# Now hiring: a high-risk job, with a touch of botanical classicism; yet, irreplaceable for saving biodiversity

D.G. Debouck

Cali, September 26, 2024

# PLAN

## Why field work continues to be relevant in the Neotropics?

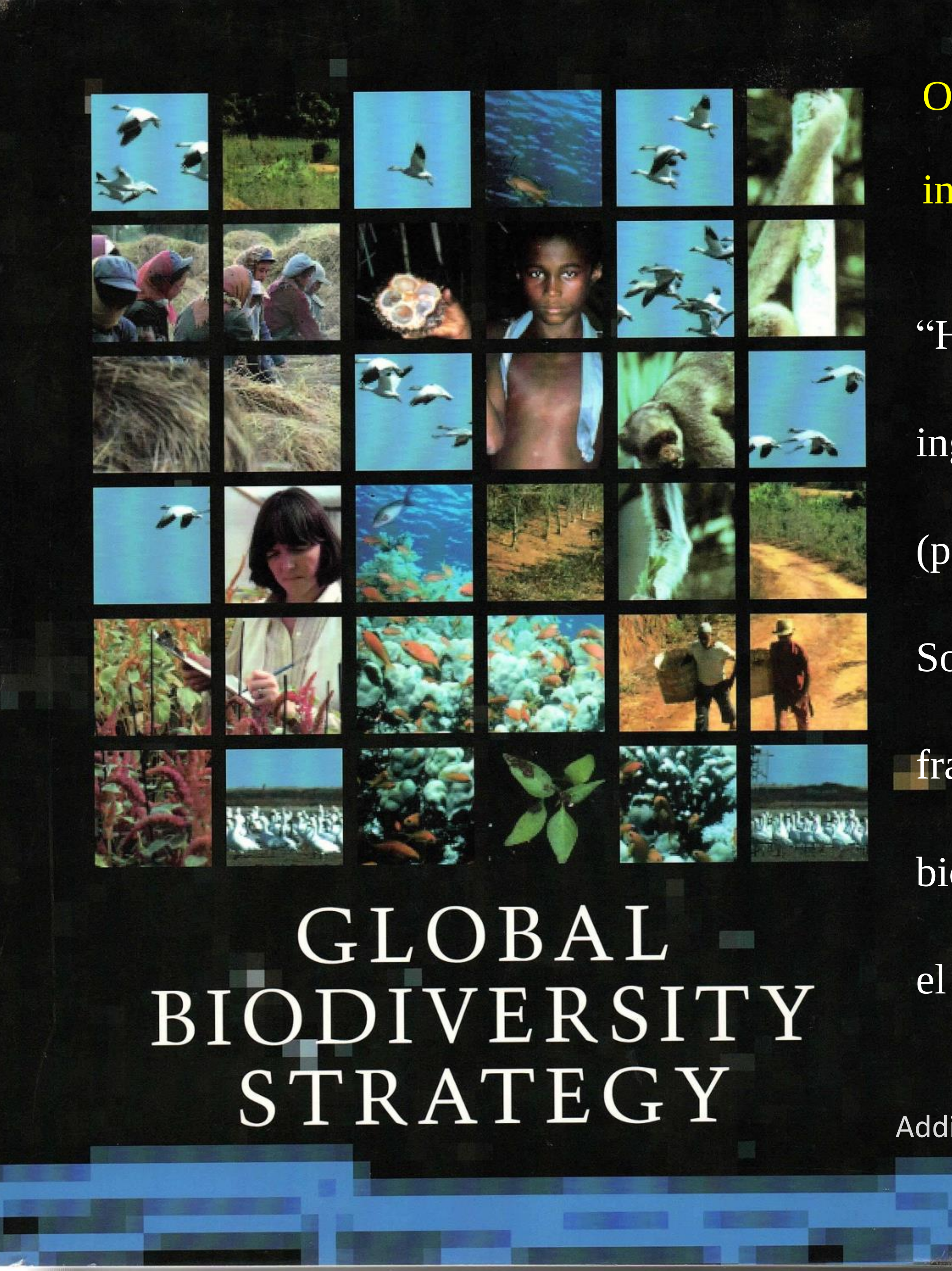
1. A dangerous imbalance
   (the unknown is not likely to be saved, surely not to be used)

