

Developing a user-friendly gap analysis tool to build more complete ex situ collections

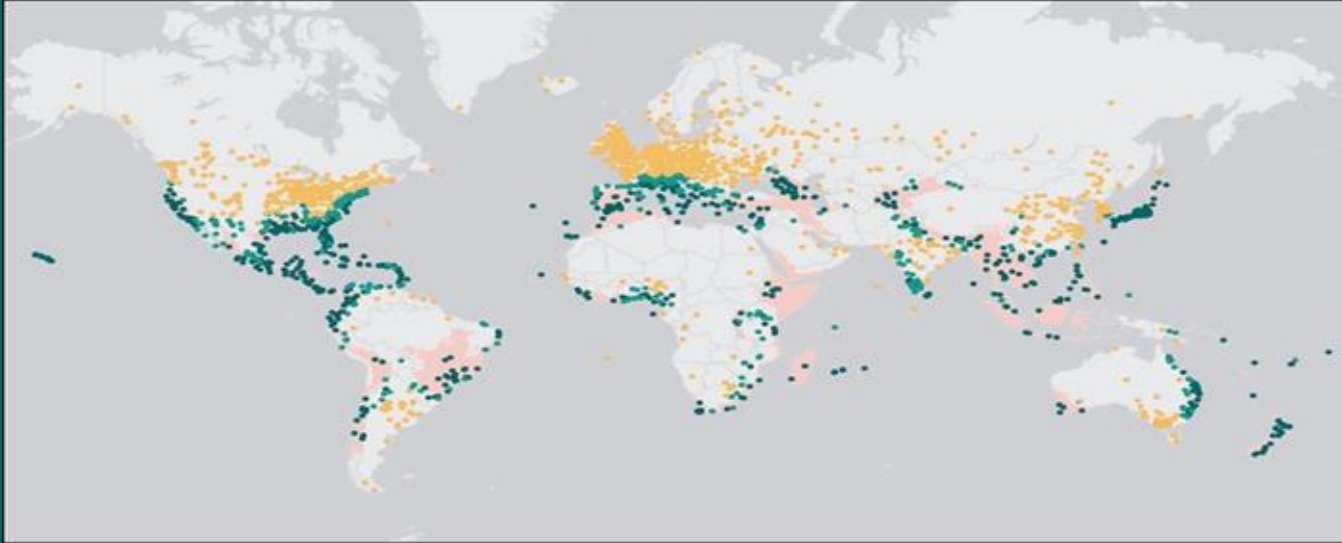
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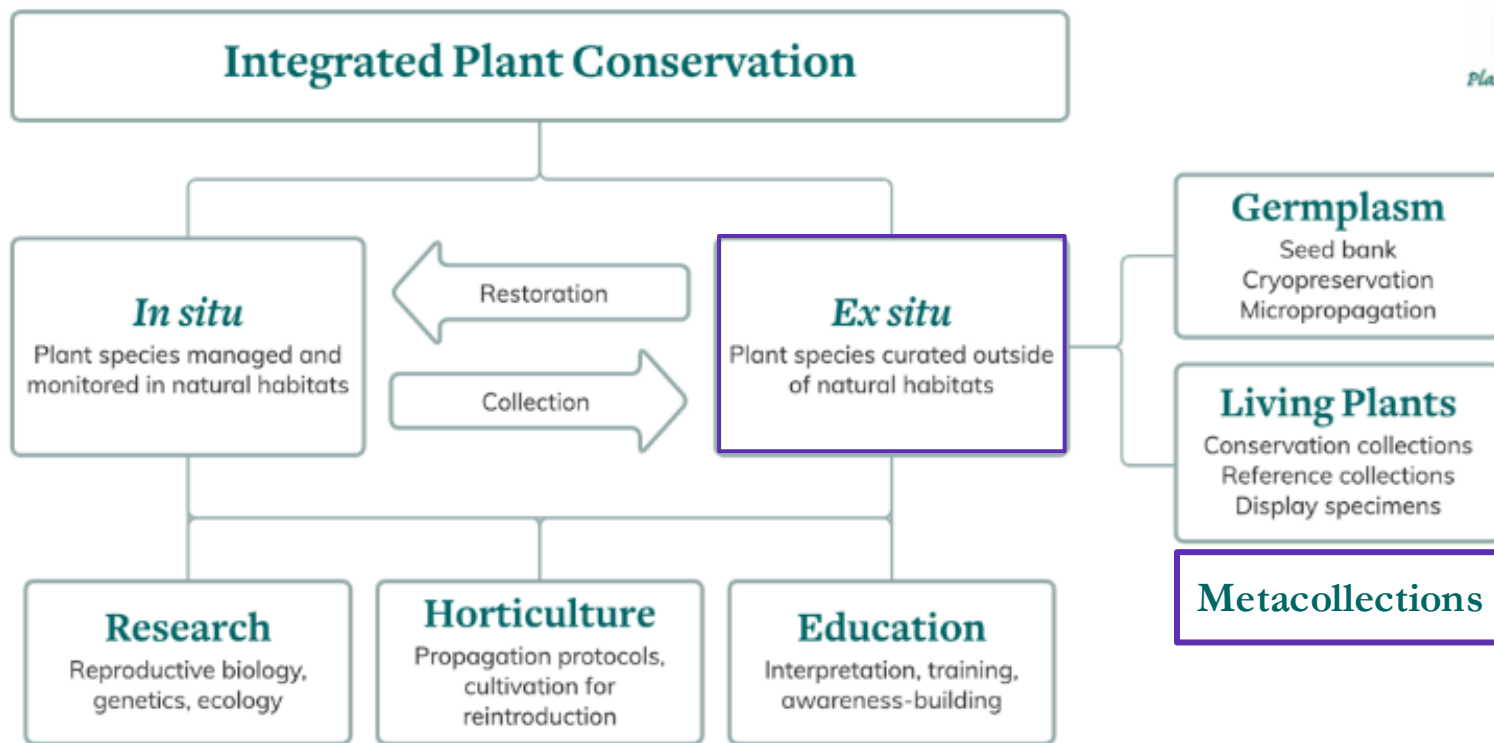
Botanical Gardens Conservation International

