Fruit types and geographic range size in the genus *Burmeistera* (Campanulaceae)

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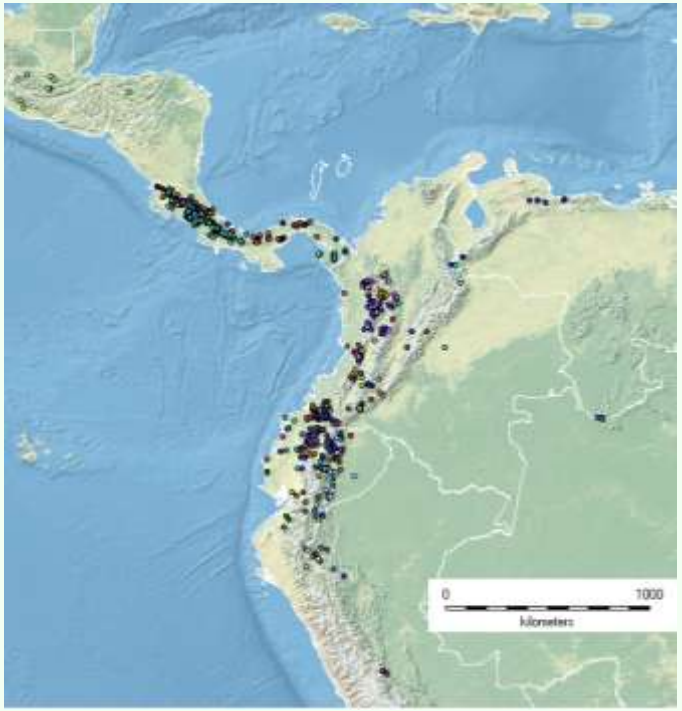
Introduction

- Geographic range size is one of the fundamental ecological and evolutionary characteristics of species.
- Range sizes are influenced by several abiotic and biotic conditions, among those: dispersal ability
- Plants with flying-animal dispersal agents tend to have larger distribution ranges.

The goal of this project is to examine how dispersal agents may influence geographic range sizes in the genus *Burmeistera spp.*

Target species

- *Burmeistera* spp. (Campanulaceae)
- 117 species
- Montane cloud forest 1000- 3000m elevation
- Pollinated by bats and birds
- Two types of fruits



B. ceratocarpa

B. parviflora

Anoura geoffroyi and *B. sodiroana*

Photo credits: www.umsl.edu/~muchhalan/Bat_Flower_Pix.html

Fruit types

1) Brightly-colored, fleshy cylinders, **non-inflated** fruits **or berries** which appear to be adapted to bird dispersal

B. smaragdi

B. succulenta

Burmeistera cyclostigmata

Fieldmuseum neotropical live plant: http://fm2.fieldmuseum.org/

OTS Herbaria (ots.ac.cr),

Garzón & Gonzales (2012)

Fruit types

2) Dull-green, **inflated** ‘balloons’ with the seeds held in a ball. Some sort of a mystery in dispersal terms. Perhaps dispersed by ants or rodents

B. glabrata

Burmeistera vulgaris

Burmeistera spp

Bailey Hortorium.http://tcf.bh.cornell.edu/

Photo: TROPICOS.org

Research questions

- Do non-inflated fruits (i.e. berries) have larger geographic range sizes than those with inflated fruits?
- Which are the climatic conditions influencing the geographic distribution of *Burmeistera* species in different biogeographic regions?

Methods

Fruit measurements:

Length and width of the most developed fruit.

Fruit type: designated using field observations, herbarium specimens and available literature.

FLORA OF PANAMA[1]

BY ROBERT E. WOODSON, JR. AND ROBERT W. SCHERY AND COLLABORATORS

Part IX

FAMILY 183. CAMPANULACEAE[2]

ROBERT L. WILBUR[3]

6. **Burmeistera glauca** (F. E. Wimmer) Gleason, Bull. Torrey Bot. Club 52: 98. 1925.

tube, the anthers 3.5–5.5 mm long, the 2 shorter anthers apically densely fringed with white, pilose trichomes, otherwise all anthers glabrous. *Berries* much inflated, (2–)3–5 cm in diameter, 3–6 cm long, magenta, oblong-ovoid with a truncate apex; seeds fusiform or cylindric, light brown with dark apiculate tips, minutely foveate-reticulate, 0.9–1.2 mm long.