2. The variation between and within populations: the arcelins

3. Discovery of new species in unpredicted environments

4. Field work as key to integrate conservation approaches

José Celestino Mutis (1732-1808) ca. 1773



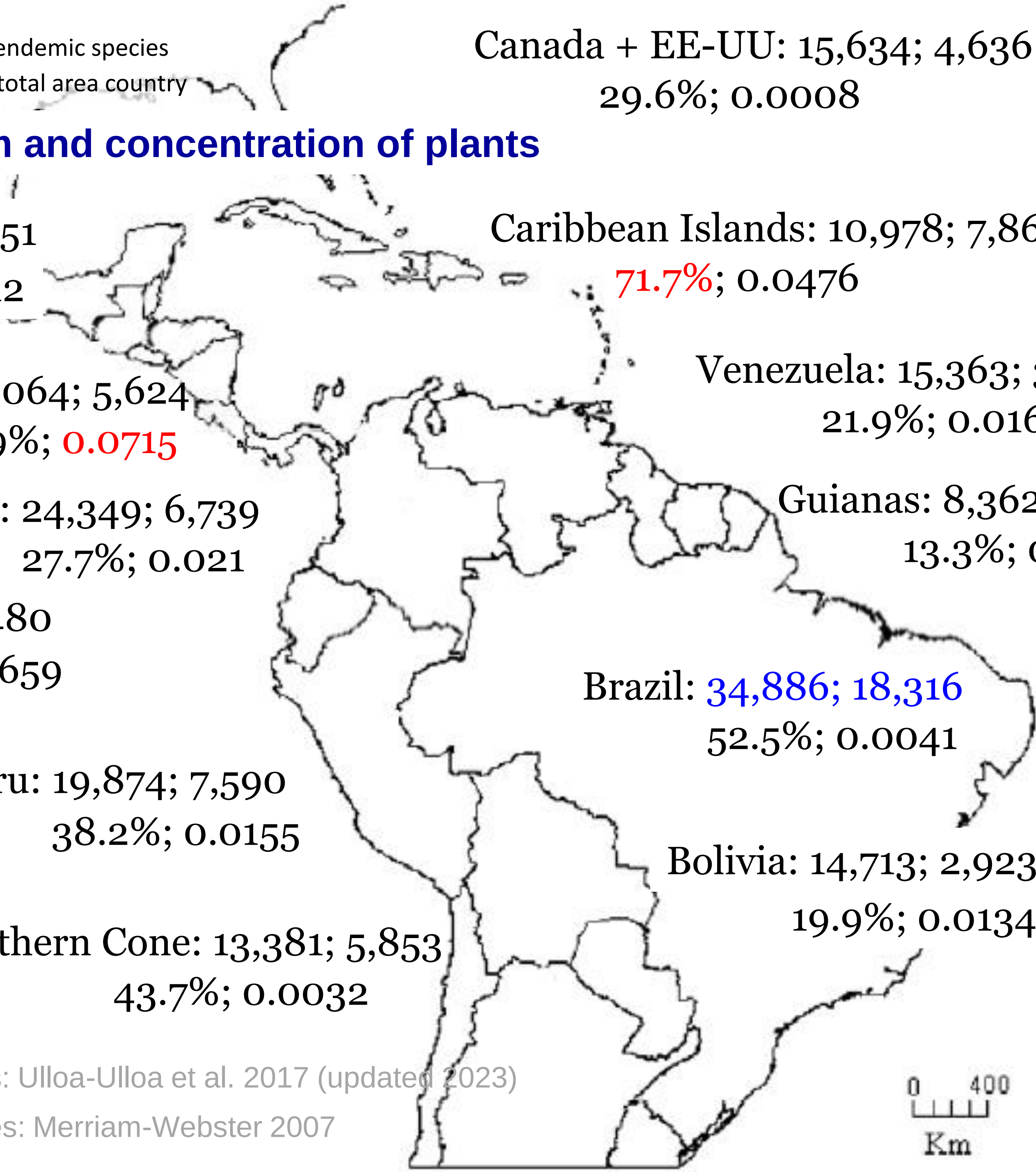

On the road to Río de Janeiro for UNCED, in 1992, the Minister of Costa Rica told us:

“Hemos podido proteger las playas (por los ingresos del turismo) y las altas cumbres (por ser fuentes de agua para las ciudades). Somos conscientes de la importancia de la franja intermedia para la conservación de la biodiversidad, pero denos información sobre el qué, cómo y para qué?”

Additional reading: WRI et al. 1992, Cardinale et al. 2012, Tscharntke et al. 2012, Wilson 2016, Schaal 2019

no. total plant species; no. endemic species
% endemism; index no. sp/ total area country

