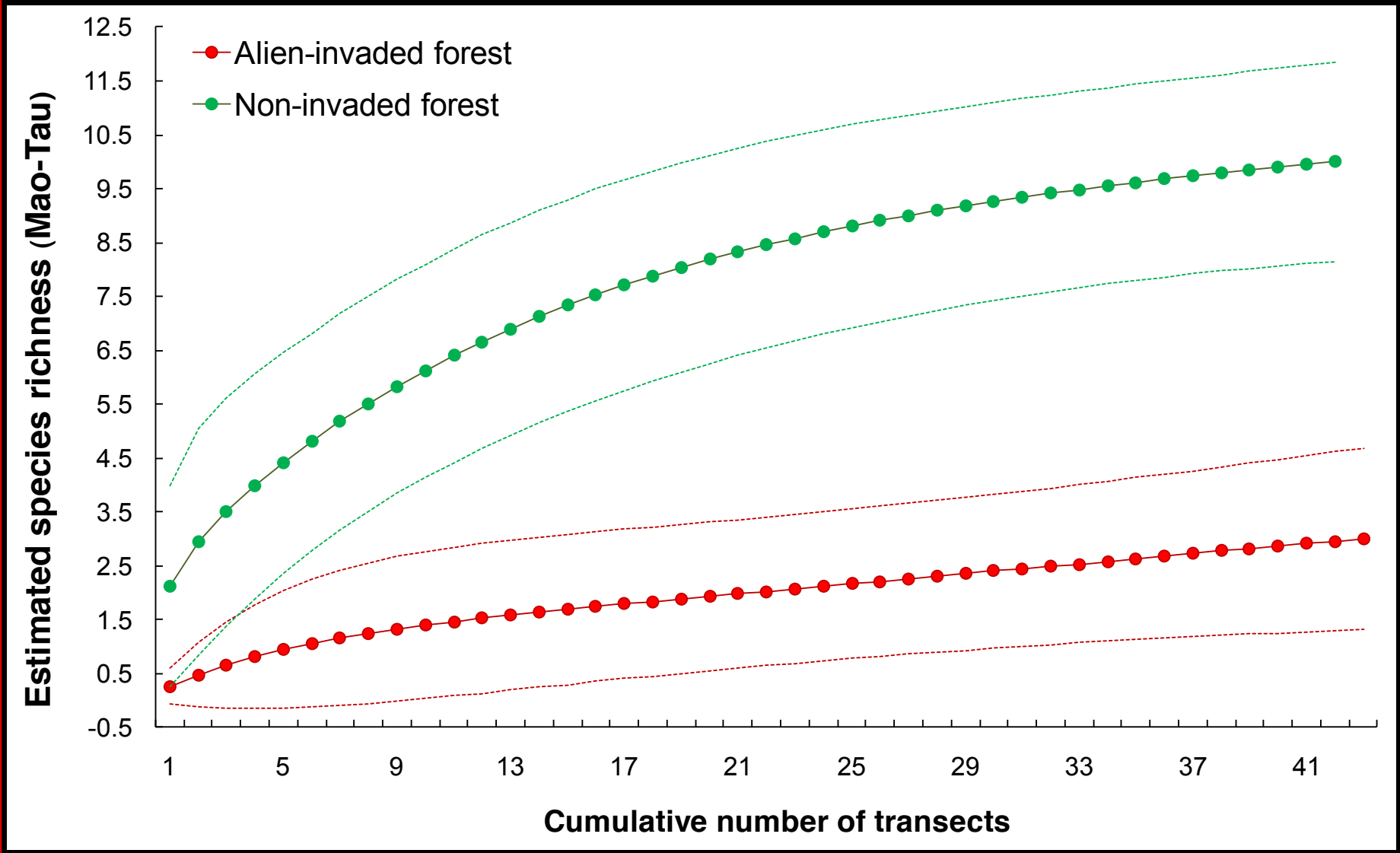
ORIGINAL PAPER

Recovery of indigenous butterfly community following control of invasive alien plants in a tropical island's wet forests