Specimen records:

- Geographic occurrence was taken from online databases

Tropicos® n=1979

GBIF www.gbif.org n=1173

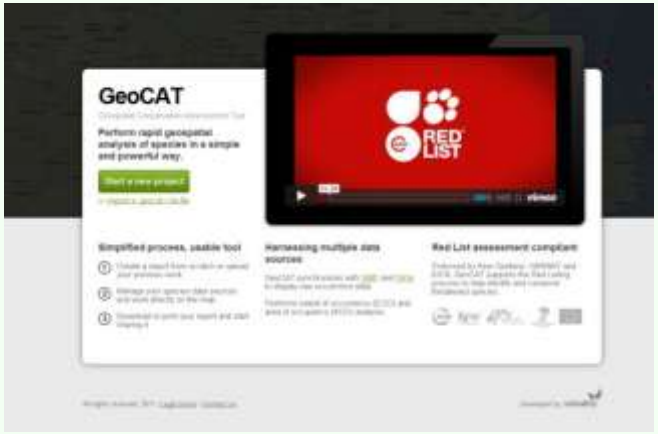
The New York Botanical Garden n=102

n=3454 unique collection for

a total of 97 species

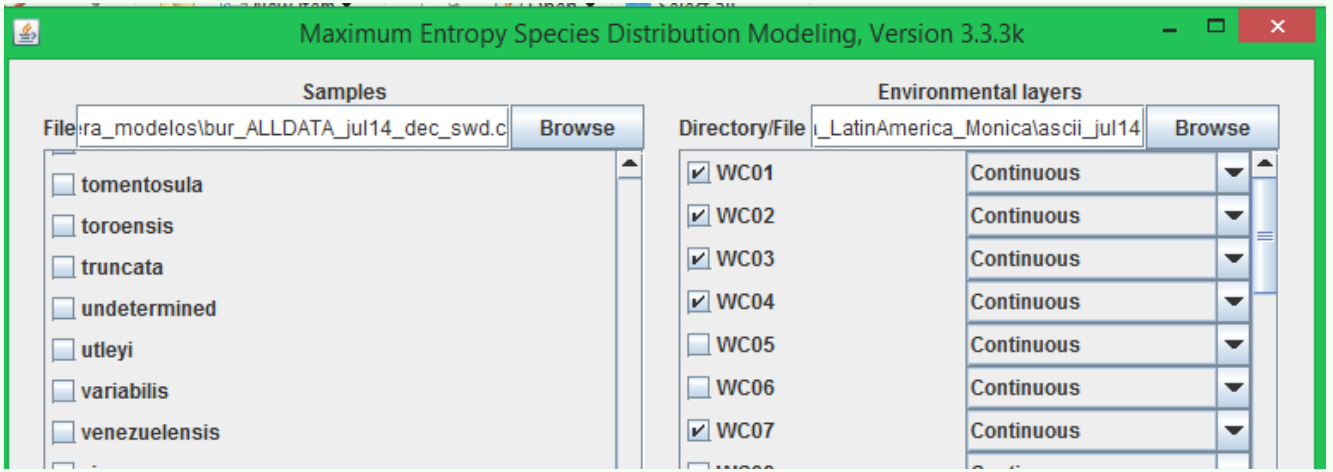
Geographic range sizes estimates

1. Extent of Occurrence (EOO): as area of polygon using GeoCAT (geocat.kew.org)