## Levels of endemism and concentration of plants



Canada + EE-UU: 15,634; 4,636
29.6%; 0.0008

Mexico: 23,596; 11,751
49.8%; 0.012

Caribbean Islands: 10,978; 7,868
71.7%; 0.0476

Venezuela: 15,363; 3,359
21.9%; 0.0168

Central America: 17,064; 5,624
32.9%; 0.0715

Colombia: 24,349; 6,739
27.7%; 0.021

Guianas: 8,362; 1,113
13.3%; 0.0176

Ecuador: 18,690; 5,480
29.3%; 0.0659

Brazil: 34,886; 18,316
52.5%; 0.0041

Peru: 19,874; 7,590
38.2%; 0.0155

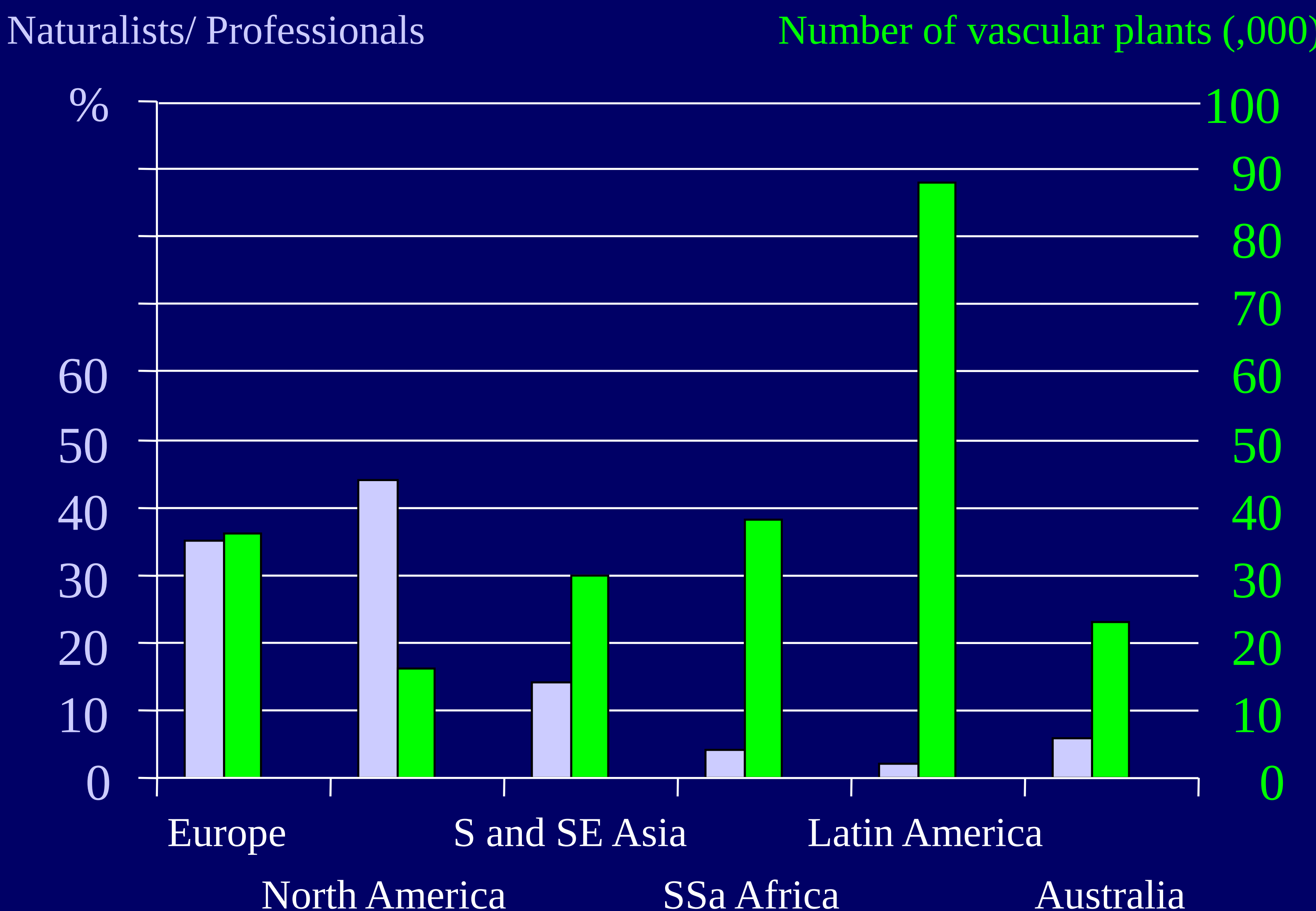
Bolivia: 14,713; 2,923
19.9%; 0.0134

Southern Cone: 13,381; 5,853
43.7%; 0.0032



sources: no. plant species: Ulloa-Ulloa et al. 2017 (updated 2023)
areas of countries: Merriam-Webster 2007