F. B. Vincent Florens · John R. Mauremootoo · Simon V. Fowler · Linton Winder · Cláudia Baider



Butterflies: Species richness



Florens et al 2010. *Biodiversity and Conservation*

Butterfly: Abundance

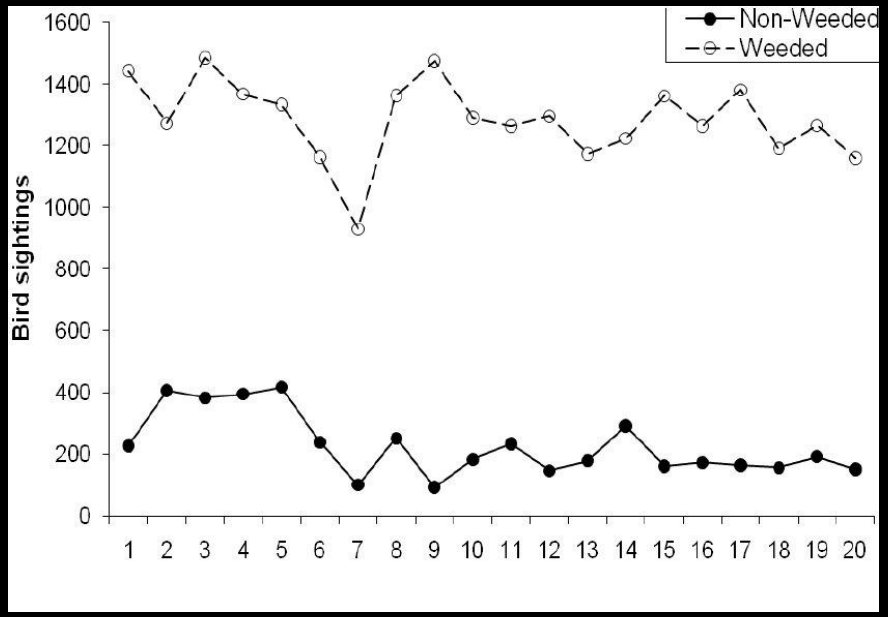
Average density of butterfly per transect

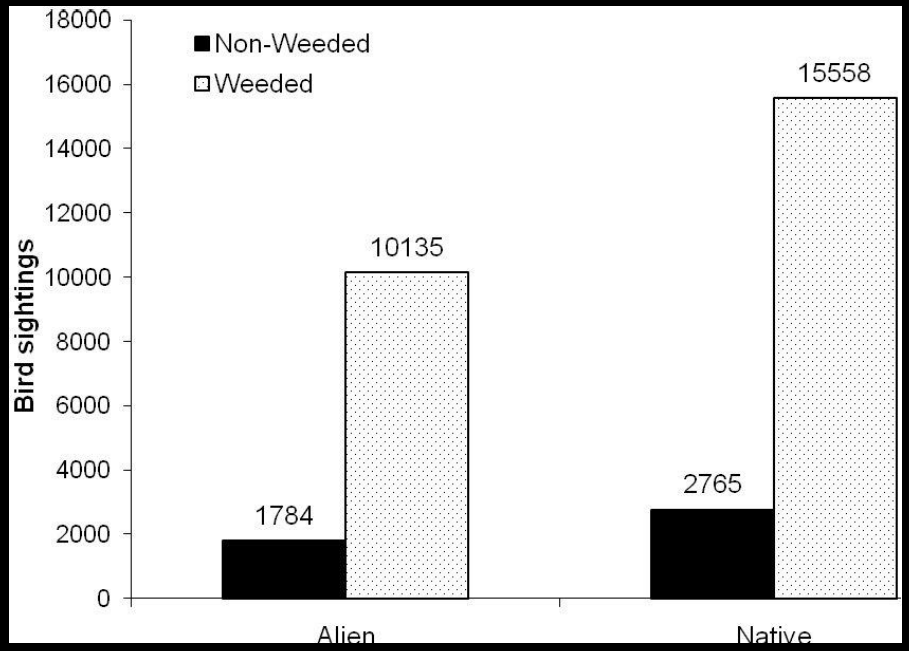
Sites	Weeded forest	Non-weeded forest
Bel Ombre (Bellouguet)	6.75	0
Bel Ombre (Fixon)	4.5	0.17
Brise Fer (‘Old Plot’)	6	0.17
Brise Fer (‘Raleigh Plot’)	2.83	0.33
Brise Fer 1 (Low canopy)	6	0.40
Brise Fer 2 (High canopy)	7.67	0.50
Macchabé	8.75	0.50
Mare Longue	5	0.40
Total	5.94	0.31

Florens et al 2010. *Biodiversity and Conservation*

Abundance of birds

Method: Fixed radius point counts, with a radius of 20 m (Hostetler & Main, 2008)





