

Biodiversity loss and ecosystem change: trends and consequences

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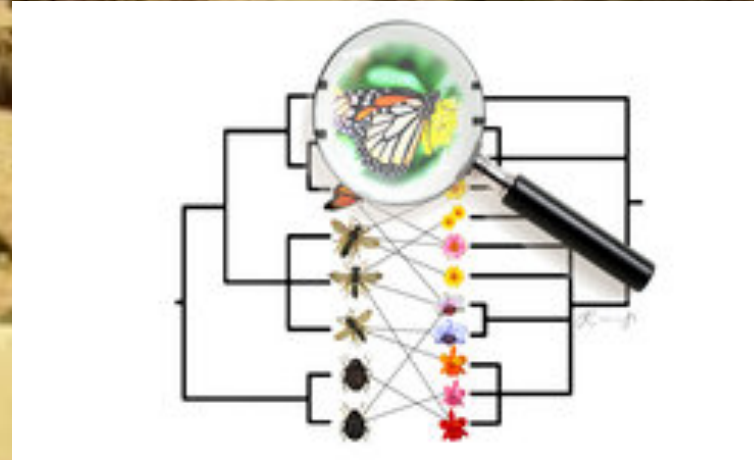
26 September 2013

FAPESP week, Royal Society, London

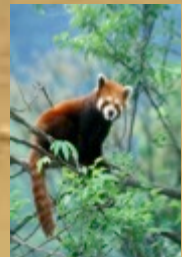
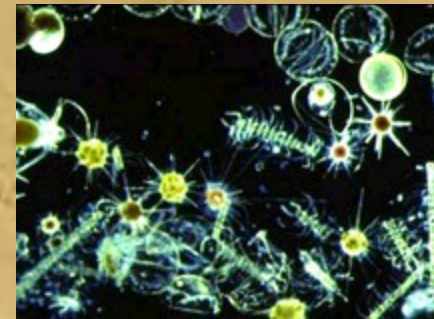


What is biodiversity?

- **The variety of life**
- at all levels...
- genes, populations, species and ecosystems...
- land, water and air.
- and the interactions between living things

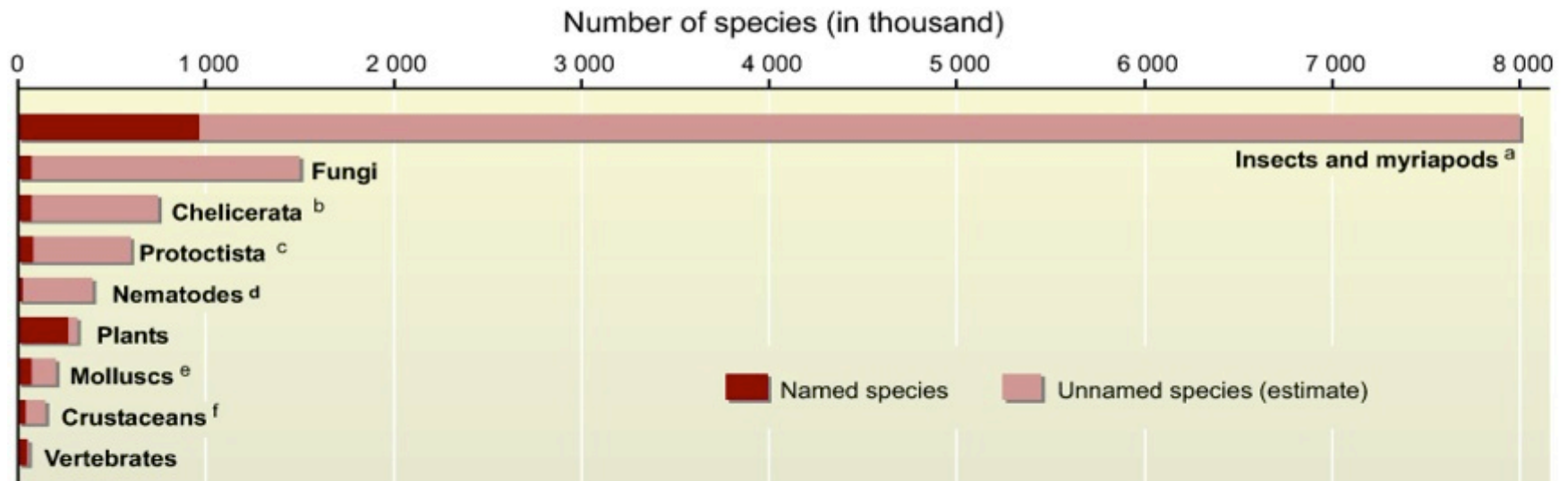


From the definition in the Convention on Biological Diversity



How many species are there?