BGCI's mission is to mobilize botanic gardens and engage partners in securing plant diversity for the well-being of people and the planet



3,500 botanic gardens worldwide
60,000 botanical experts
1 billion visitors

Botanic Gardens Contribute to Plant Conservation



Setting the scene:

Global Tree Assessment

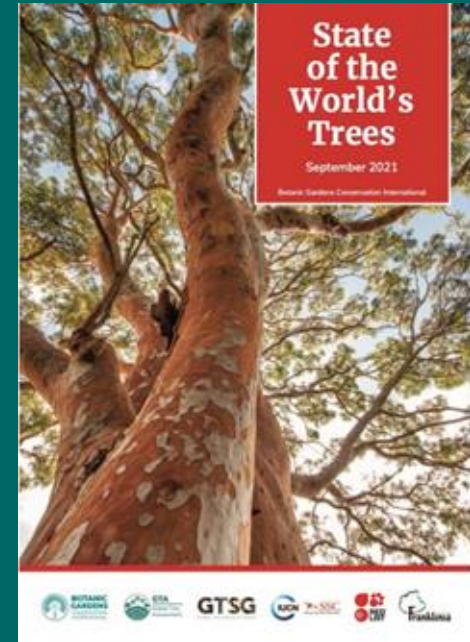
Global Trees Campaign

- Cataloguing the world's trees
- Prioritising tree species for conservation action
- Taking direct conservation action working with local partners
- **Zero** tree species extinctions



Global Conservation Consortia (GCC)

- One in three tree species are threatened with extinction
- Scale-up tree conservation via GCC's
- Utilizing specialist knowledge of target taxa
- Conserve trees where the need is greatest
- *In situ* and *ex situ* work focused in centres of diversity
- To be led by institutions based in centres of diversity
- Initial focus on trees is expanding to non-tree taxa



...to mobilise a coordinated network of institutions and experts to collaboratively develop and implement comprehensive conservation strategies for priority threatened plant groups

Taxonomic groups selected for GCC meet several of the following criteria:

- **Highly threatened** groups
- **Technically challenging to grow**
- **Technically challenging to manage** (e.g. exceptional species that cannot be seed banked)
- Plant groups with diversity centres of **low capacity** → opportunity to build capacity
- Plant groups with a **distribution that spans many regions** → requires coordination
- **Plant groups overlooked by other sectors**
- Plant groups **already prioritised in the botanic garden sector** → leverage momentum
- Plant groups that are **keystone species** in biodiversity hotspots



Current Consortia



Acer



Conifers



Cycads



Dipterocarps



Ebenaceae



Erica



Food Plants



Magnolia



Nothofagus



Oak



Rhododendron



**Whitebeams, Rowans
and Service Trees**



GCC Objectives

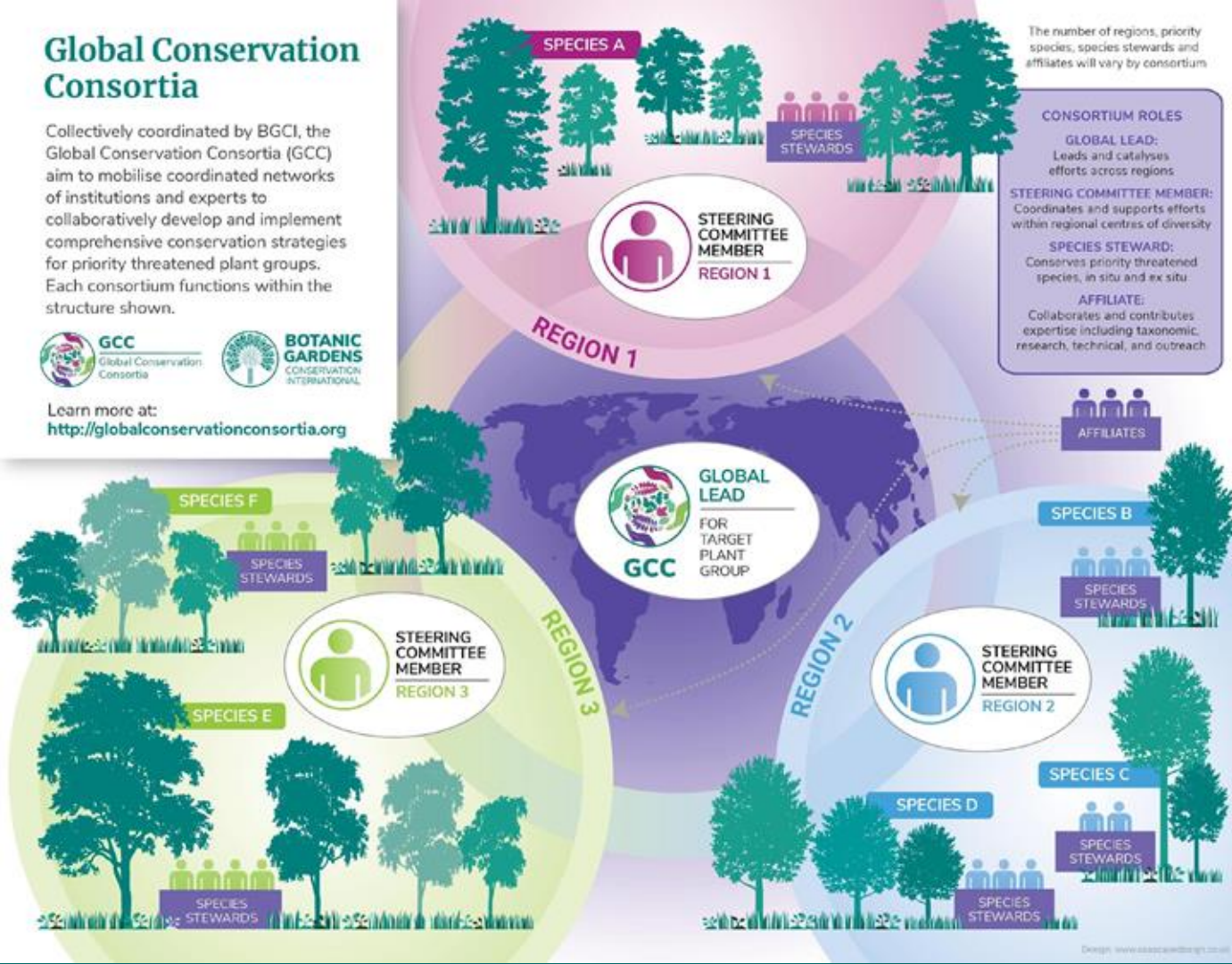
- Establish and foster a **network of experts**
- **Identify, prioritize** species of greatest conservation concern
- Develop coordinated **ex situ collections** of **conservation value**
- Undertake and facilitate applied **research**
- Ensure that threatened species are conserved ***in situ***
- **Build capacity** of in-country partners in **diversity centres**
- Increase **public awareness** and engagement
- Raise **funding** to scale-up conservation action