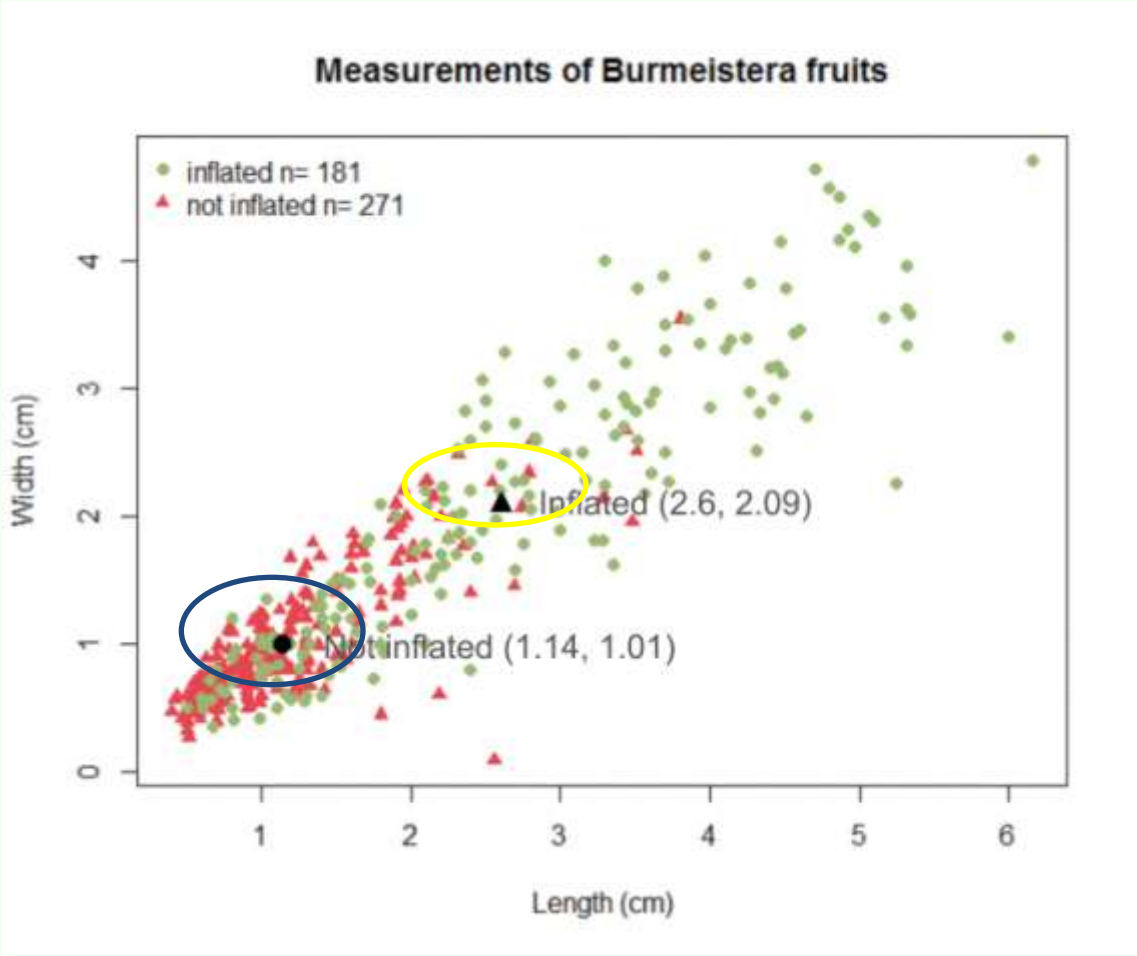
2. Maxent models (Phillips 2006) with 11 non-correlated bioclimatic variables (Hijmans 2005).

- Default settings
- 30% random test
- Equal training sensitivity and specifity



RESULTS

A comparison of *Burmeistera* fruit types



Burmeistera glauca

Inflated fruits are usually bigger than non-inflated (berries)