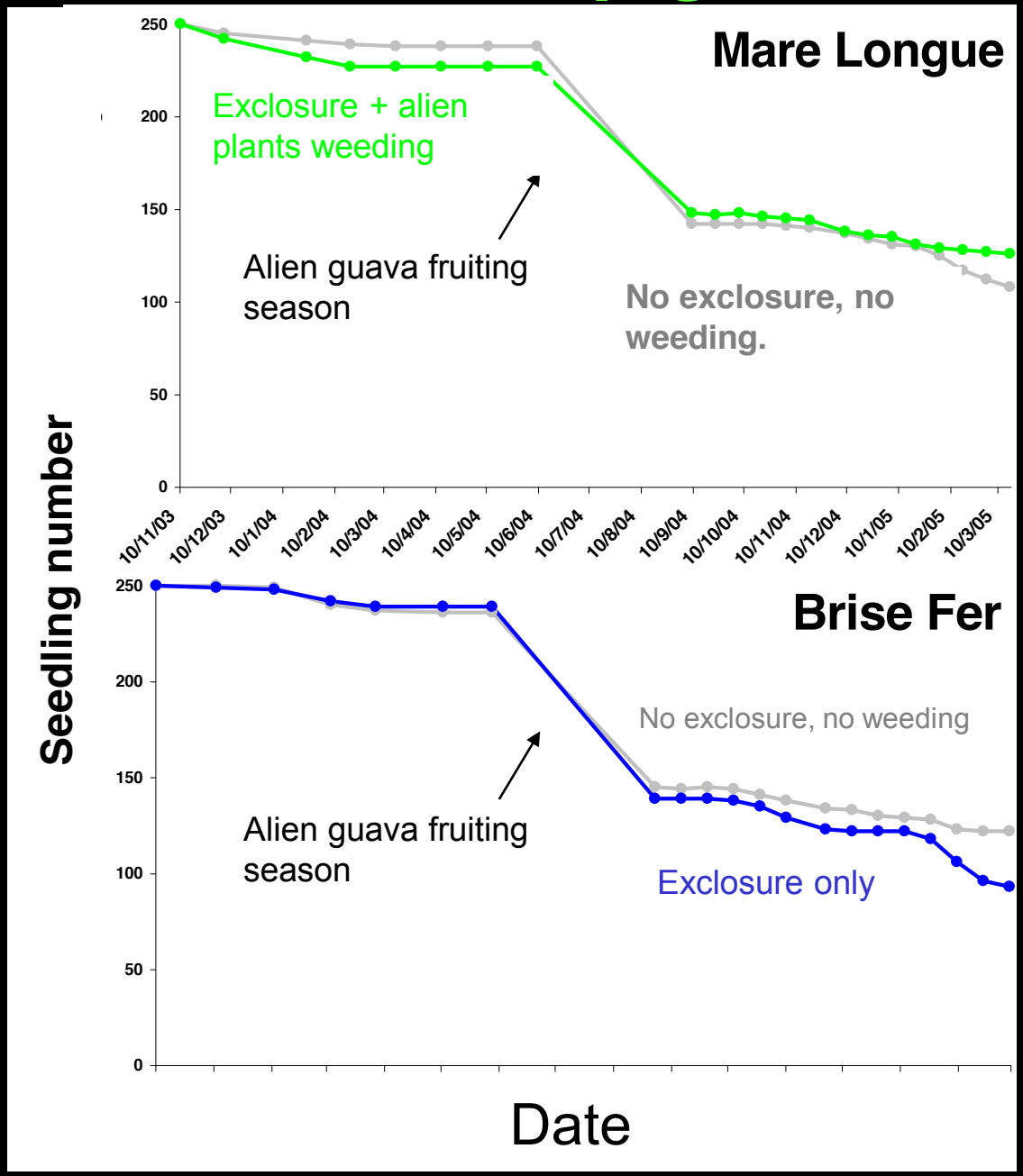
Namah, Baider & Florens unpubl

Exclusion fencing as conservation measure

Fenced to exclude alien pigs (*Sus scrofa*) and Java deer (*Rusa timorensis*)

Fencing assumed to work… But did not

Influence of pig and deer exclosures



Exclosures are ineffective in controlling trampling / uprooting damage by large alien mammals

