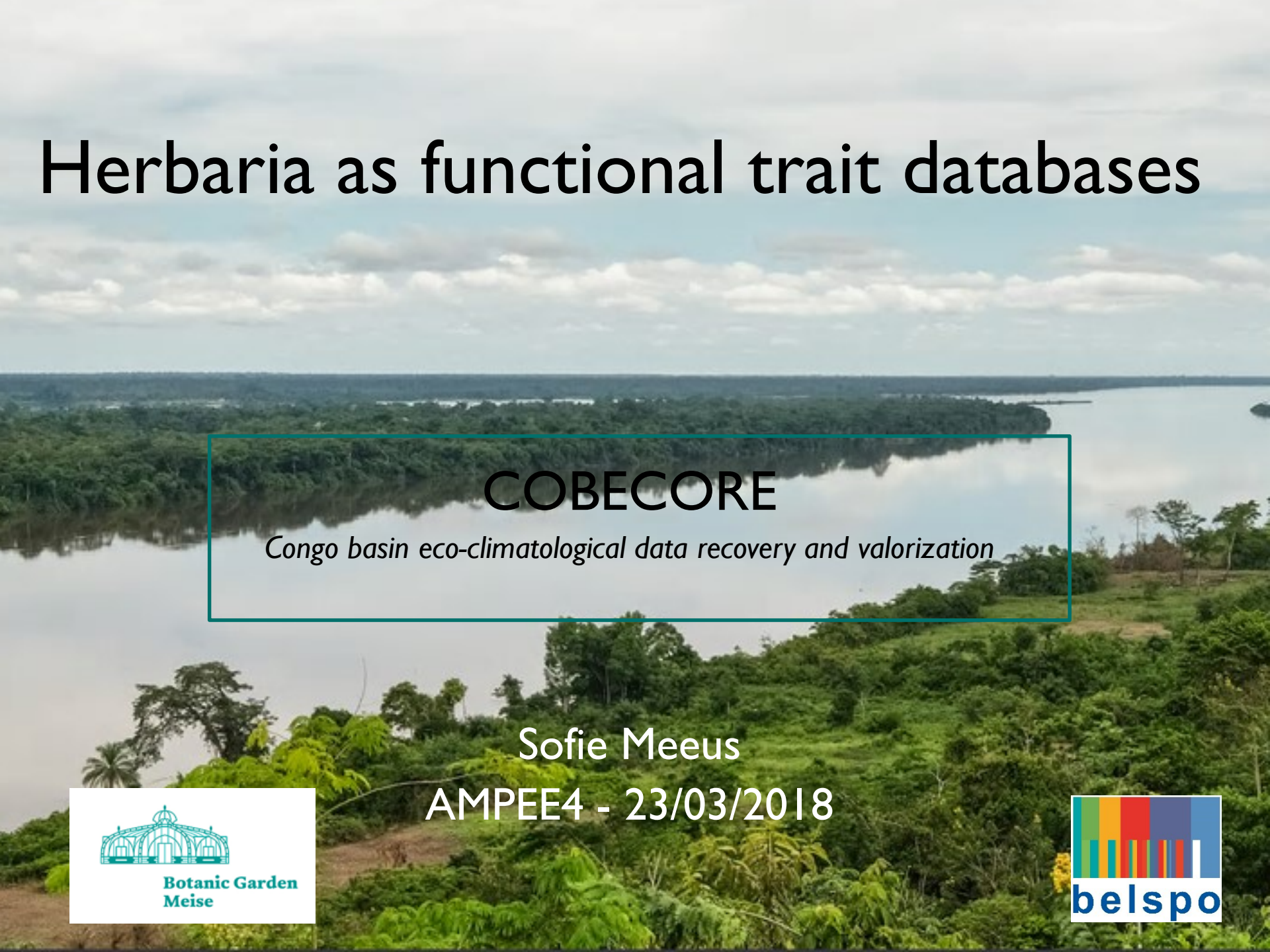
Herbaria as functional trait databases



COBECORE

Congo basin eco-climatological data recovery and valorization

Sofie Meeus

AMPEE4 - 23/03/2018

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belspo

Introduction

The African rainforest & climate change

LETTER

doi:10.1038/nature13265

Widespread decline of Congo rainforest greenness in the past decade

Liming Zhou[1], Yuhong Tian[2], Ranga B. Myneni[3], Philippe Ciais[4], Sassan Saatchi[5], Yi Y. Liu[6], Shilong Piao[7], Haishan Chen[8], Eric F. Vermote[9], Conghe Song[10,11] & Taehee Hwang[12]