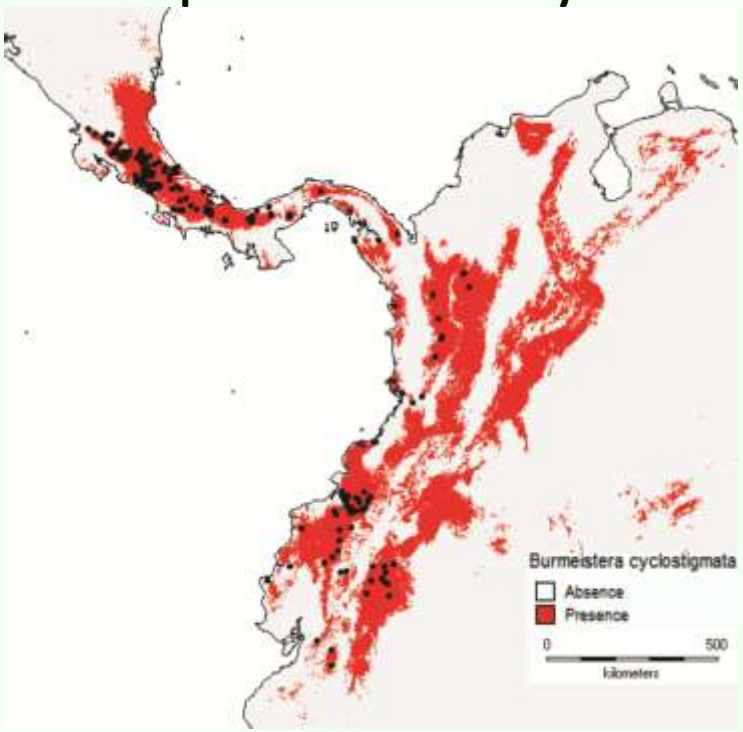
Geographic range sizes

B. cyclostigmata

Extent Of Occurrence (EOO)

Area= 897,099,292 km^2

Area of predicted suitability



Area= 508,662 km^2

Estimates of geographic range sizes for *Burmeistera cyclostigmata.* Sampling size n=509 (black/blue dots)

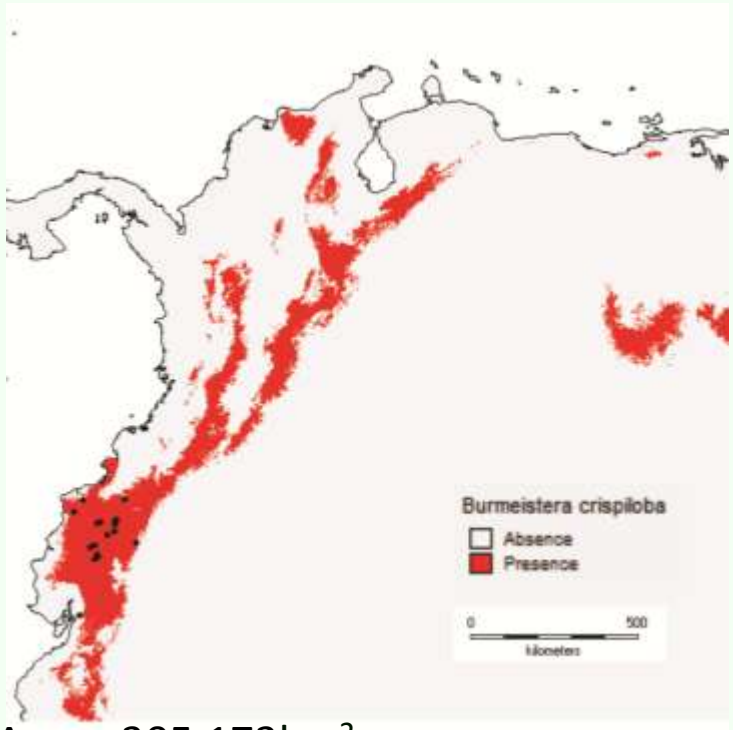
Geographic range sizes

B. crispiloba

Extent Of Occurrence (EOO)