Alien rats

Rattus rattus and *R. norvegicus*

Seed predation

Canarium - Burseraceae

Mimusops - Sapotaceae

Predator control

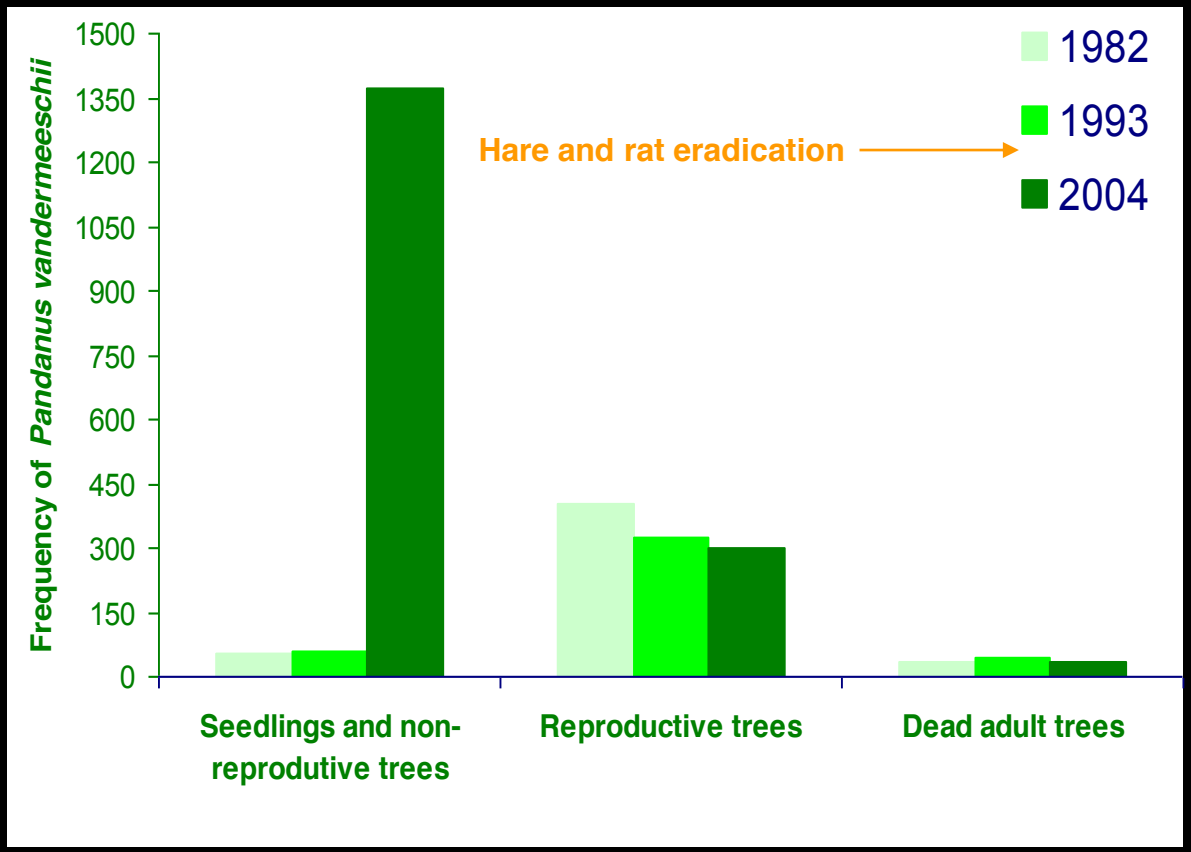
Traps (rat, mongoose, cat…)

Trap (Macaque)

Poison stations (rat)

Predator control: e.g. Hare and rat

Alien mammal eradication from an offshore islet (Gunner's Quoin): 'spectacular' recovery



Screwpine (*Pandanus vandermeeschii*)

Re-introduction/augmentation programs

Mauritius is well known for some conservation successes…

- Captive breeding
- Re-introduction
- Artificial nests (nest boxes)
- Supplementary feeding
- Predator control

Land tortoise analogue species

PERSPECTIVES

ECOLOGY

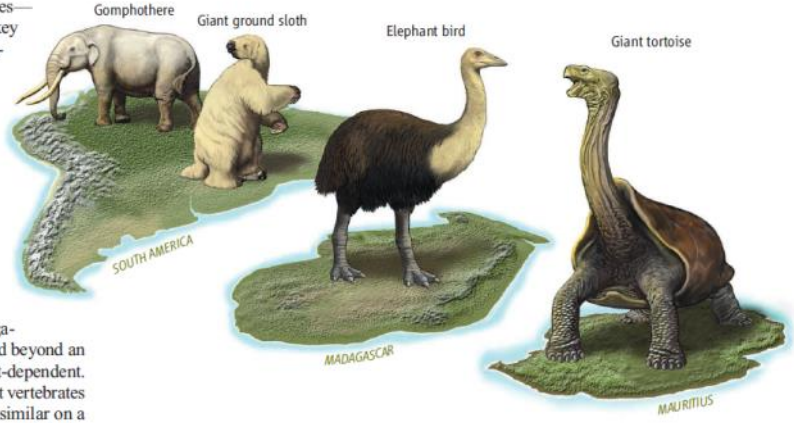
The Forgotten Megafauna

An expanded megafauna concept elucidates how extinctions of the largest vertebrates in any ecosystem have similar effects.