Global Conservation Consortia

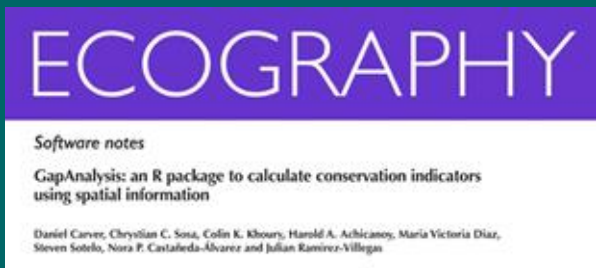
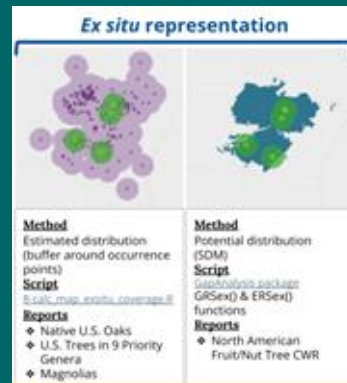
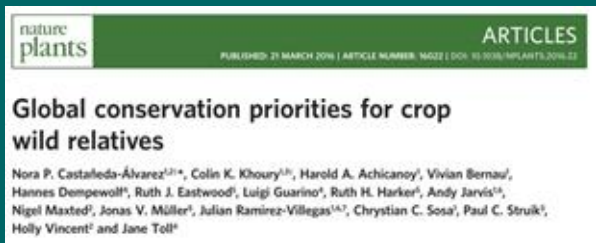
Collectively coordinated by BGCI, the Global Conservation Consortia (GCC) aim to mobilise coordinated networks of institutions and experts to collaboratively develop and implement comprehensive conservation strategies for priority threatened plant groups. Each consortium functions within the structure shown.



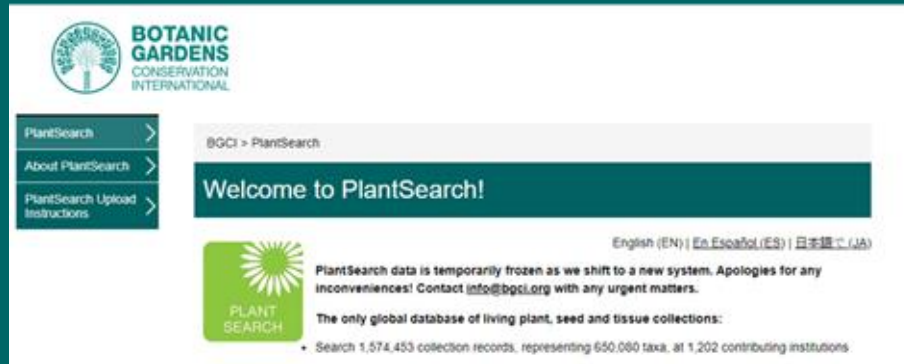
Learn more at:
<http://globalconservationconsortia.org>



Conservation Gap Analysis – a growing practice



Accession level data



- Develop coordinated *ex situ* collections of conservation value
- Accession level data gathering
- Gap Analysis

	C	D	F	G	I	J	K	W
1	submission_year	species_name_acc	prov_type	gps_det	lat_dd	long_dd	all_locality	num_indiv
4	2019	Magnolia fraseri	W	L	35.434649	-82.237985	Hickory Nut Gorge; Bat Ca	1
5	2019	Magnolia fraseri	W	C	35.672215	-82.067684	Crabtree Meadows; on the	2
6	2019	Magnolia fraseri	W	G	36.65997778	-81.54455833	Mt. Rodgers; Jefferson Na	2
7	2020	Magnolia fraseri	W	C	34.868083	-83.426229	Rabun Georgia Unite	2
8	2019	Magnolia fraseri	W	G	34.775215	-83.623161	Chattahoochee National F	1
9	2019	Magnolia fraseri	W	G	34.775215	-83.623161	Chattahoochee National F	1
10	2019	Magnolia fraseri	W	G	34.775215	-83.623161	Chattahoochee National F	1