Area= 41,339,543 km^2

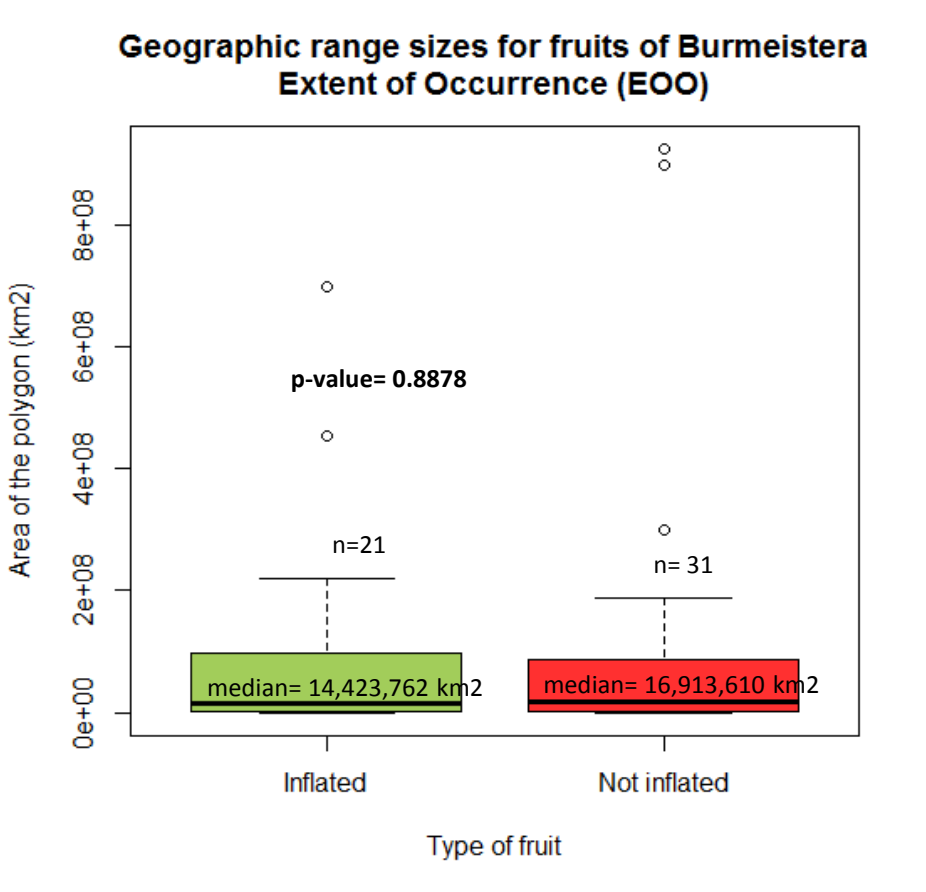
Area of predicted suitability

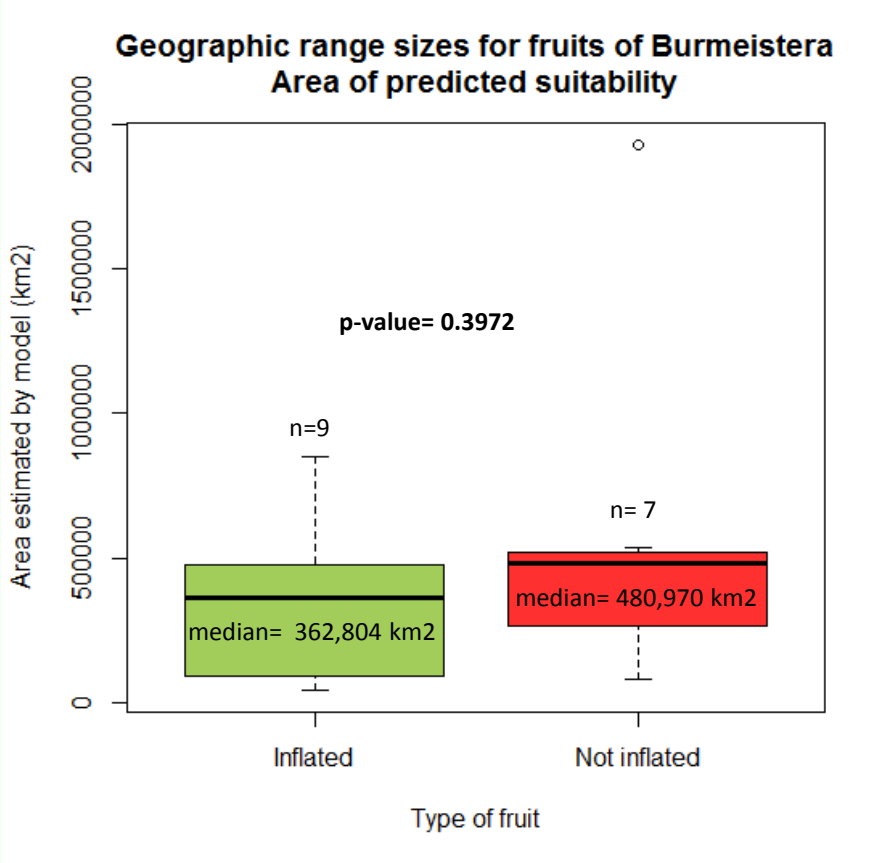


Area= 305,173km^2

Estimates of geographic range sizes for *Burmeistera crispiloba* . Sampling size n=25 (black/blue dots)

Comparison between fruit types and geographic ranges





Apparently, there is no relationship between geographic range sizes and fruit types (p>0.05)

Climatic conditions

We extracted each BIOCLIM values for all occurrences and divided them into **4 biogeographic regions.**

DAR (Darién) **WDS** (Widespread, with specimen records from both continent)

SA (South America) **CA** (Central America)