Dennis M. Hansen[1] and Mauro Galetti[1,2]

Large terrestrial vertebrates—called megafauna—play key roles in ecosystem dynamics by feeding on plants and by maintaining habitat heterogeneity (*1*). A global wave of megafauna extinctions occurred 50,000 to 10,000 years ago, when many large continental mammals were lost (*2*–*5*). Classical definitions of megafauna are based on such continental mammals and are variously given as animals larger than 44 kg (*6*) or above 1000 kg (*7*). Here, we argue that the megafauna concept should be extended beyond an absolute animal size to be context-dependent. In any given ecosystem, the largest vertebrates have ecosystem impacts that are similar on a relative scale to those of the largest vertebrates in another ecosystem: One ecosystem's mesofauna is another ecosystem's megafauna.

An ecosystem function that clearly illus-



Scaling the megafauna. The magnitude of loss of frugivorous megafauna is currently most dramatic on islands, as illustrated by the smaller drawn sizes of the giant ground sloth and the gomphothere from South America, compared with the elephant bird in Madagascar and the giant tortoise of Mauritius. However, many continental regions are poised to catch up.

OPEN ACCESS Freely available online

PLoS one

Seed Dispersal and Establishment of Endangered Plants on Oceanic Islands: The Janzen-Connell Model, and the Use of Ecological Analogues

2008

Dennis M. Hansen[¤a*], Christopher N. Kaiser[¤b], Christine B. Müller[†]

Institute of Environmental Sciences, University of Zurich, Zurich, Switzerland

Journal of Biogeography, 29, 721–734

Trees, birds and bees in Mauritius: exploitative competition between introduced honey bees and endemic nectarivorous birds?

Dennis M. Hansen[1]*, Jens M. Olesen[1] and Carl G. Jones[2] [1]*Department of Ecology and Genetics, Institute of Biology, University of Aarhus, Aarhus, Denmark, and* [2]*Mauritian Wildlife Foundation, Black River, Mauritius*

2002

biology letters

Biol. Lett.
doi:10.1098/rsbl.2006.0458
Published online

Mauritian coloured nectar no longer a mystery: a visual signal for lizard pollinators

Dennis M. Hansen*, Karin Beer and Christine B. Müller

Institute of Environmental Sciences, University of Zurich, Winterthurerstrasse 190, 8057 Zurich, Switzerland
**Author for correspondence (dhansen@uwinst.unizh.ch).*

Vol. 6/3, pp. 187–203

http://www.urbanfischer.de/journals/ppees

Perspectiv
in Plant Ec
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Systemati

Herbivore-deterring secondary compounds in heterophyllous woody species of the Mascarene Islands

Ina Hansen[1,*], Leon Brimer[2] & Per Mølgaard[3]

[1] Department of Ecology, The Royal Veterinary and Agricultural University, Rolighedsvej 21, 1958 Frederiksberg C., Denma
[2] Department of Pharmacology and Pathobiology, The Royal Veterinary and Agricultural University, Ridebanevej 9, 1870 Frederiksberg C., Denmark
[3] Department of Medicinal Chemistry, The Danish University of Pharmaceutical Sciences, Universitetsparken 2, 2100 Copenhagen, Denmark

VOL. 169, NO. 4 THE AMERICAN NATURALIST APRIL 2007

Biol Invasions
DOI 10.1007/s10530-010-9703-1

2010

ORIGINAL PAPER

Contrasting effects of an invasive ant on a native and an invasive plant

Lori Lach · Chadwick V. Tillberg · Andrew V. Suarez

Natural History Miscellany

Positive Indirect Interactions between Neighboring Plant Species via a Lizard Pollinator

Dennis M. Hansen,[1,*] Heine C. Kiesbüy,[1,†] Carl G. Jones,[2,‡] and Christine B. Müller[1,§]

ECOTROPICA 11: 69–72, 2005

POLLINATION OF THE ENIGMATIC MAURITIAN ENDEMIC *ROUSSEA SIMPLEX* (ROUSSEACEAE): BIRDS OR GECKOS?