Our knowledge of the world's species is far from complete. We don't even know how many there are and we've described less than one tenth



^a Myriapods: centipedes and millipedes

^b Arachnids

^c Algae, slime mold, amoeboids, and other single-celled organisms (excluding bacteria)

^d Roundworms

^e Snails, clams, squids, octopuses and kin

^f Barnacles, copepods, crabs, lobsters, shrimps, krill and kin

Source: Millennium Ecosystem Assessment

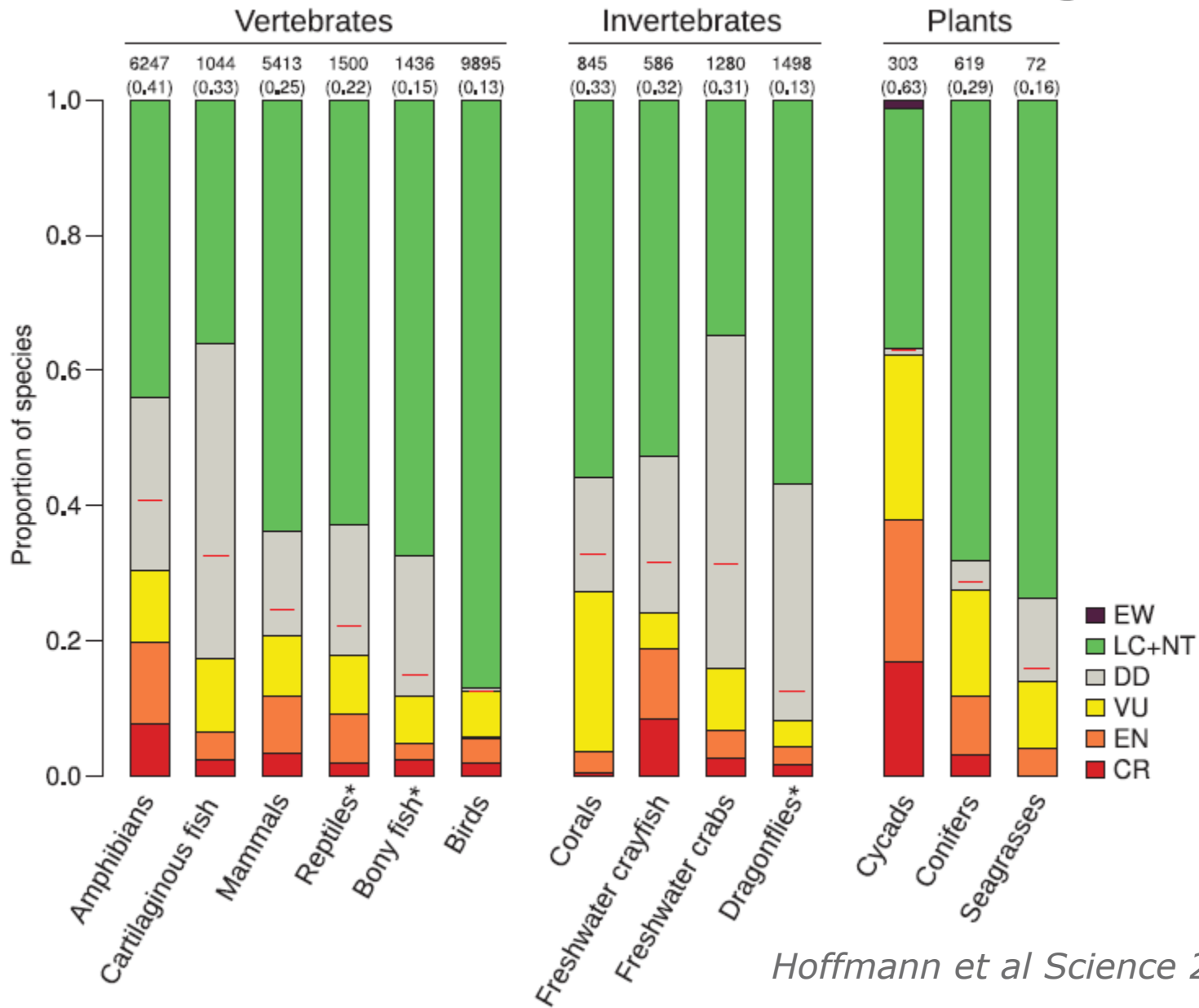
Analysing taxonomic patterns for all kingdoms gives a prediction of **8.7 million** (~1.2 million SE) species, of which 2.2 million (~0.18 million SE) are marine.

86% of the species on Earth, and 91% in the ocean, still await description.

Table 2. Currently catalogued and predicted total number of species on Earth and in the ocean.