	Temperature					Precipitation					
	BIO01 Annual Mean Temperature	BIO02 Mean Diurnal Range	BIO03 Isothermality	BIO04 Temperature Seasonality	BIO07 Temperature Annual Range	BIO12 Annual Precipitation	BIO13 Precipitation of Wettest Month	BIO15 Precipitation Seasonality	BIO17 Precipitation of Driest Quarter	BIO18. Precipitation of Warmest Quarter	BIO19. Precipitation of Coldest Quarter
DAR-CA	>	<	>	<	<	=	=	=	=	=	>
DAR-SA	>	<	<	>	<	=	>	>	<	<	>
DAR-WDS	>	<	=	<	<	<	=	=	<	<	>
WDS-CA	>	>	>	<	=	>	>	<	>	>	>
WDS-SA	>	<	<	>	=	>	>	>	<	>	=
SA-CA	>	>	>	<	=	<	<	<	>	<	>

- Species with wider distributions can tolerate a wider gradient of environmental factors than those more restricted
- In general, South American species are exposed to higher temperatures and lower precipitation than Central American species

- Environmental conditions in the Darién region might be acting as a dispersal barrier in *Burmeistera* species.

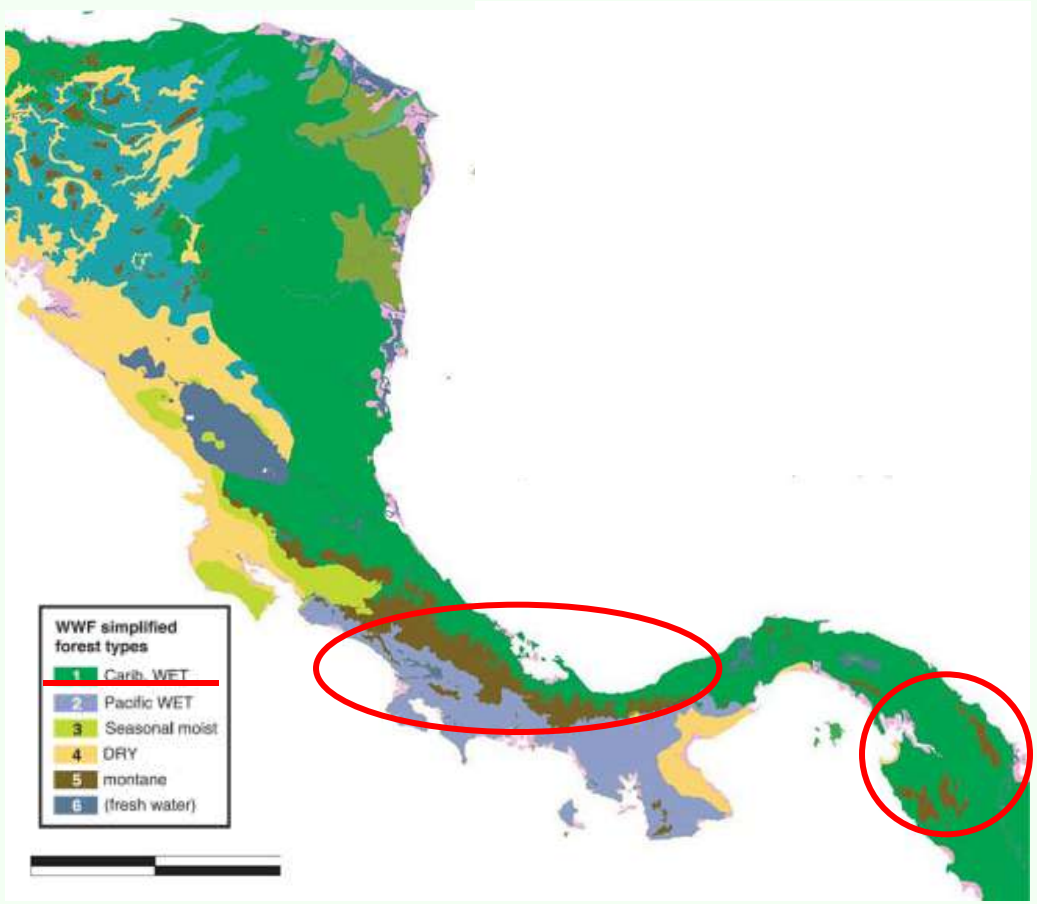
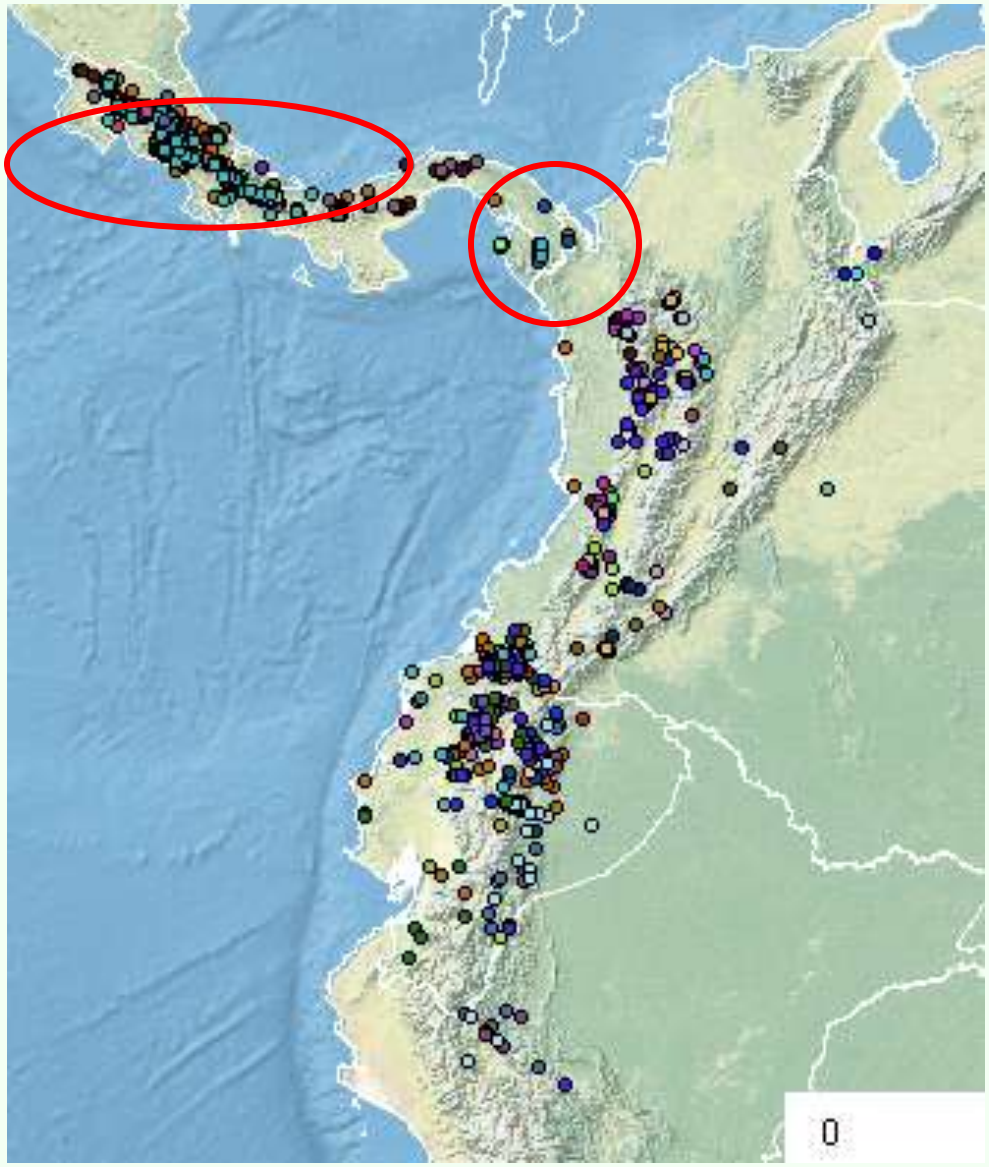


Fig. […] Coloured regions in the main map represent simplified World Wildlife Fund ecoregions (‘**Caribbean WET**’ combines three WWF ecoregions: Central American Atlantic moist, Isthmian-Atlantic moist, and Chocó-Darién moist. ‘Montane’ combines three WWF ecoregions: Central American, Talamancan and Eastern Panamanian montane forests)[..]