Dennis M. Hansen

Dept. of Ecology and Genetics, University of Aarhus, Ny Munkegade, Building 540, 8000 Aarhus C, Denmark

Restoration sites

Most of the restoration activities and research are however carried out on offshore islets

Native habitats on mainland Mauritius harbor more endemic and threatened species (1-2 orders of magnitude more compared to the islets), deserving far greater conservation attention

Initial alien weed control (Mainly *Psidium cattleianum*)

Herbicide use:

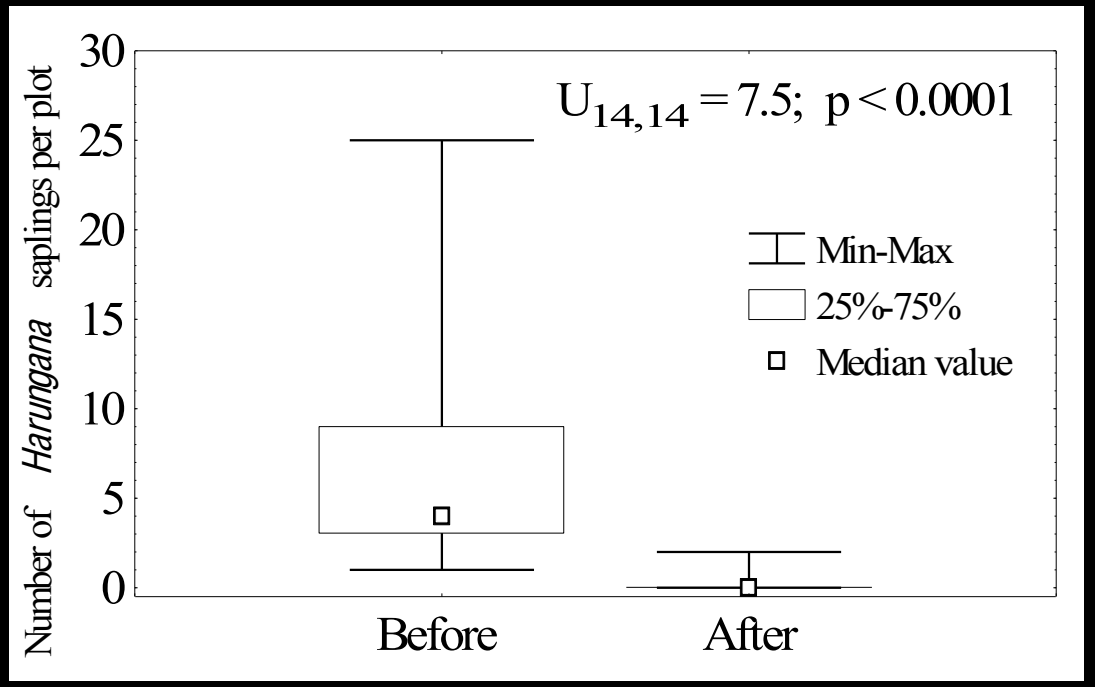
Cheaper

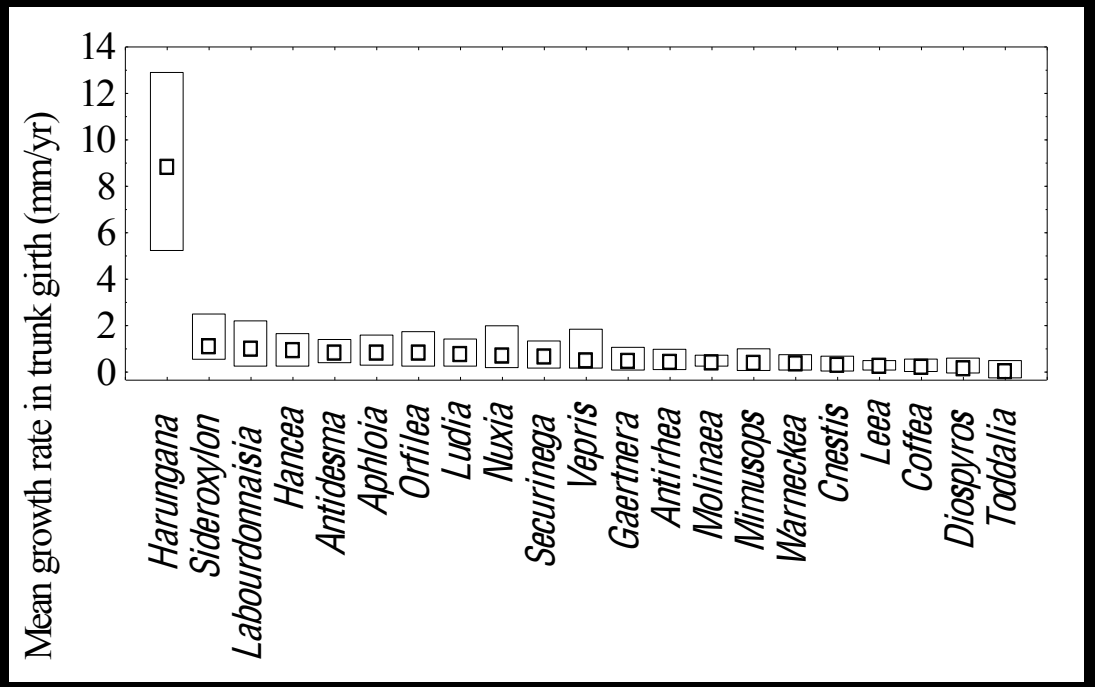
Less collateral damage

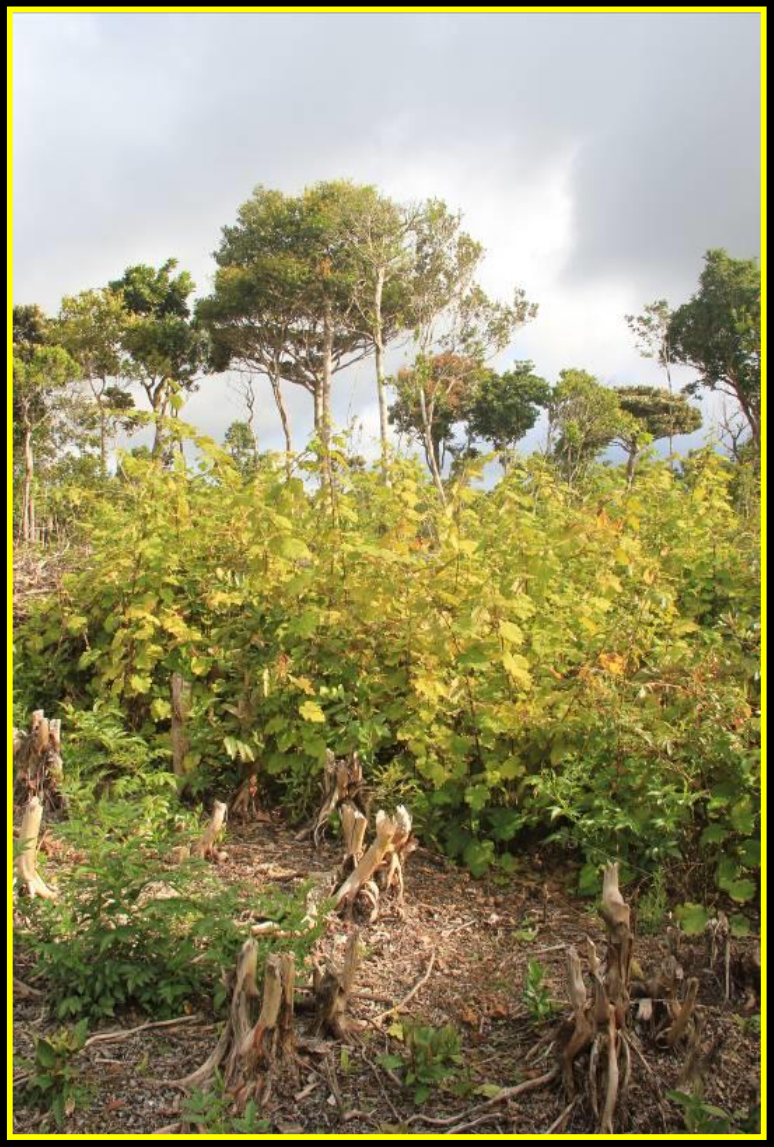
Quickly adopted by private sector

Regular maintenance weeding to control re-infestation

Harungana madagascariensis (Hypericicaceae)


$U_{14,14} = 7.5;\ p < 0.0001$
Number of *Harungana* saplings per plot
30
25
20
15
10
5
0
Min-Max
25%-75%
Median value
Before
After


Mean growth rate in trunk girth (mm/yr)
14
12
10
8
6
4
2
0
Harungana
Sideroxylon
Labourdonnaisia
Hancea
Antidesma
Aphloia
Orfilea
Ludia
Nuxia
Securinega
Vepris
Gaertnera
Antirhea
Molinaea
Mimusops
Warneckea
Cnestis
Leea
Coffea
Diospyros
Toddalia



Recent policies

Government policy:
restrictions of ecological research to `office hours` (08.00-16.00)…

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National parks: Mauritius is putting conservation at risk

F. B. Vincent Florens

Nature **481**, 29 (05 January 2012) | doi:10.1038/481029b
Published online 04 January 2012

A government policy for the national parks of Mauritius is threatening important research into conservation and undermining the ownership and sustainability of conservation projects. Appeals to modify this policy have remained unanswered.