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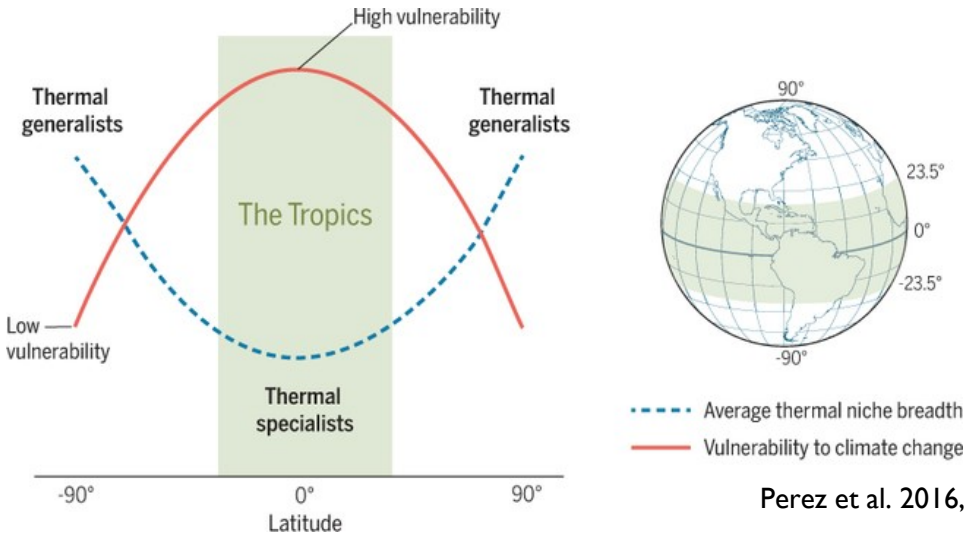
The African rainforest & climate change

Tropical species

Vulnerable?



Perez et al. 2016, *Science*

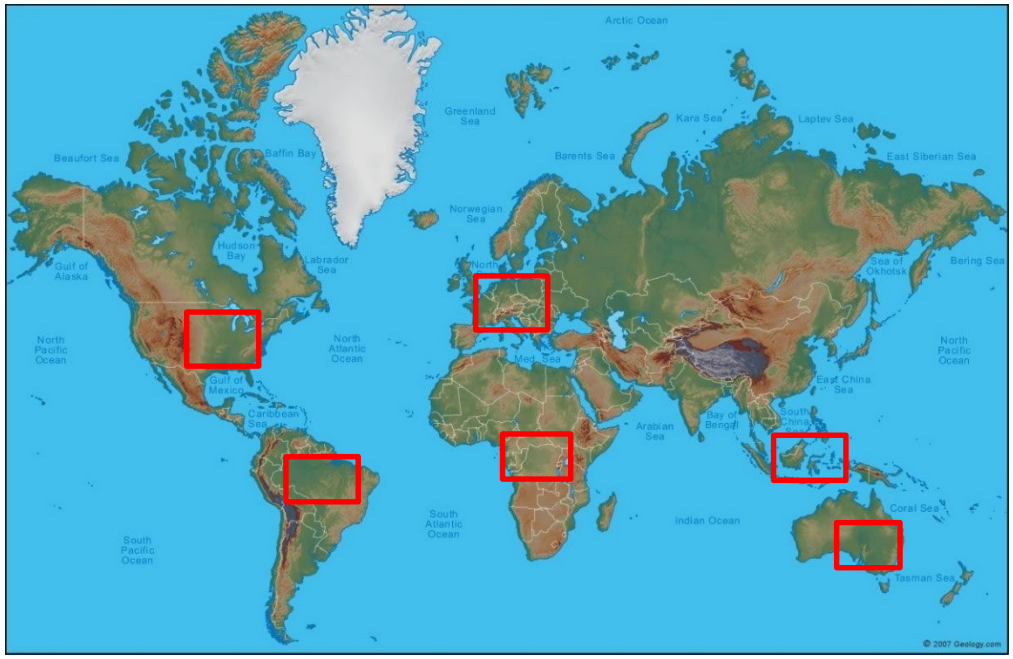
Tropical forest warming: looking backwards for more insights

Pieter A. Zuidema[1], Roel J.W. Brienen[2] and Jochen Schöngart[3,4]