Species	Earth			Ocean		
	Catalogued	Predicted	± SE	Catalogued	Predicted	± SE
Eukaryotes						
Animalia	953,434	7,770,000	958,000	171,082	2,150,000	145,000
Chromista	13,033	27,500	30,500	4,859	7,400	9,640
Fungi	43,271	611,000	297,000	1,097	5,320	11,100
Plantae	215,644	298,000	8,200	8,600	16,600	9,130
Protozoa	8,118	36,400	6,690	8,118	36,400	6,690
Total	1,233,500	8,740,000	1,300,000	193,756	2,210,000	182,000
Prokaryotes						
Archaea	502	455	160	1	1	0
Bacteria	10,358	9,680	3,470	652	1,320	436
Total	10,860	10,100	3,630	653	1,320	436
Grand Total	1,244,360	8,750,000	1,300,000	194,409	2,210,000	182,000

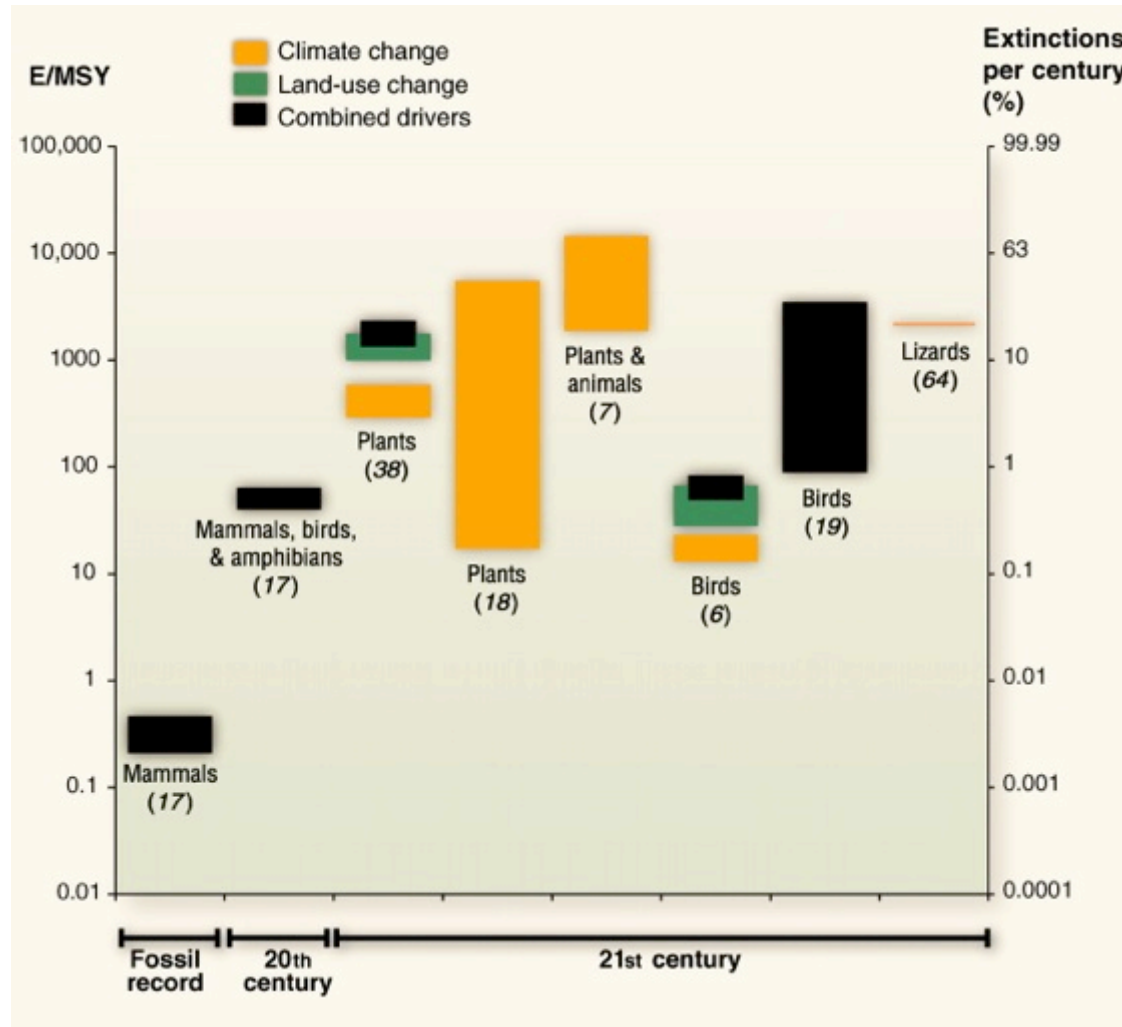
Extinction risk for all assessed groups



Hoffmann et al Science 2010

Species extinction rates

Comparison of recent and distant past extinction rates with rates at which species are “committed to extinction” during the 21st century.