# A true problem: the imbalance in knowledgeable people *vs*. no. plants




sources: WRI 1992, Ulloa Ulloa et al. 2017

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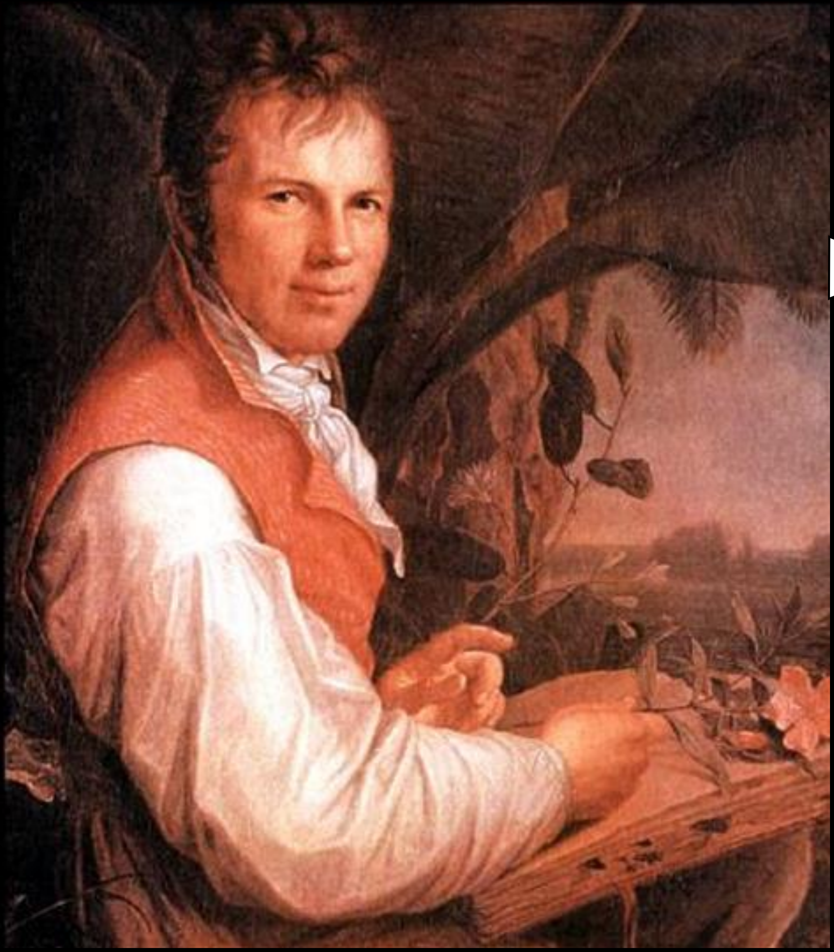

Alexander von Humboldt (1769-1859) ca. 1797

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additional information: Wulf 2015


map: Toro et al. 1990

# Distribution of the wild form of *Phaseolus vulgaris* L.

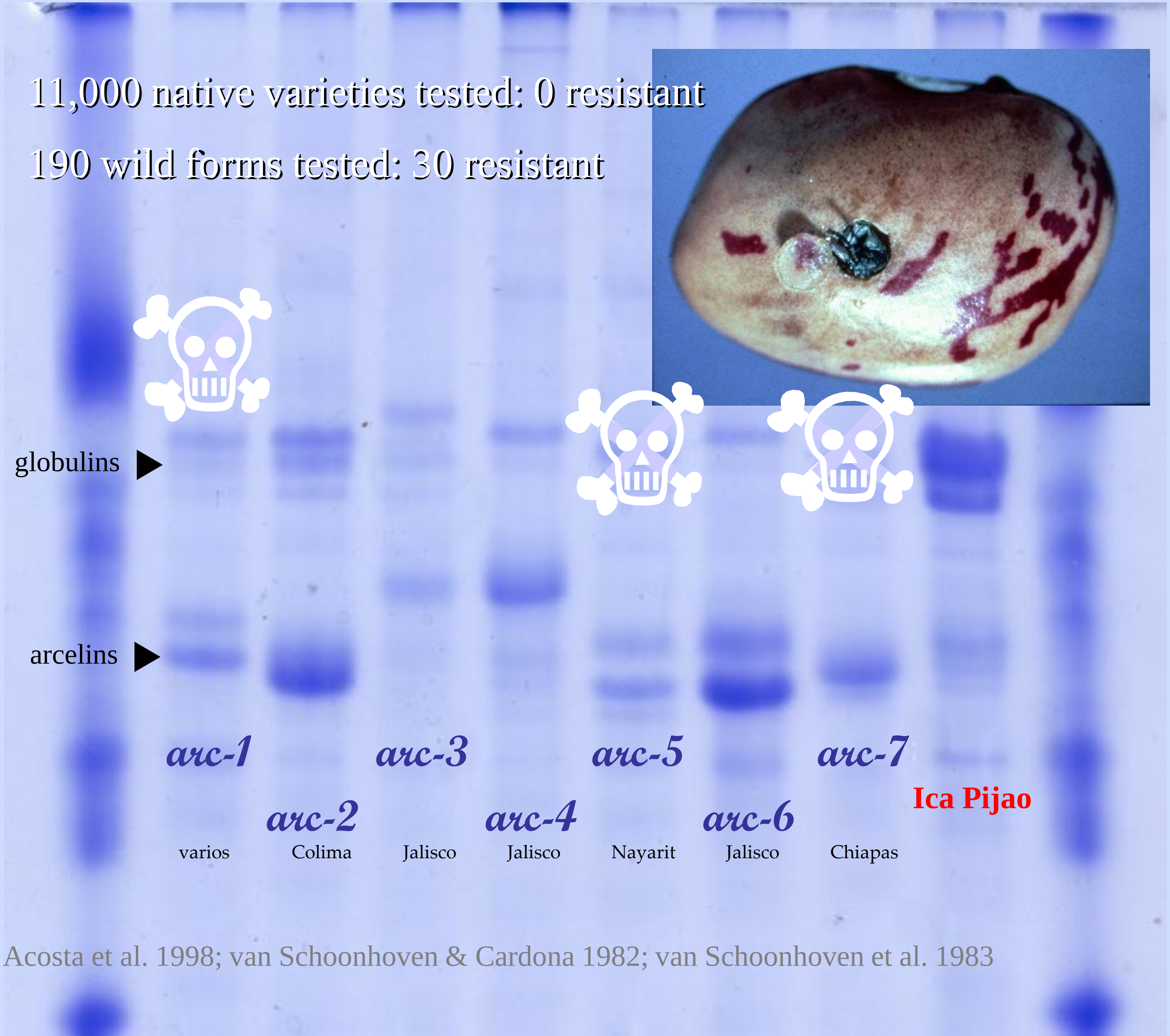
Chihuahua: Nabhan, 1985
Eje Volcánico: Miranda-Colín, 1967
Oaxaca: Gentry, 1969
Guatemala: McBryde, 1947
Honduras: Burkart & Brücher, 1953
El Salvador: Debouck & Borja, 2012
Nicaragua: Debouck et al., 2008
Costa Rica: Debouck et al., 1989
Colombia: Toro-Chica et al., 1990
Venezuela: Berglund-Brücher & Brücher, 1976
Ecuador: Debouck et al., 1989
NW Perú: Debouck et al., 1993
Cusco Perú: Weberbauer, 1945
Bolivia: Freyre et al., 1996
Salta: Burkart, 1941
Córdoba: Drewes, 2006