[1] Forest Ecology and Forest Management, Centre for Ecosystem Studies, Wageningen University, PO Box 47, 6700 AA Wageningen, Netherlands
[2] School of Geography, Leeds University, Woodhouse Lane, Leeds LS2 9JT, UK
[3] Max-Planck-Institute for Chemistry, Biogeochemistry Department, P.O. Box 3060, 55020 Mainz, Germany
[4] Instituto Nacional de Pesquisas da Amazônia (INPA), Av. André Araújo 2936, P.O. Box 478, 69011-970 Manaus-AM, Brazil

African rainforest lacks legacy data

TRY



	Measurements
Tropical South America	366629
Central Europe	254132
North America	83374
Tropical SE Asia	53632
Australia	29776
Tropical Africa	14675

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Aim COBECORE:

Recovering eco-climatological data from Belgian colonial collections

State Archives www.arch.be

Climate data

Africa TERVUREN

Aerial photos

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African herbarium

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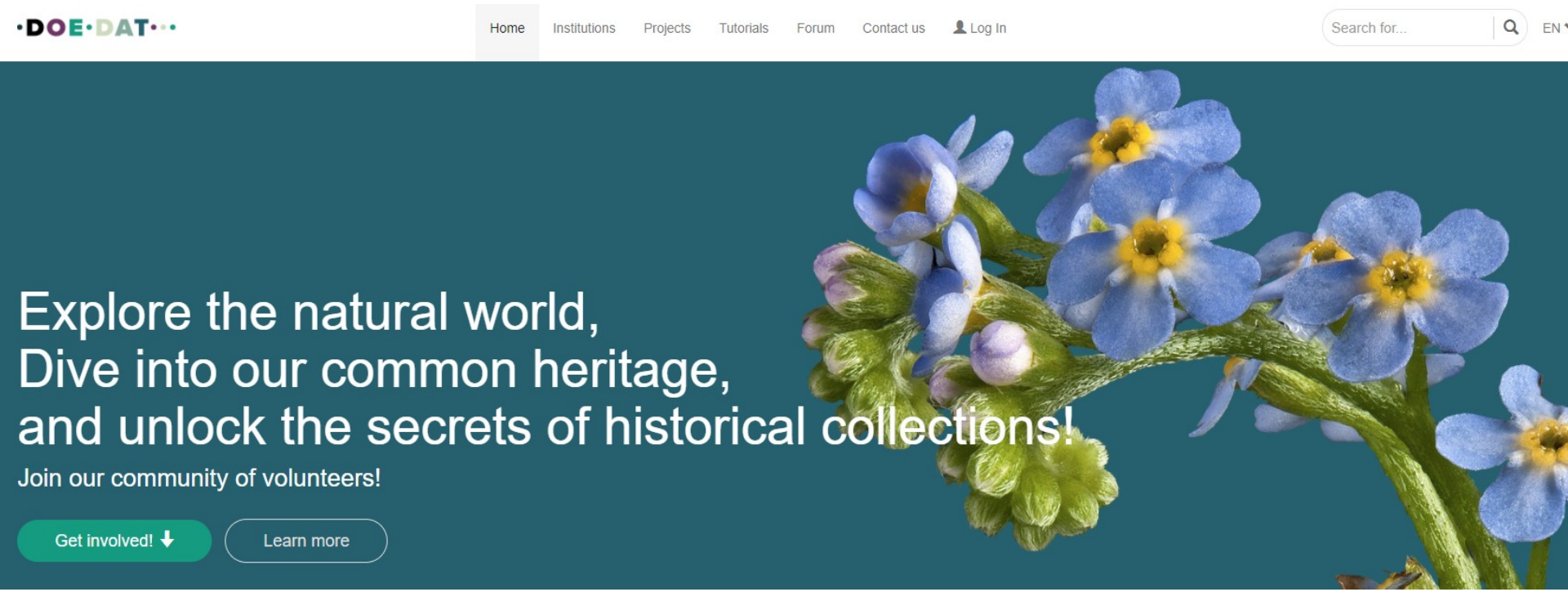
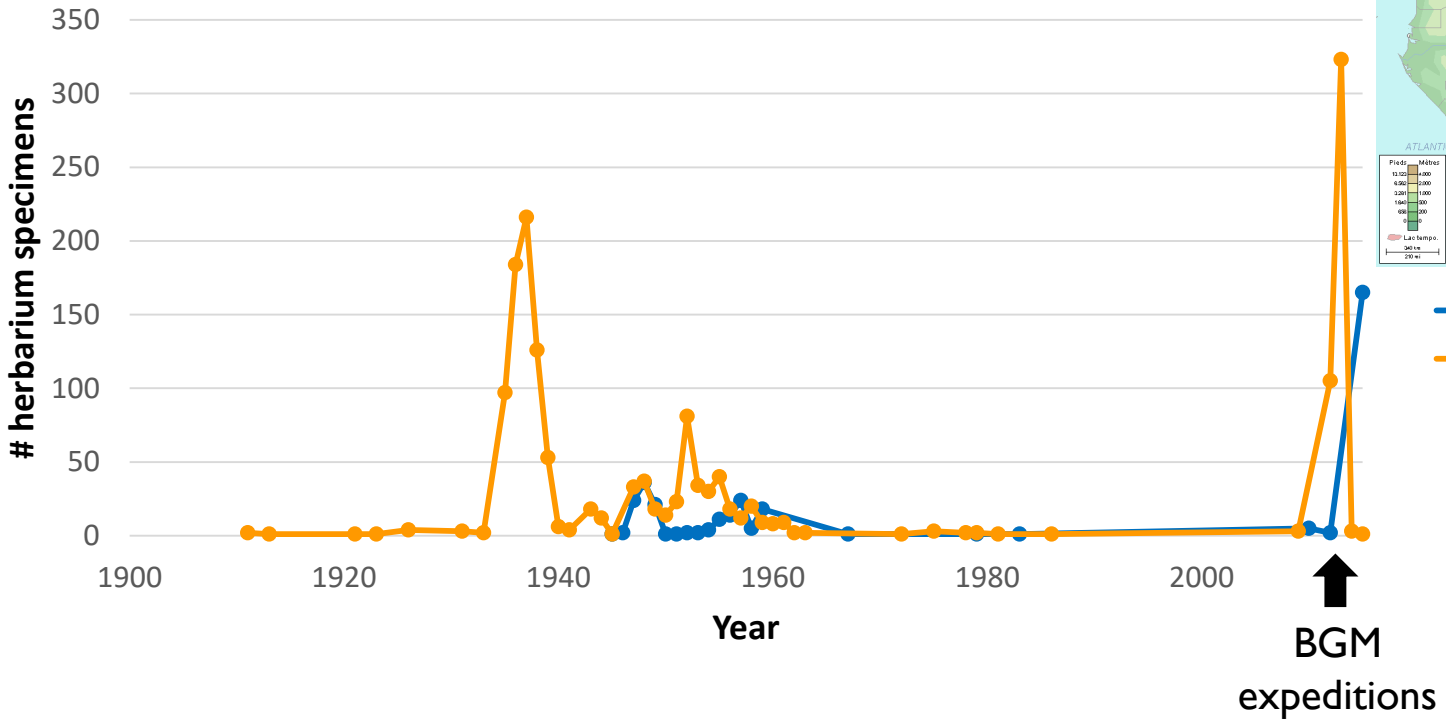
Herbarium Botanic Garden Meise (BR)