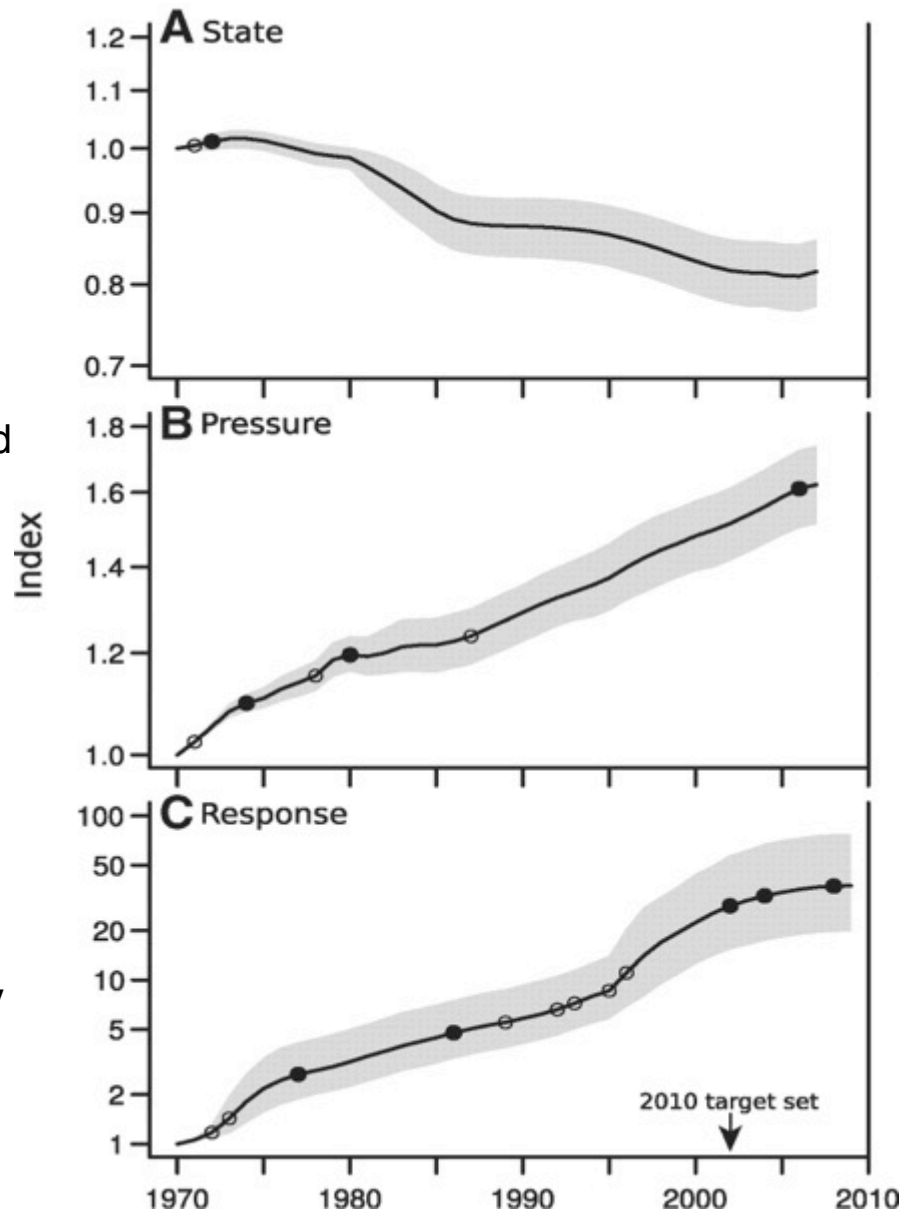


H M Pereira et al. Science 2010;330:1496-1501



Aggregated indices of

- A. the state of biodiversity** based on nine indicators of species' population trends, habitat extent and condition, and community composition;
- B. pressures on biodiversity** based on five indicators of ecological footprint, nitrogen deposition, numbers of alien species, overexploitation, and climatic impacts;
- C. based on six indicators** based on six indicators of protected area extent and biodiversity coverage, policy responses to invasive alien species, sustainable forest management, and biodiversity-related aid





Why does it matter?



Image courtesy of Global Mountain Biodiversity Assessment
www.diversitas-international.org/activities/research/global-mountain

Three roles of biodiversity

Intrinsic/inherent values.