Working towards comprehensive species diversity in garden collections

→ *ex situ* gap analysis

- The **gap** is wild genetic diversity not currently represented in the collection
- Close gaps by adding missing genetic diversity to the collection



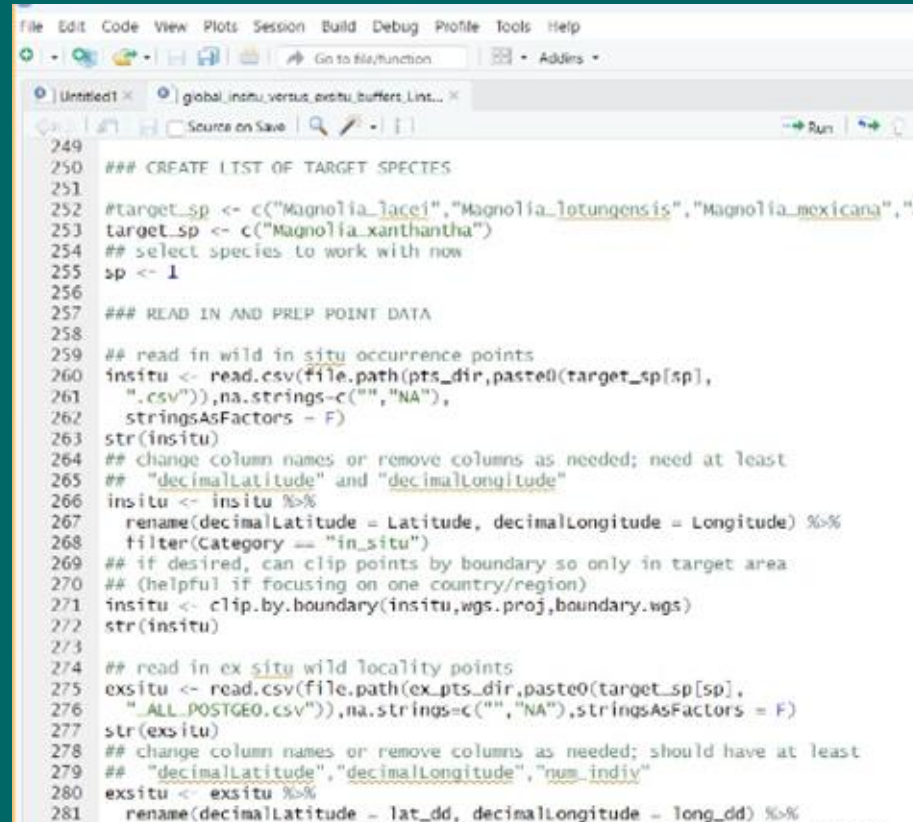


Using gap analysis to determine the status of a collection

- How genetically complete is the collection?
- What diversity is currently in the collection and what is not in the collection?
- Are any plants redundant?
- Should new plants be brought into the collection?

Gap analysis: expanding the practice

- Gap analysis conducted in R
- Capacity gaps remain—time, expertise, patience...

A screenshot of an R script editor window. The window has a menu bar (File, Edit, Code, View, Plots, Session, Build, Debug, Profile, Tools, Help) and a toolbar. The script content is as follows:

```
249  
250 ### CREATE LIST OF TARGET SPECIES  
251  
252 #target_sp <- c("Magnolia_lancei", "Magnolia_lotungensis", "Magnolia_mexicana",  
253 target_sp <- c("Magnolia_xanthantha")  
254 ## select species to work with now  
255 sp <- 1  
256  
257 ### READ IN AND PREP POINT DATA  
258  
259 ## read in wild in situ occurrence points  
260 insitu <- read.csv(file.path(pts_dir, paste0(target_sp[sp],  
261 ".csv")), na.strings=c("", "NA"),  
262 stringsAsFactors = F)  
263 str(insitu)  
264 ## change column names or remove columns as needed; need at least  
265 ## "decimalLatitude" and "decimalLongitude"  
266 insitu <- insitu %>%  
267   rename(decimalLatitude = Latitude, decimalLongitude = Longitude) %>%  
268   filter(category == "in_situ")  
269 ## if desired, can clip points by boundary so only in target area  
270 ## (helpful if focusing on one country/region)  
271 insitu <- clip.by.boundary(insitu, wgs.proj, boundary.wgs)  
272 str(insitu)  
273  
274 ## read in ex situ wild locality points  
275 exsitu <- read.csv(file.path(ex_pts_dir, paste0(target_sp[sp],  
276 "_ALL_POSTGEO.csv")), na.strings=c("", "NA"), stringsAsFactors = F)  
277 str(exsitu)  
278 ## change column names or remove columns as needed; should have at least  
279 ## "decimalLatitude", "decimalLongitude", "num_indiv"  
280 exsitu <- exsitu %>%  
281   rename(decimalLatitude = lat_dd, decimalLongitude = long_dd) %>%
```