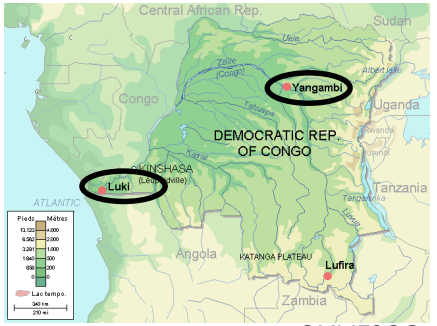


Herbarium BR: A source of legacy data

Number of specimens of 64 tropical tree species in African herbarium BR



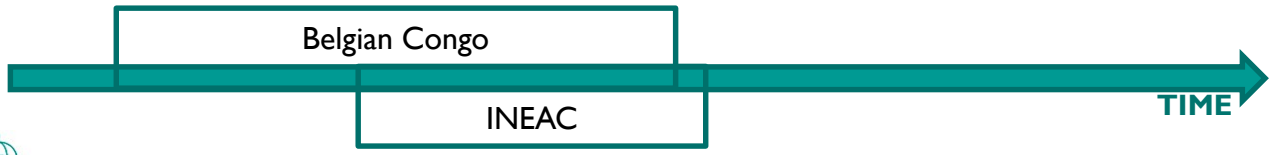
UNESCO Biosphere reserves



©UNESCO

Luki (N=341)