Crawford *et al. (*2007)



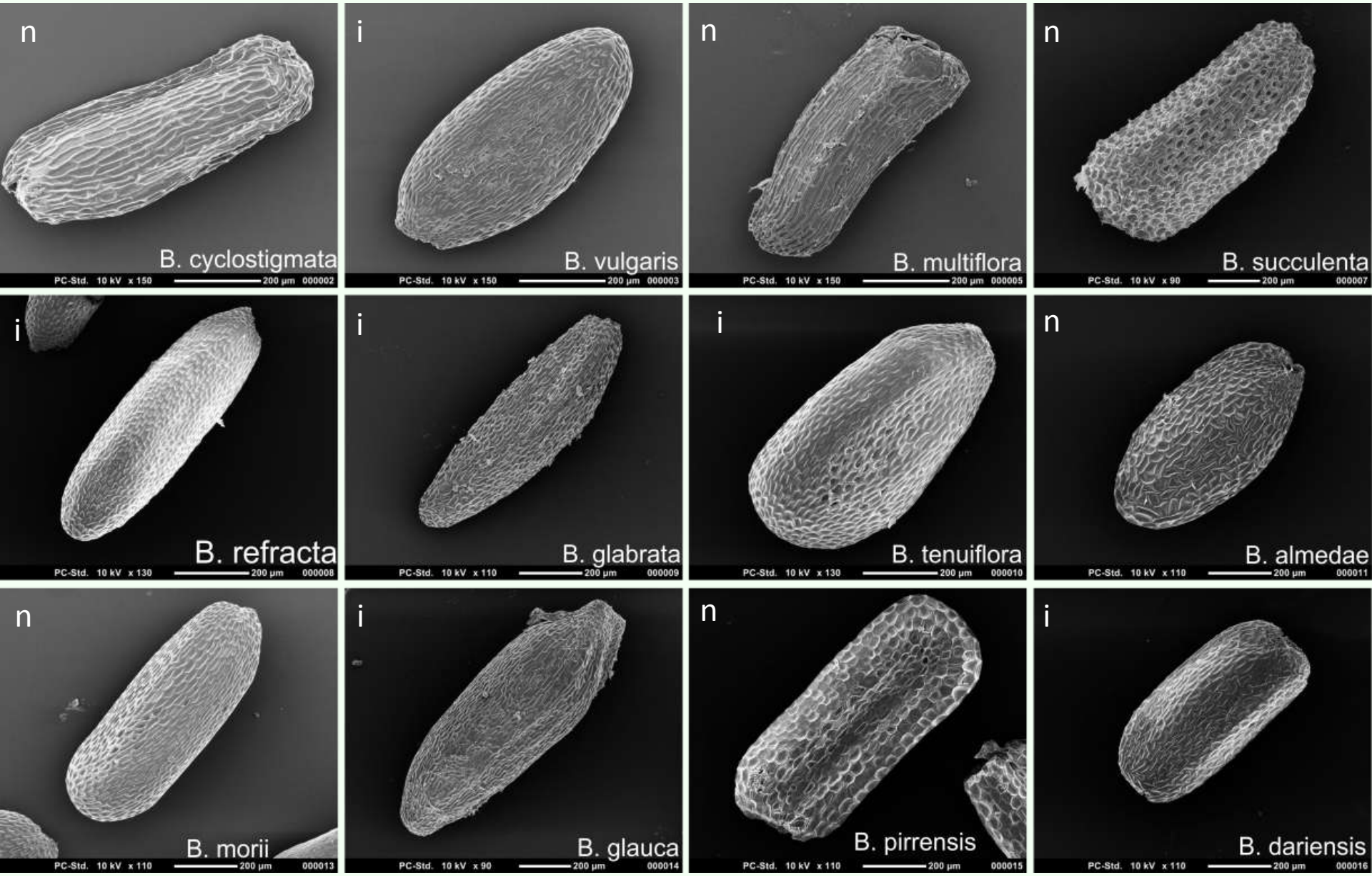
All *Burmeistera* occurrence points with unique values

Total species= 97
Number of points =3454

Conclusions

- Geographic range sizes do not seem to differ among species with non-inflated and inflated fruits.
- Bioclimatic conditions - temperature and precipitation - vary among biogeographic regions, which in turn may influence the geographic distribution of *Burmeistera* species within the Neotropics.

Other observations



SEM micrographs of *Burmeistera* seeds

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