The value of something independent of its value to anyone or anything else

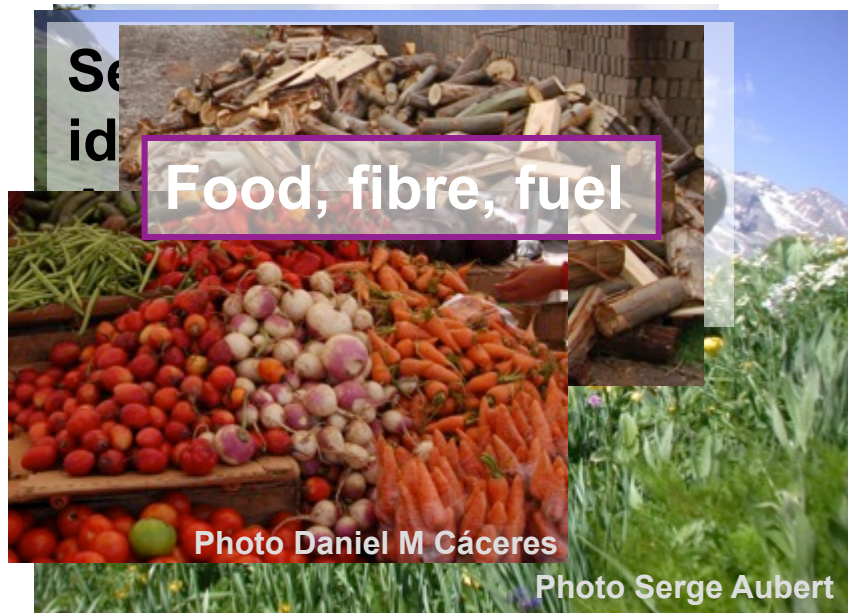
The genetic library of life.

The source of all evolutionary innovation necessary for future adaptive potential and diversification

Instrumental and extrinsic values

For example as natural capital and for ecosystem services

Extrinsic values from ecosystems (ecosystem processes, functions & services)



Regulation of water
quality & quantity

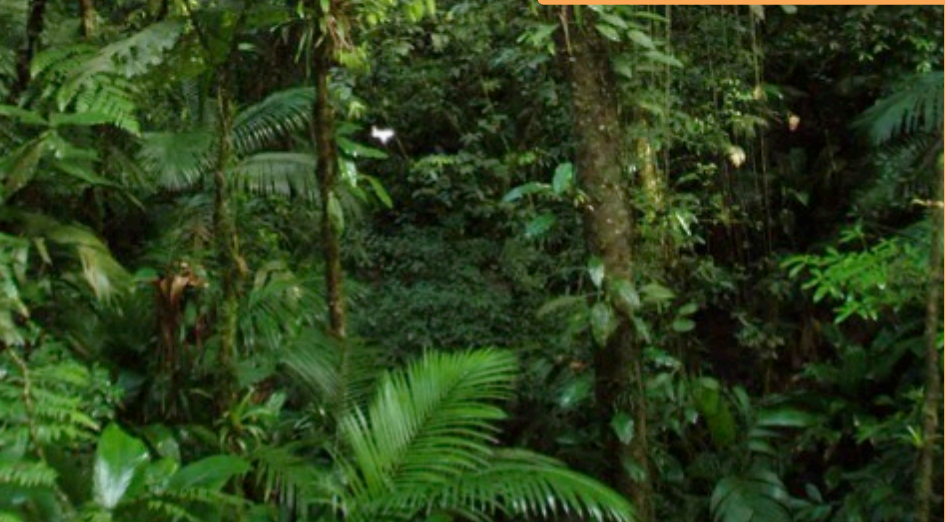
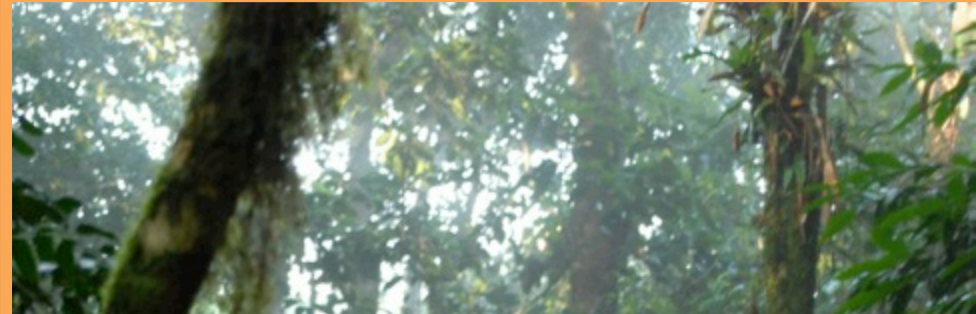


Thanks to Sandra Diaz

Biodiversity in Brazil

70% of the world's catalogued animal and plant species. It is estimated that Brazil hosts between 15-20% of all the world's biological diversity, and **the greatest number of endemic species on a global scale**