Yangambi (N=1566)



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Herbaria as functional trait databases

ON THE NATURE OF THINGS: ESSAYS
New Ideas and Directions in Botany

Herbarium specimens as exaptations: New uses for old collections[1]

J. Mason Heberling[2–4] and Bonnie L. Isaac[2]

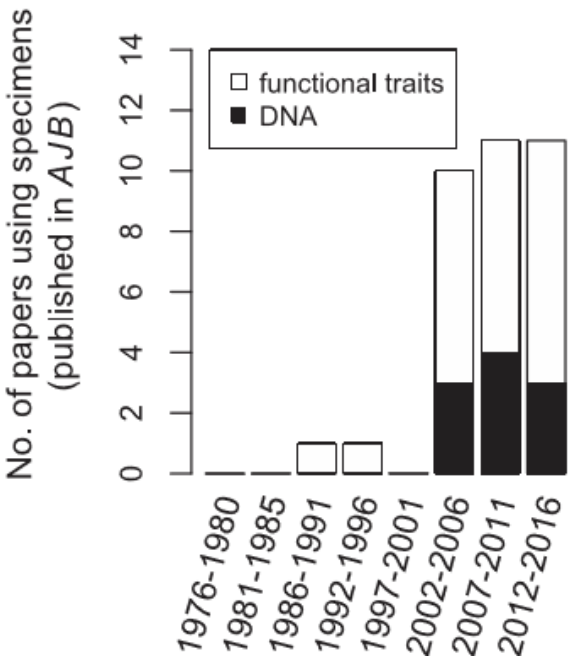
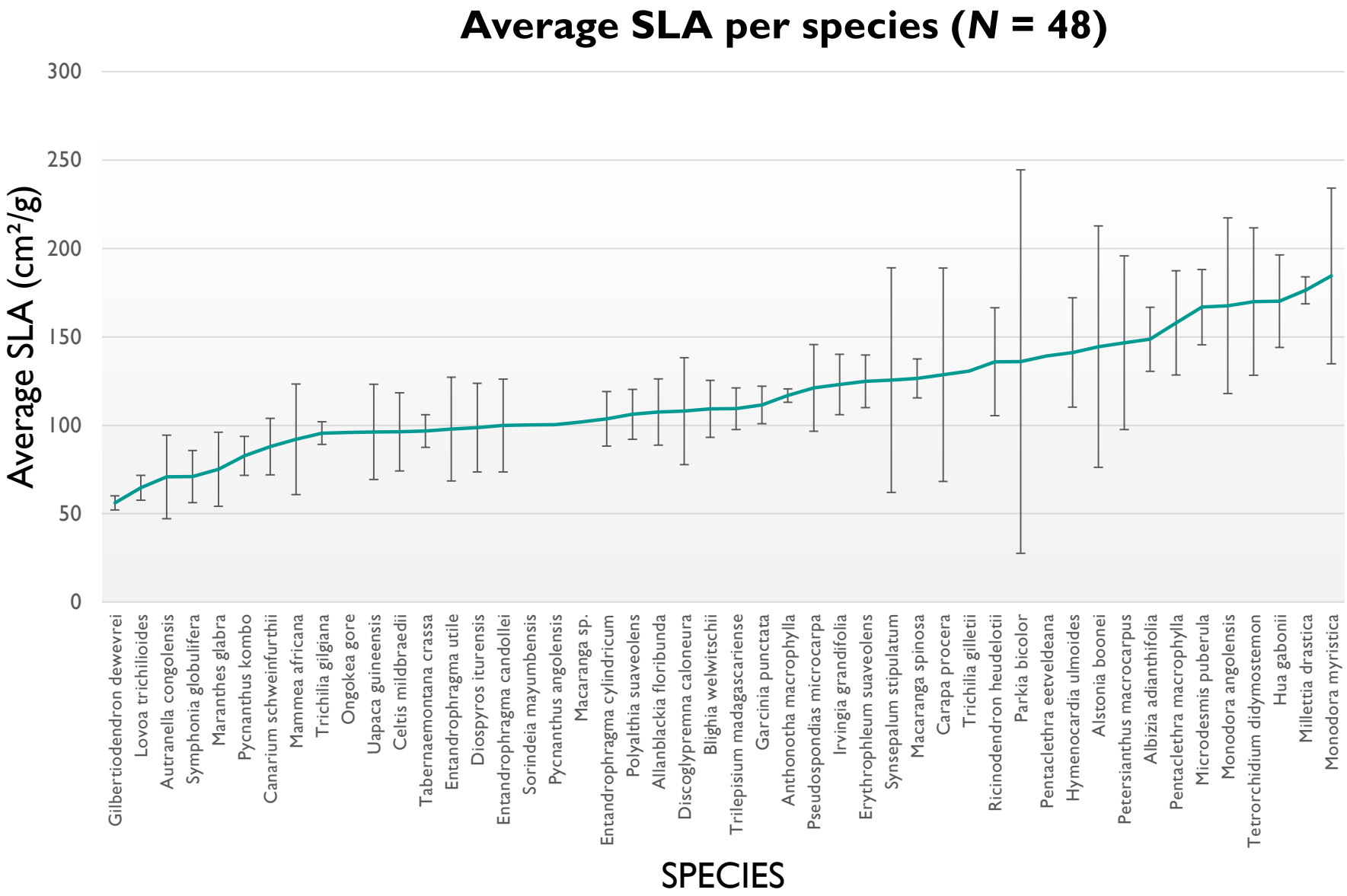