Gap Analysis & Metacollection Management tool

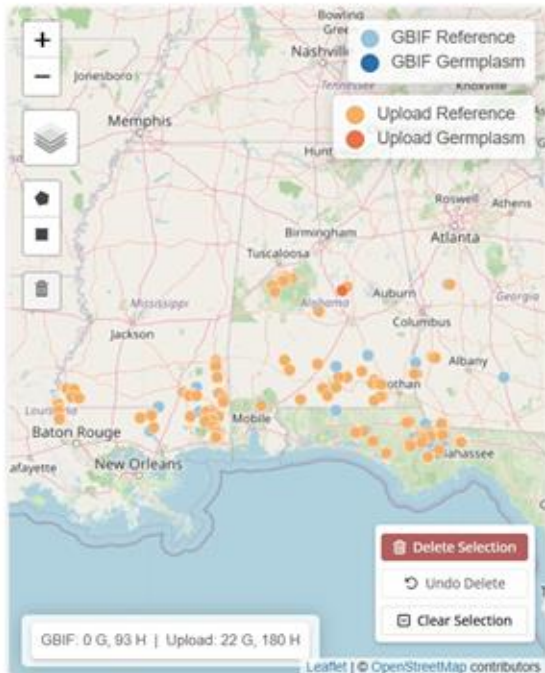
GAMMA

Home

Data Analysis

Gap Analysis

About



GBIF

Accession Number

Taxon Name

6195266186	Magnolia fraseri var. pyramidata (W.Bar
5938167282	Magnolia fraseri var. pyramidata (W.Bar
5867966035	Magnolia fraseri var. pyramidata (W.Bar
5134151984	Magnolia fraseri var. pyramidata (W.Bar
4004603555	Magnolia fraseri var. pyramidata (W.Bar

Upload

Accession Number

Taxon Name

Current

4153062803	Magnolia pyramidata W.Bartram	H
4898042145	Magnolia pyramidata W.Bartram	H
399-2019	Magnolia fraseri	G
4898083389	Magnolia pyramidata W.Bartram	H
1800007477	Magnolia pyramidata W.Bartram	H

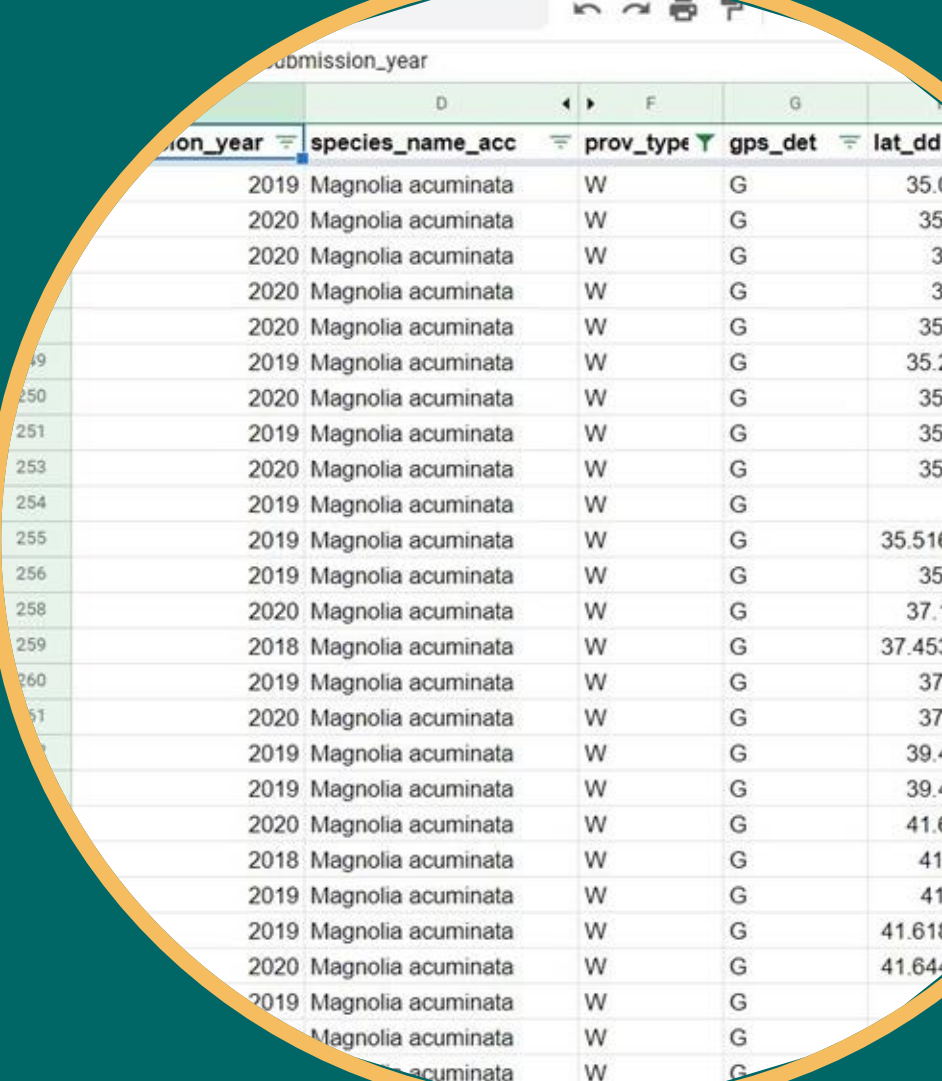
Use GAMMa to

- Visualize
- Quantify
- Assess

the geographical and ecological coverage (and gaps) of their collections

Data types for *ex situ* gap analysis

- ***Ex situ* collections records** (with information about where living material in a gene bank or garden came from)
- **Wild occurrence point data** (where does the species occur in the wild)