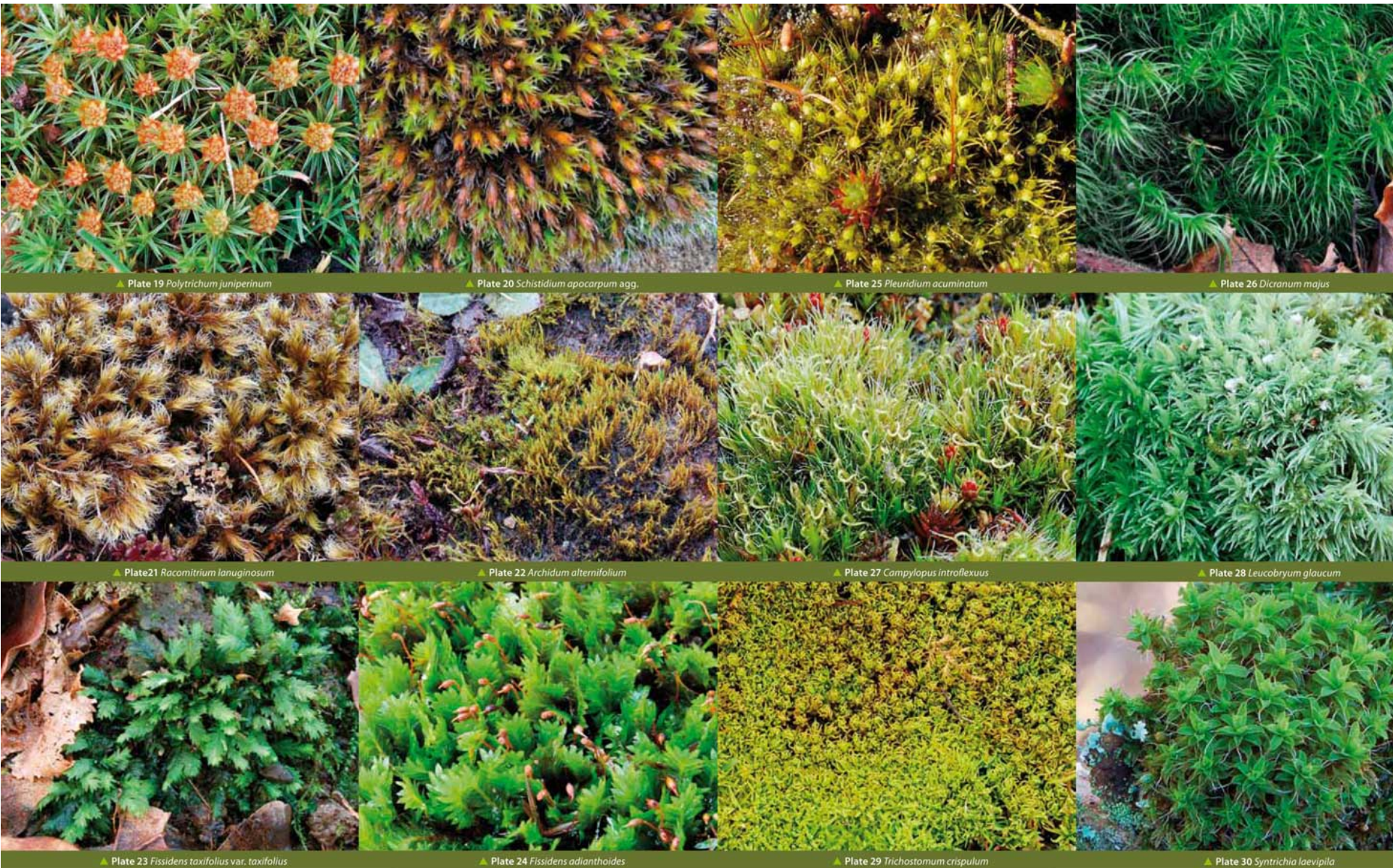
Biodiversity in the UK

- England's species are probably the best studied in the world, with a history of recording by amateur naturalists dating back three centuries.
- England has just over half of the bryophyte species occurring in the European flora (with three endemic species).



The Lundy cabbage is one of the UK's endemic species



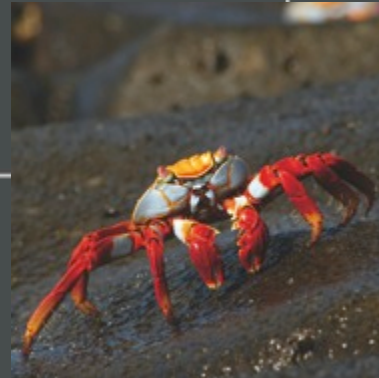
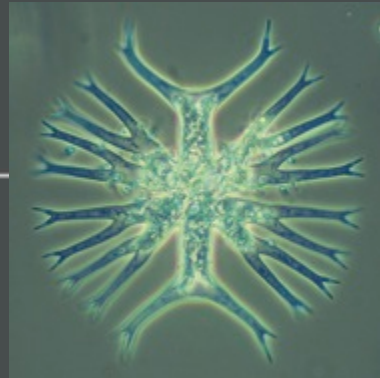