- huge, over > 9,000 km, 28° N-31° S
- discontinuous, in 700-2,900 masl
- in 6 big blocks; SW ECD and NW Perú!
- in montane moist forests, with a dry season

# Resistance to bean weevils

11,000 native varieties tested: 0 resistant

190 wild forms tested: 30 resistant




sources: Acosta et al. 1998; van Schoonhoven & Cardona 1982; van Schoonhoven et al. 1983

- the area of distribution of *arc* is less than 2 % of the total distribution area
- only 10-20% of the plants in the populations have the right *arc* variant
- the selection pressure by the bruchids did not work to have the right *arc* in all plants
- domestication occurred elsewhere, thus the right *arc* variants were never included


photo: Debouck 1989

fuentes: Osborn et al. 1986, 1988, Chacón-Sánchez et al. 2005, Kwak et al. 2009

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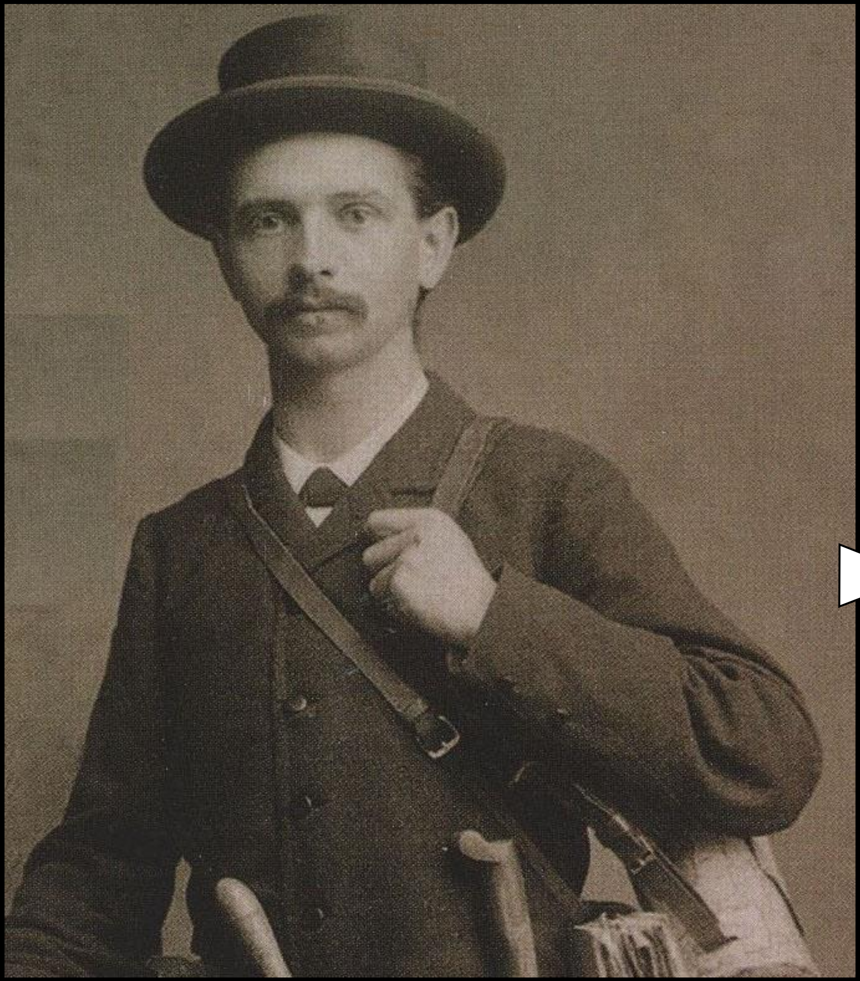