Mauritius is known for its conservation successes — including that for the Mauritian kestrel, *Falco punctatus* — thanks to the development of innovative techniques. Its national parks provide ideal terrain for conservation

Microsoft PowerPoint - [Florens & Baider ATBC 2012.ppt [Compatibility Mode]]

Plan to cull Endangered species

Department of Neurobiology, Duke University Medical Center, Durham, NC 27710, USA.

*To whom correspondence should be addressed. E-mail: platt@neuro.duke.edu

References

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2. S. Heim *et al.*, *Acta Neurobiol. Exp.* **68**, 73 (2008).
3. T. Hadzibeganović *et al.*, *Cortex* **46**, 1312 (2010).
4. C. Enns, L. D. Lafond, *Am. Ann. Deaf* **152**, 63 (2007).
5. V. J. Samar, I. Parasnis, G. P. Berent, *Brain Lang.* **80**, 21 (2002).
6. C. Musselman, *J. Deaf Stud. Deaf Educ.* **5**, 1 (2000).
7. M. Harris, C. Moreno, *J. Deaf Stud. Deaf Educ.* **9**, 253 (2004).

Going to Bat for an Endangered Species

THE LAST SURVIVING (*1*) OF THE THREE Mascarene-endemic fruit bat species of Mauritius (*Pteropus niger*) now faces elevated extinction risks, as the government disregards science and bows instead to the demands of industry. In response to pressure from fruit growers, the Mauritian government is working to amend the country's law that protects bats (*2*). Meanwhile, the Parent Ministry of the National Parks and Conservation Service is calling on the World Conservation Union (IUCN) to review the bat's threat category (*3, 4*). Together, these moves will enable culling of an endangered species (*2*). Conservationists' appeals to the government to adopt a more evidence-based approach have gone unheeded.

In 2008, the species' IUCN Red List category was reclassified from Vulnerable to Endangered (*5*). The bats have suffered extensive habitat loss and degradation (*6*), and they are highly vulnerable to stochastic events like cyclones (*1*). Legalizing culling would add to these pressures, putting the species at further risk. The government's move is particularly troubling because it coincides with a recent policy that is restrictive to conservation research and local capacity building in conservation (*7*).

Seeking to cull a species with a recent history of worsening conservation status will be detrimental to Mauritius's good reputation (*1, 8*), built on having saved several endemic species from extinction (e.g., the pink pigeon, *Columba mayeri*) (*1*). The government has lost further credibility by providing no reasonable evaluation of expected benefits of specific quotas of bat culling. Moreover, the current bat protection law has proved difficult to enforce (*2, 5*), which casts serious doubts on the government's ability to enforce culling quotas in the future.

The international community should encourage Mauritius to conserve the bat population by exploring and extending alternative programs, such as protective netting. Mauritius should not undermine the bats' key ecological role as the largest surviving frugivore in the island's threatened native forests (*9*).

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Published by AAAS

Conclusions

Grim situation attracted considerable conservation efforts (summarized in Jones 2008)

As a result, Mauritius now contributes to the advancement of restoration and conservation science through serving as a laboratory to test various approaches

1. **Control of invasive alien plants**

2. **Control and eradication of invasive alien animals**

3. **Population reintroduction/augmentation or analogue introduction**

Conclusions

Many species, including threatened ones, can recover dramatically as a consequence of the sole removal of invasive alien plants.

It does not suffice to set protected areas. Conservation management within these areas is important. Invasions are worsening worldwide, and Mauritius provides a window into the future of other countries.

Our findings also indicate that imminent plant extinctions can be averted by little more than timely control of the invading plants.

Use of evidence-based approach to restoration and conservation is much easier said than done

Acknowledgments

British Ecological Society

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S'ouvrir aux mondes

The organisers of the workshop for inviting me to present today in particular Ehsan Dulloo, Prof.Jaufeerally-Fakim, Shelagh Kell and Nigel Maxted

Thank you for your attention