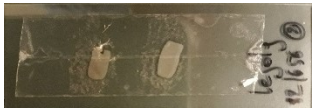
FIGURE 1 The emergence of novel research uses for herbarium specimens in the last decade as illustrated by the number of relevant publications in the *American Journal of Botany*. These studies used specimens themselves (i.e., not just specimen label data for species distribution modeling) either for genetic analysis (e.g., systematics) or for quantification of intraspecific trait variation along taxonomic, temporal, or spatial gradients (often in context of global change issues). Note that none of these papers use herbarium specimens to integrate genotypic and phenotypic changes together.

Herbaria as functional trait databases: SLA

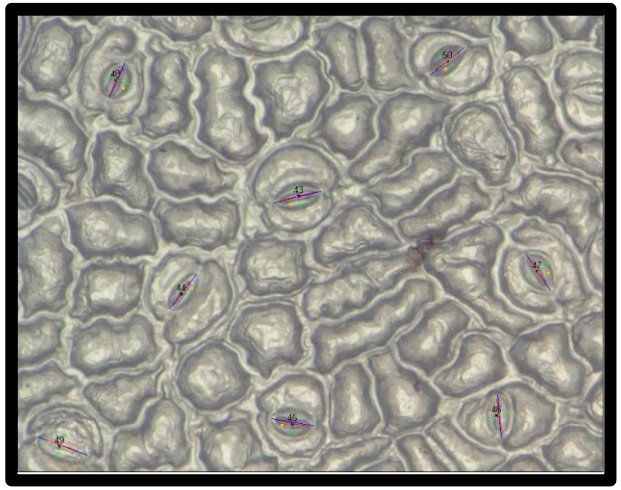


Herbaria as functional trait databases: STOMATA

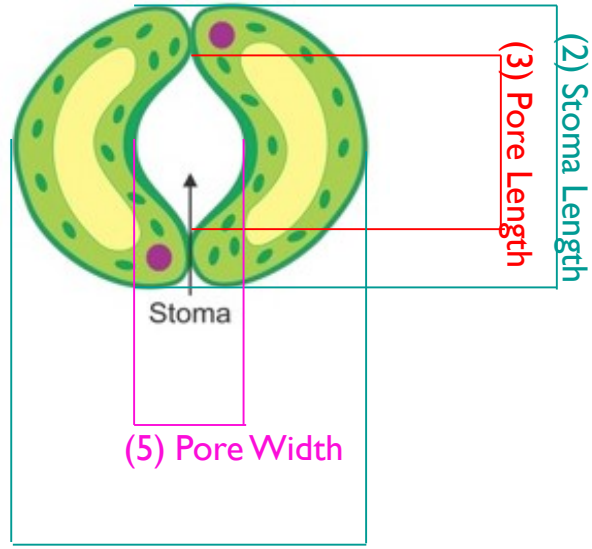
Nail varnish method



Keyence VHX Digital microscope



ObjectJ (ImageJ plugin)



Stomatal conductance (g_{wmax})

$$g_{wmax} = \frac{d}{v} \cdot D \cdot a_{max} \Big/ \left(l + \frac{\pi}{2} \sqrt{a_{max}/\pi} \right)$$

d = Diffusivity coefficient water vapor (m^2/s)
v = molar volume of air (m^3/mol)
D = Stomatal density (number of stomata/m^2)
a_{max} = max area pore (m^2)
l = pore depth (m)