submission_year				
	D	F	G	
on_year	species_name_acc	prov_type	gps_det	lat_dd
2019	Magnolia acuminata	W	G	35.0
2020	Magnolia acuminata	W	G	35.0
2020	Magnolia acuminata	W	G	3.0
2020	Magnolia acuminata	W	G	3.0
2020	Magnolia acuminata	W	G	35.0
2019	Magnolia acuminata	W	G	35.2
2020	Magnolia acuminata	W	G	35.0
2019	Magnolia acuminata	W	G	35.0
2020	Magnolia acuminata	W	G	35.0
2019	Magnolia acuminata	W	G	35.516
2019	Magnolia acuminata	W	G	35.0
2020	Magnolia acuminata	W	G	37.0
2018	Magnolia acuminata	W	G	37.453
2019	Magnolia acuminata	W	G	37.0
2020	Magnolia acuminata	W	G	37.0
2019	Magnolia acuminata	W	G	39.0
2019	Magnolia acuminata	W	G	39.0
2020	Magnolia acuminata	W	G	41.0
2018	Magnolia acuminata	W	G	41.0
2019	Magnolia acuminata	W	G	41.0
2019	Magnolia acuminata	W	G	41.613
2020	Magnolia acuminata	W	G	41.64
2019	Magnolia acuminata	W	G	
	Magnolia acuminata	W	G	
	Magnolia acuminata	W	G	

Output and Results of GAMMa

GAMMA

[Home](#)[Data Analysis](#)[Gap Analysis](#)[About](#)

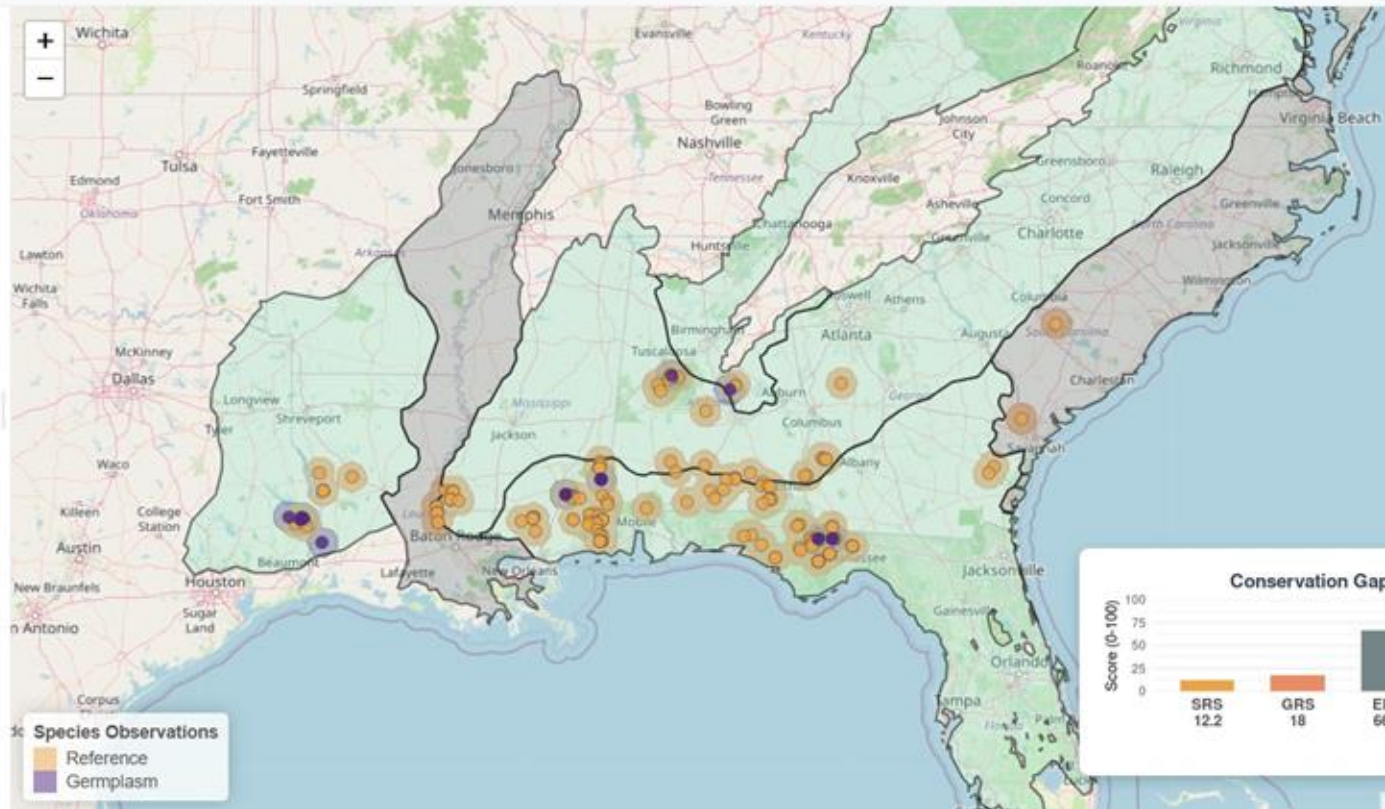
Controls

Buffer Distance (km)

25

Run Gap Analysis

Download Report



OpenStreetMap

Topography

Imagery

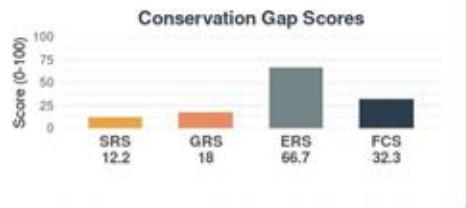
Reference Records

Germplasm Records

Buffers

GRS Gap

ERS Regions



Output and Results



Three metrics are aggregated into a Final Conservation Score (FCS) ranging from 0 to 100.