Adolphe Tonduz (1862-1921) ca. 1895

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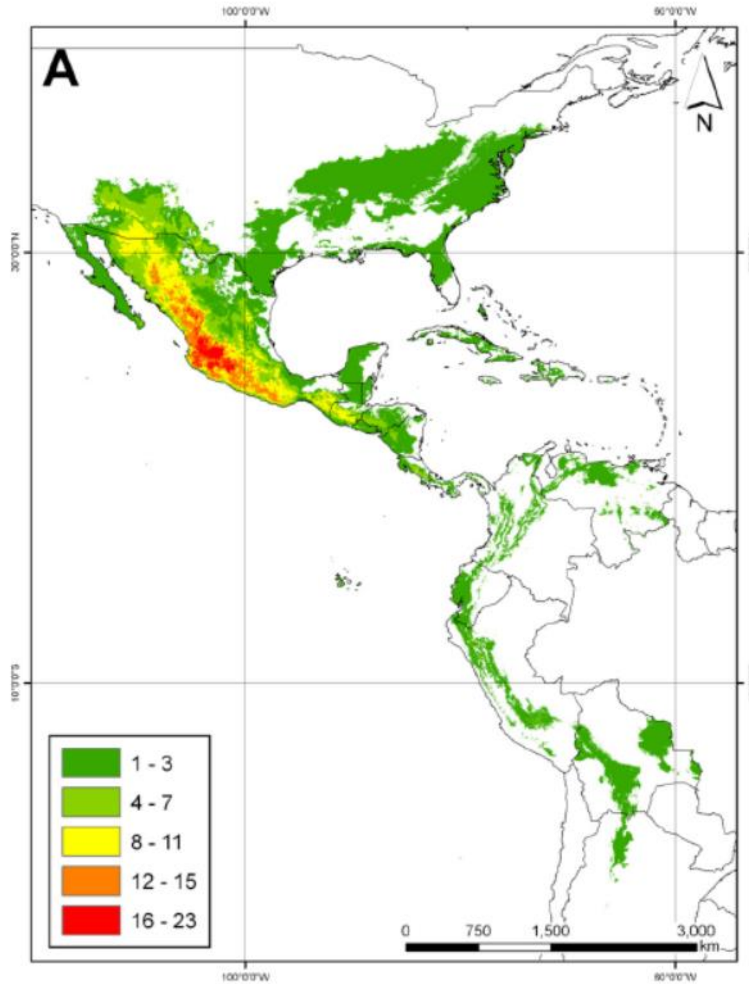
additional information: Grayum et al. 2004, Dauphin-López 2017

# Use of geographical information systems for plant germplasm exploration

(perhaps also to consider: number of days without any precipitation + day air moisture during these days)

| ID | Variable name | Units |
|---|---|---|
| P1 | Annual mean temperature | °C |
| P2 | Mean diurnal temperature range | °C |
| P3 | Isothermality | N/A |
| P4 | Temperature seasonality (standard deviation) | °C |
| P5 | Maximum temperature of warmest month | °C |
| P6 | Minimum temperature of coldest month | °C |
| P7 | Temperature annual range | °C |
| P8 | Mean temperature of wettest quarter | °C |
| P9 | Mean temperature of driest quarter | °C |
| P10 | Mean temperature of warmest quarter | °C |
| P11 | Mean temperature of coldest quarter | °C |
| P12 | Annual precipitation | mm |
| P13 | Precipitation of wettest month | mm |
| P14 | Precipitation of driest month | mm |
| P15 | Precipitation seasonality (coefficient of variation) | % |
| P16 | Precipitation of wettest quarter | mm |
| P17 | Precipitation of driest quarter | mm |
| P18 | Precipitation of warmest quarter | mm |
| P19 | Precipitation of coldest quarter | mm |




- ➢ these models work on an average ecological behavior; the genebank has interest in off-types
- ➢ the models cannot work for species still to be discovered, and do not well when records < 5