UK Brazil collaborations

- International
 - DIVERSITAS science programme
 - Future Earth – IPBES
- National collaborations
 - NERC FAPESP - joint funding scheme
- Collaborative projects between the UK, Sao Paulo and Brazil

Biodiversity and ecosystems: the DIVERSITAS science plan

2012-2020



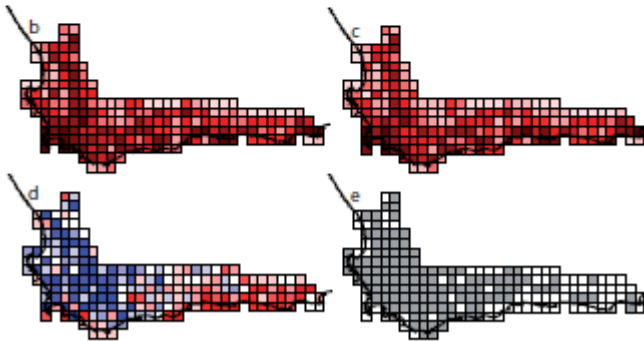
Biodiversity & ecosystem services science for a sustainable planet

- Challenge 1: Identify **urgent detrimental changes** in biodiversity & ecosystem services and provide the knowledge to avoid, limit or mitigate such changes
- Challenge 2: Enhance the capacity of **socio-ecological systems** to support biodiversity & ecosystem services **under global change**
- Challenge 3: Develop the knowledge base on the use and conservation of biodiversity to **sustain ecosystem services and human well-being**
- Challenge 4: Build a **global network of biodiversity science**



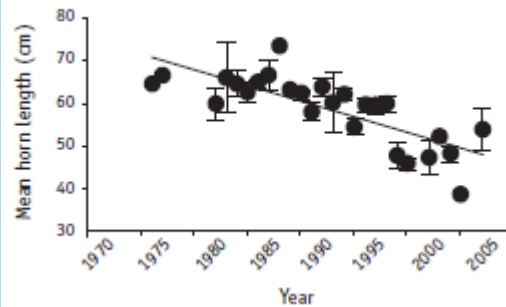
Biodiversity science

Taxonomic, phylogenetic and functional diversity



Forest F, et al 2007. Preserving the evolutionary potential of floras in biodiversity hotspots. *Nature* 445(7129):757-760

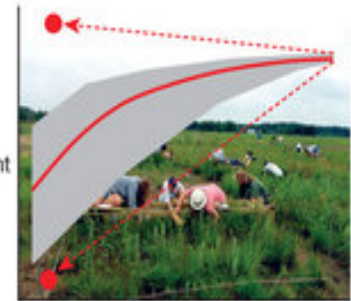
Rapid evolution



Coltman DW, et al. 2003. Undesirable evolutionary consequences of trophy hunting. *Nature* 426:655-658

Biodiversity and ecosystem function relationships

Ecosystem function
(resource capture, biomass production, decomposition, nutrient recycling)



Biological diversity
(variation in genes, species, functional traits)

Cardinale B, et al 2012. Biodiversity loss and its impact on humanity. *Nature* Volume: 486, 59-67

IPBES developments in the past year



- Panama meeting establishes IPBES (April 2012)



- IPBES-1 Bonn, Germany (January 2013)



NERC & FAPESP agreement

NERC IOF (International Opportunities Fund):

Collaboration since 2010, has enabled joint funding of 3 collaborative projects. A representative from FAPESP attends the panel meeting. Brazilian Partners submit a separate budget sheet for the costs that will be covered by FAPESP.

PI: Professor Gordon McFiggans. *Brazil-UK Network for Investigation of Amazonian Atmospheric Composition and Impacts on Climate.*

PI: Dr Hartmut Boesch. *UK/Brazil Research Network for an Amazonian Carbon Observatory*

PI Professor Peter Cox. *Impact of Climate Extremes on Ecosystem and Human Health in Brazil (PULSE-Brazil)*

NERC & FAPESP

Human-modified Tropical Forests:

Carlos Joly & Jos Barlow

Biodiversity and Ecosystem Processes in Human Modified Tropical Forests programme, seeks to understand how land-use change such as agriculture and logging affects biodiversity and biogeochemical cycles.

NERC & FAPESP

Collaborative projects

- The Memorandum of understanding between RCUK and FAPESP was initially set up to cover standard grants.
- The number of applications wishing to apply under the agreement are increasing.