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Case study: ***Prioria*** *sp.*

- 6 Central African *Prioria* species, 3 species very well-represented in herbarium of BGM
- Uses: commercial timber for construction, furniture, etc.
- Suffers from habitat loss and overexploitation

Prioria oxyphylla © Samuel Vanden Abeele

Botanic Garden Meise

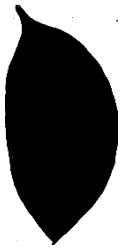
Case study: *Prioria sp.*

Prioria balsamifera

Endangered

133 specimens in BGM

SLA=108±12 cm²/g



Prioria oxyphylla

164 specimens in BGM

SLA=68±8 cm²/g

Prioria buchholzii

126 specimens in BGM

SLA=81±7 cm²/g

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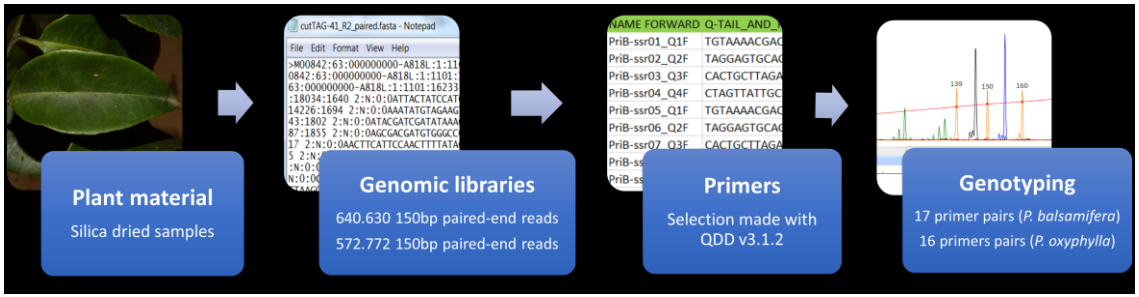
Case study: *Prioria sp.*

Genetic analysis

Samuel Vanden Abeele (BGM/ULB)

Microsatellite development & analysis on *P. balsamifera* and *P. oxyphylla* for genetic diversity assessment (conservation purposes)



High-throughput sequencing for reconstruction phylogeography of all (14) *Prioria* species

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Building a database

g_{wmax}

3.72 mol/m²s

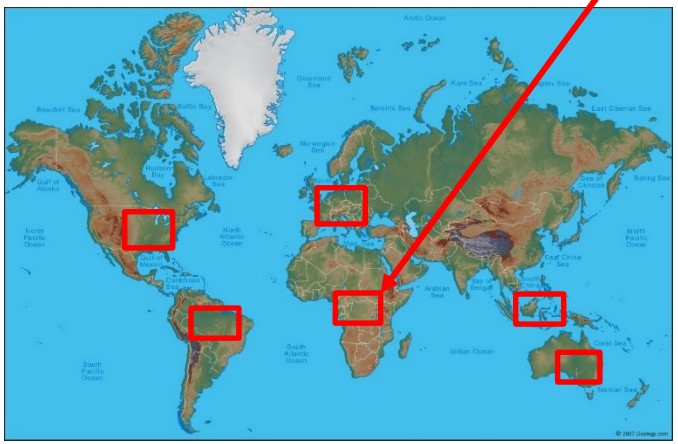
4.32 mol/m²s

3.85 mol/m²s

4.93 mol/m²s

Specimen	coordinates	g_{wmax}	SLA	…
Spec 1		3.72 mol/m²s		
Spec 2		4.32 mol/m²s		
Spec 3		3.85 mol/m²s		
Spec 4		4.93 mol/m²s		

TRY



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THANK YOU

Visit our website at cobecore.org

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Nuno Veríssimo Pereira
Wim Baert
Myriam de Haan

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Koen Hufkens (Gent University)
Jan Van den Bulcke (Gent University)
Hans Beeckman (Royal Museum for Central Africa)
Kim Jacobsen (Royal Museum for Central Africa)
Piet Stoffelen (Botanic Garden Meise)
Filip Vandelook (Botanic Garden Meise)
Steven Janssens (Botanic Garden Meise)
Michael Amara (National Archives of Belgium)
Leen Van Hirtum (National Archives of Belgium)

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