sources: Jones et al. 1997, Ramírez-Villegas et al. 2010

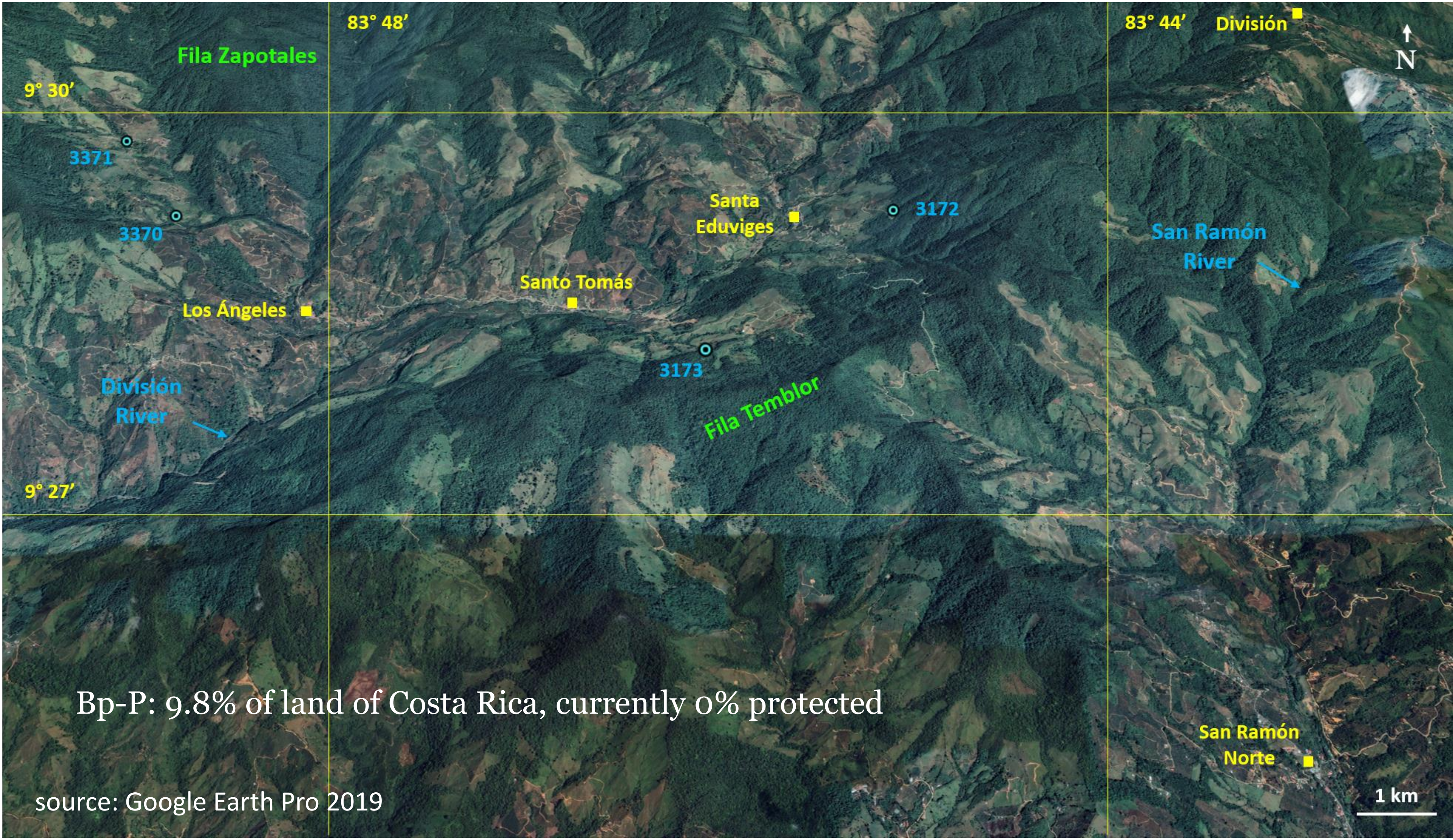
# Discovery of *Phaseolus hygrophilus*, the first species found in Premontane rain forest

(4,000 to 6,500 mm rainfall/ year; ‘dry season’ about 6 weeks in Jan-Feb; 1380-1640 masl)




sources: Salcedo-Castaño et al. 2011, Debouck et al. 2024

Habitat of *Phaseolus hygrophilus*,: the watershed of upper Río División in Costa Rica




In January 2024, two populations (# 3173, #3370) not found, and two new populations (#3404, #3405) added so four populations known to date; evaluated as 'Endangered B2ab(iii)' along IUCN criteria

additional information: Hartshorn 1983, Bolaños-M. & Watson-C. 1993, Sánchez-A. et al. 2001, 2003, Debouck et al. 2024

# 1.5 km NE of Sta. Eduviges in Jan. 2024

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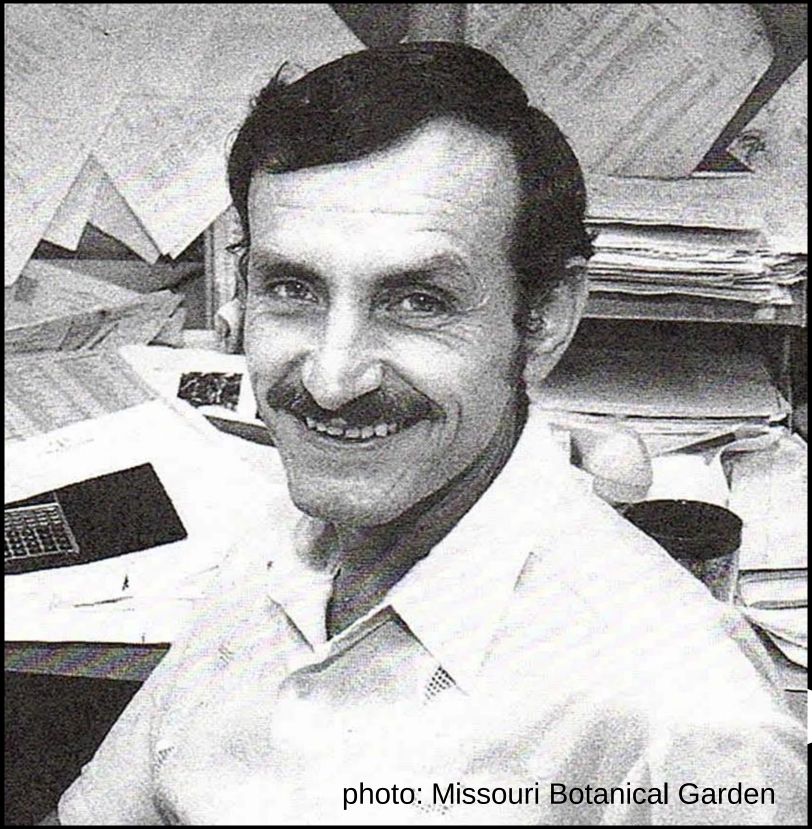