- *Sampling Representativeness Score (SRS)*
- *Geographic Representativeness Score (GRS)*
- *Ecological Representativeness Score (ERS)*

Project Team



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GAMMa Use case:
Magnolia pyramidata

Establish, expand and manage ex situ collections of high conservation value

- Understanding current status of collections of focal species
- Identifying ways to expand collections
- Collective management of metacollections

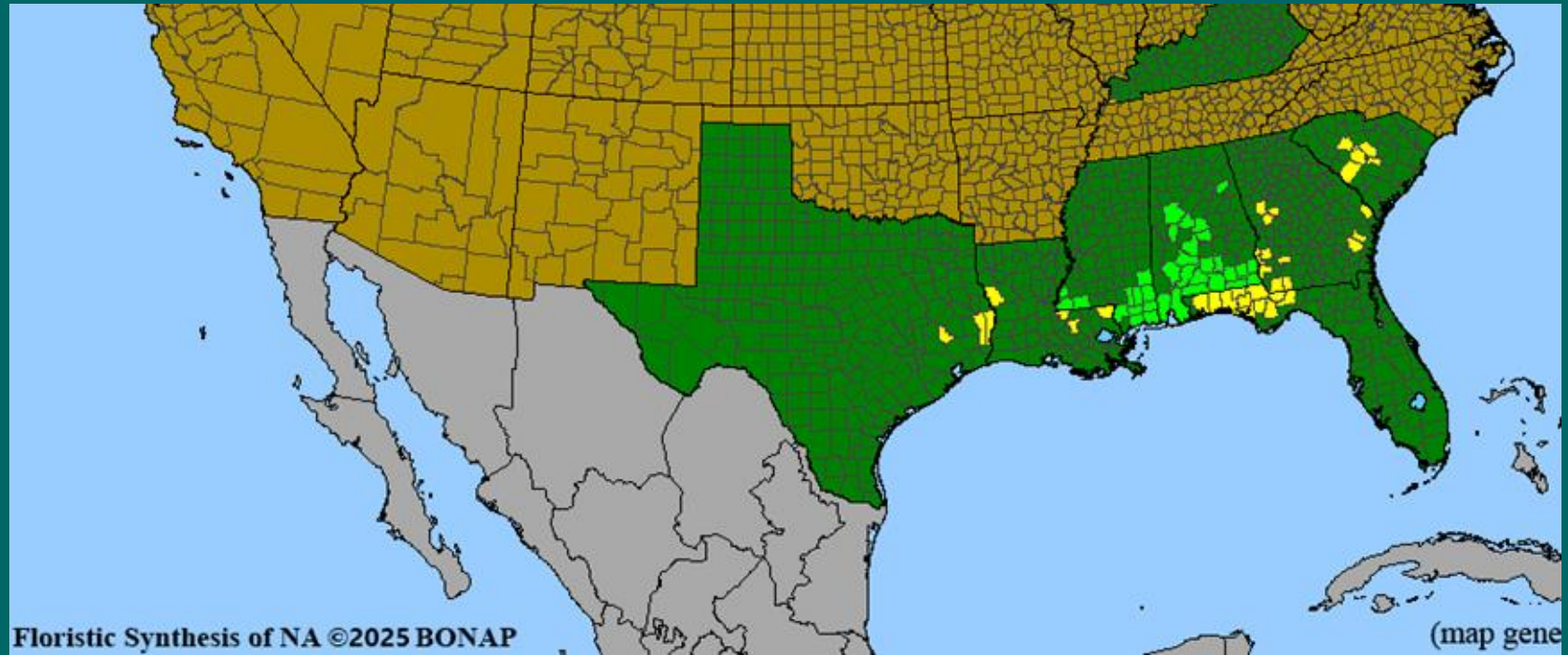


Pyramid magnolia (*Magnolia pyramidata*)