Modelling deforestation

Predictive modelling of contagious deforestation in the Brazilian Amazon

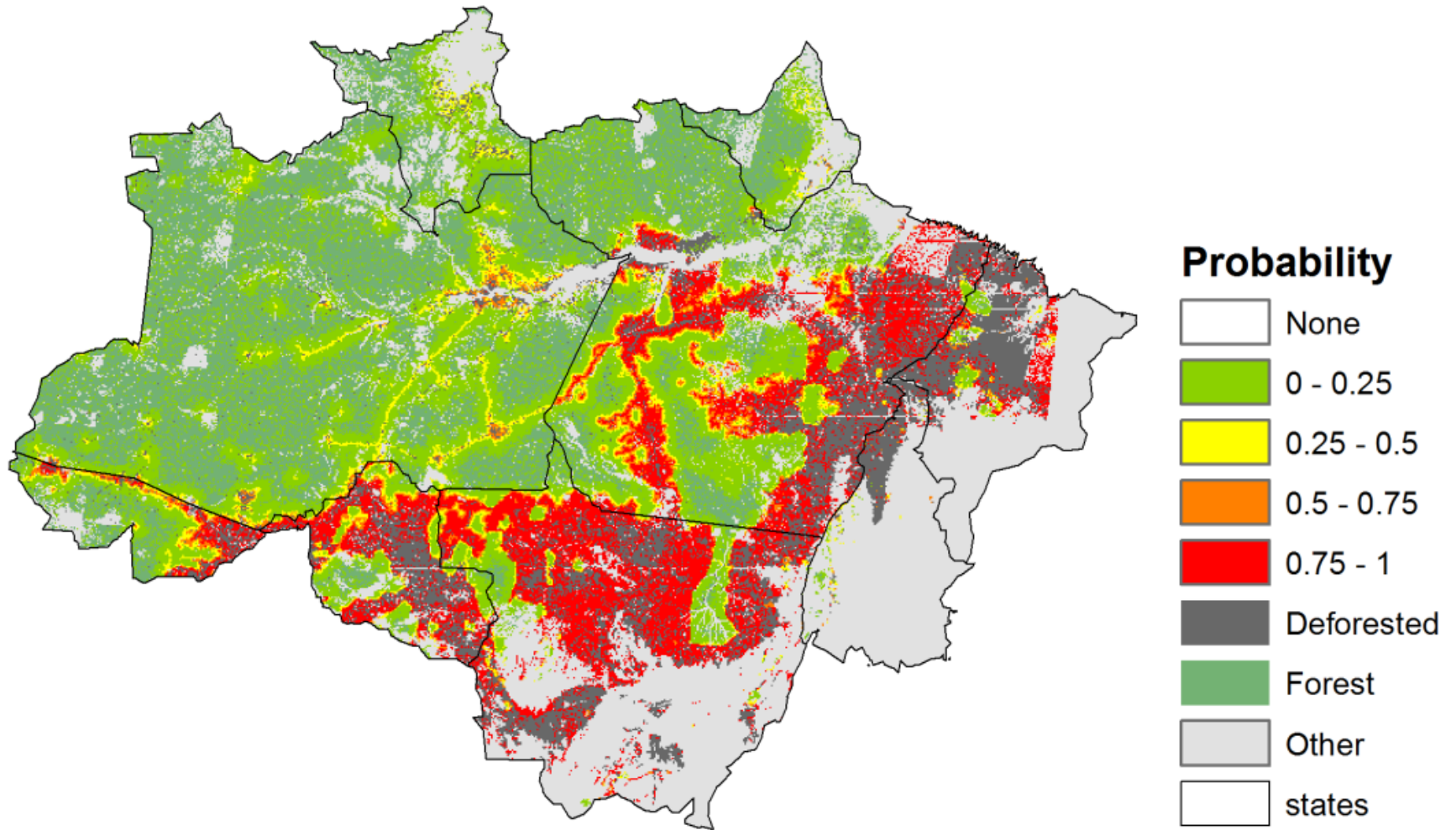
Isabel M.D. Rosa¹, Drew Purves², Carlos Souza Jr.³ and
Robert M. Ewers¹

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²Computational Ecology and Environmental Science, Microsoft Research Cambridge, Roger Needham Building, 7 J J Thomson Ave, Cambridge CB3 0FB, United Kingdom

³IMAZON – Amazon Institute of People and the Environment, Rua Domingos Marreiros, 2020, Fátima, CEP: 66.060-160, Belém, Pará, Brazil

Deforestation 2050



Rosa et al. (sub)
PLoS ONE

The role of vertebrates on ecosystem functioning under climate and habitat change

Cristina Banks-Leite, Imperial College &
Luiz Antonio Martinelli, CENA/USP

Experimental exclusions of vertebrates using cages placed in the forest understorey along a gradient of altitude and distance from forest edge.

Within the cages assess changes in invertebrate biomass and species composition (identified to order), herbivory and nutrient cycling.

Birds and mammals will be trapped in the vicinity and their diet will be assessed by analysing stable isotopes from feathers and tissue.

Thanks to

- DIVERSITAS,
- Gina Adams, Avril Allman, Victoria Fairweather (NERC)
- Cristina Banks-Leite, Robert Ewers (Imperial College) below in the field with Luis Antonio Martinelli