Alwyn H. Gentry (1945-1993) ca. 1992

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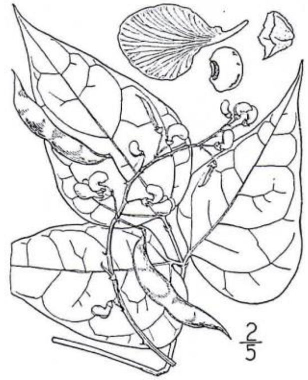
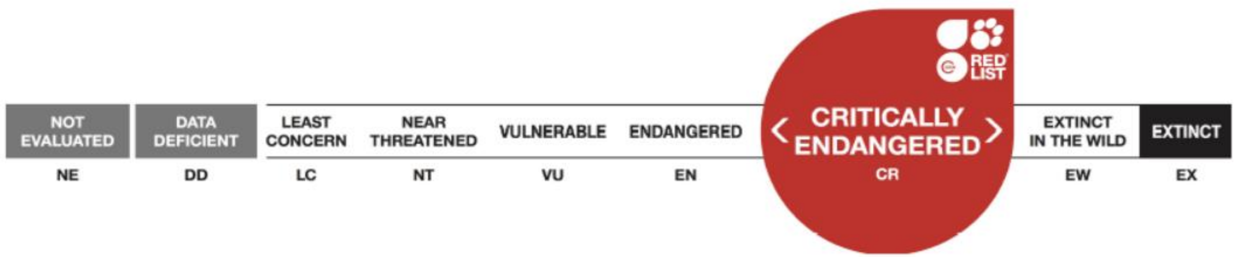
*The IUCN Red List of Threatened Species™*
ISSN 2307-8235 (online)
IUCN 2008: T56960811A56960839




## ***Phaseolus lignosus,*** **Bermuda Bean**

**Assessment by: Copeland, A., Malcolm, P. & Bárrios, S.**

because of change in land uses (housing, agriculture, roads, recreation areas) and invasive flora




"It is estimated that there are now a total of 29 mature individuals surviving in the wild".

"There is not currently much awareness of this species in Bermuda, so programmes to increase its knowledge to the general public and advocate for its planting should be carried out. Additionally, seeds from this species should be sent to the International Centre for Tropical Agriculture (CIAT) and to Meise Botanic Gardens, which hold the world's *Phaseolus* collections, in order to make this species available for further studies".

source: Copeland et al. 2014

• 10 seeds of CW3 obtained from MSB, Wakehurst, UK
• planted in Popayán in 2013, still in production in 2016!
• total of seeds harvested: 6,768, up to Feb 2015
additional information: Britton 1918, Copeland et al. 2014, Debouck 2015
photo: Debouck Popayán 7 Jan 2016

# *Bermuda Islands*

- archipelago of 180 islands and islets; lat. N ~32$^{o}$ 20’, long. W ~64$^{o}$ 45’
- 52 km$^2$, highest point 78 m; karst topography, limestone rock, sandy or silty soils
- mean rainfall 1,445 mm/year, temperature 22.6$^{o}$ C, no frost
- colonization started in 1515; density of people in 2023: 1,181/ km$^2$

is Bermuda willing to give land back to its original flora?

additional information: Watson et al. 1965, Kier et al. 2009, Pettit et al. 2012

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# Now hiring: a high-risk job, with a touch of botanical classicism; yet, irreplaceable for saving biodiversity.

D.G. Debouck
Genetic Resources Program
Alliance of Bioversity International and Centro Internacional de Agricultura Tropical
AA 6713 Cali COLOMBIA; d.debouck@cgiar.org

As it has been over the last two centuries, conservation of biodiversity will likely continue to be short of resources and human talents. This seems especially true in tropical megadiverse countries, where the lack of specialists is often verified for biota beyond mammals and birds. In spite of all shortcomings, tropical biologists and ecologists have from now onwards inherited responsibilities as managers. While computer technologies can provide valuable assistance, field work continues to be relevant in four aspects of these managerial tasks. First, the inventory of the biota in the Neotropics needs to be pursued and is still rewarding in disclosing new options for future economic and social development. Second, an assessment of risk of losing parts of ecosystems has to be done continuously. Satellite and drone imagery may help to that monitoring, increasingly in real time mode, but field validation is essential. Third, specialized studies will result in disclosing natural solutions of problems linked to food, health and ecosystem services. Here, field work will contribute to orient and/ or focus these specialized studies. Finally, because human societies will face hard choices when giving back land to wildlife – and this seems the sole option to slow down the sixth extinction, field work will help decide between options preselected by artificial intelligence. The chosen examples will show the power of integrative approaches.