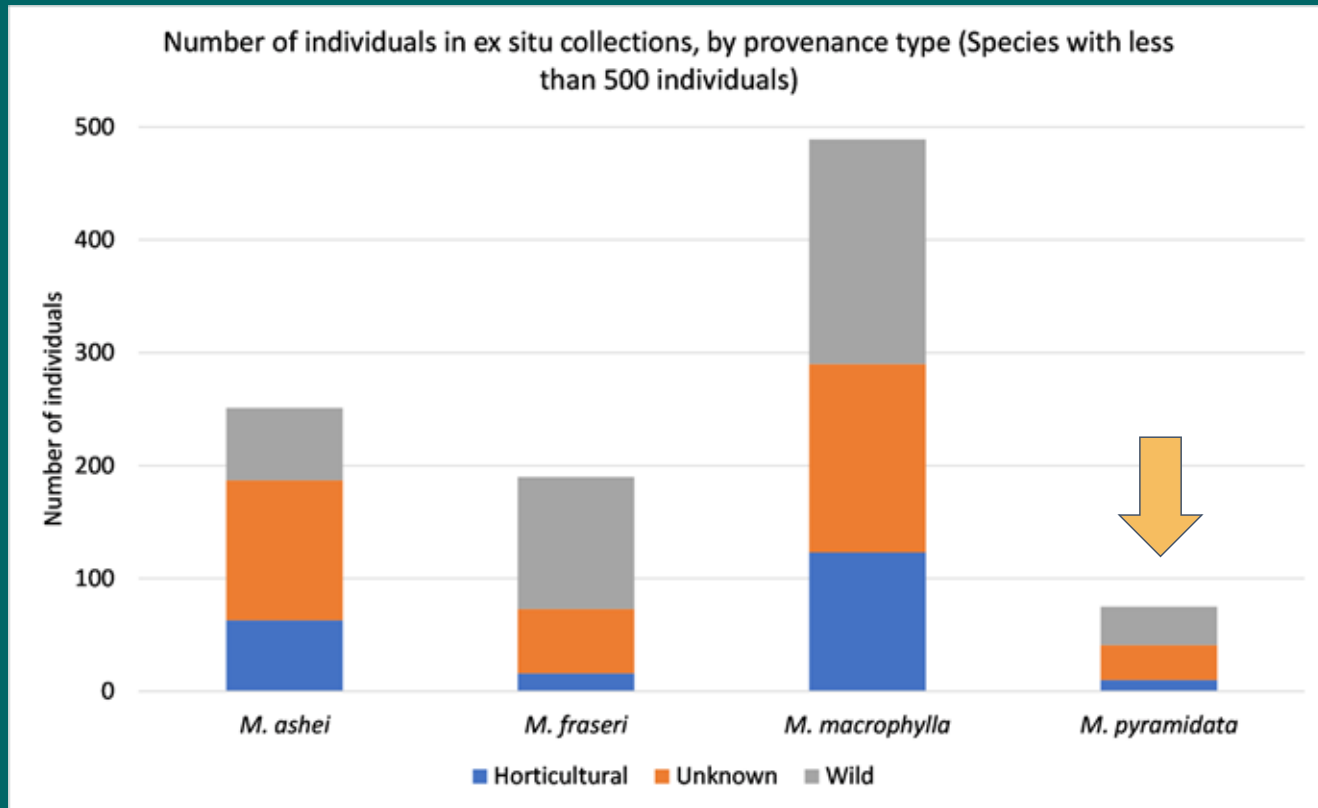


Pyramid Magnolia

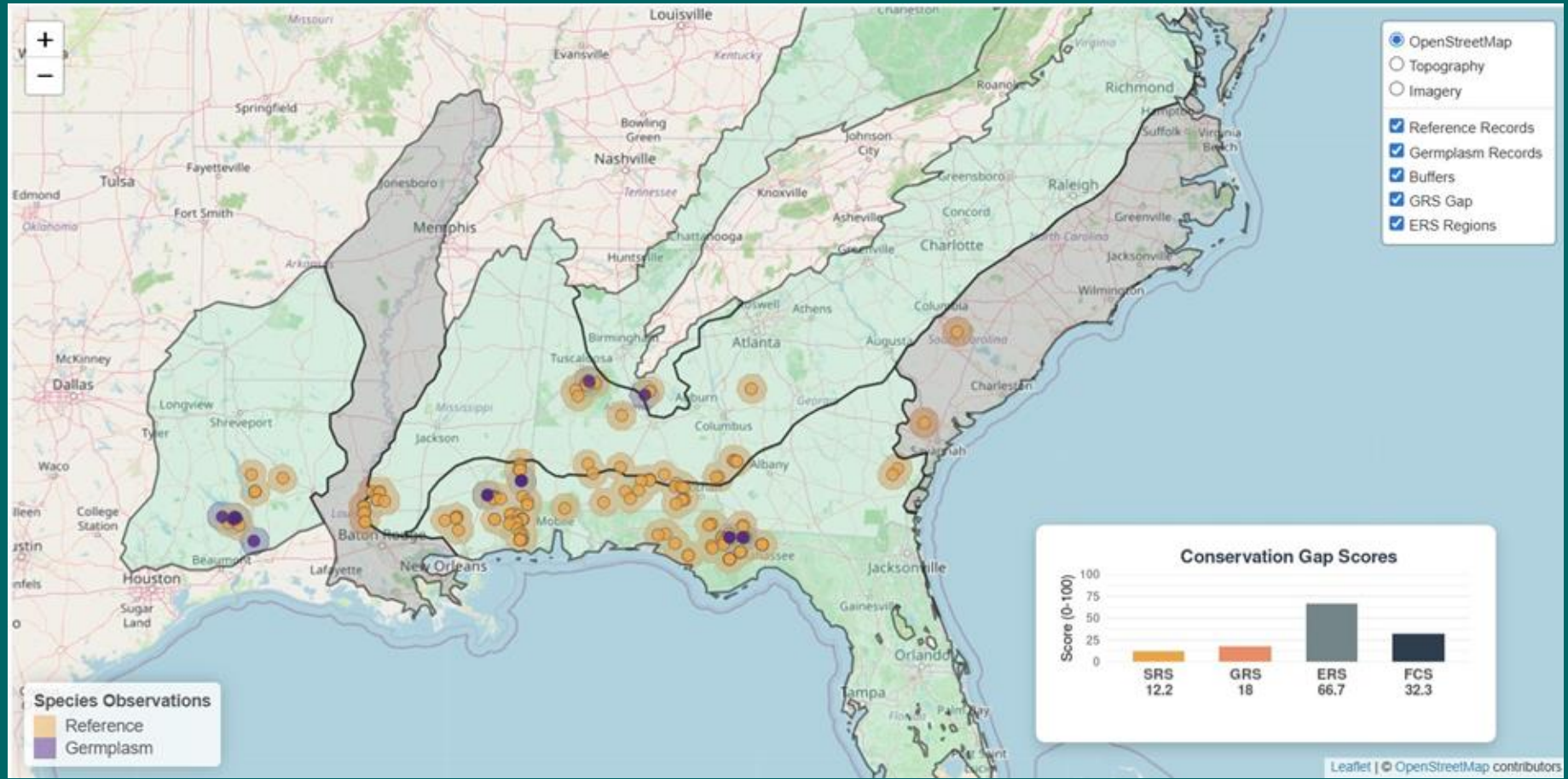
(*Magnolia pyramidata*)



Results: *Ex situ*



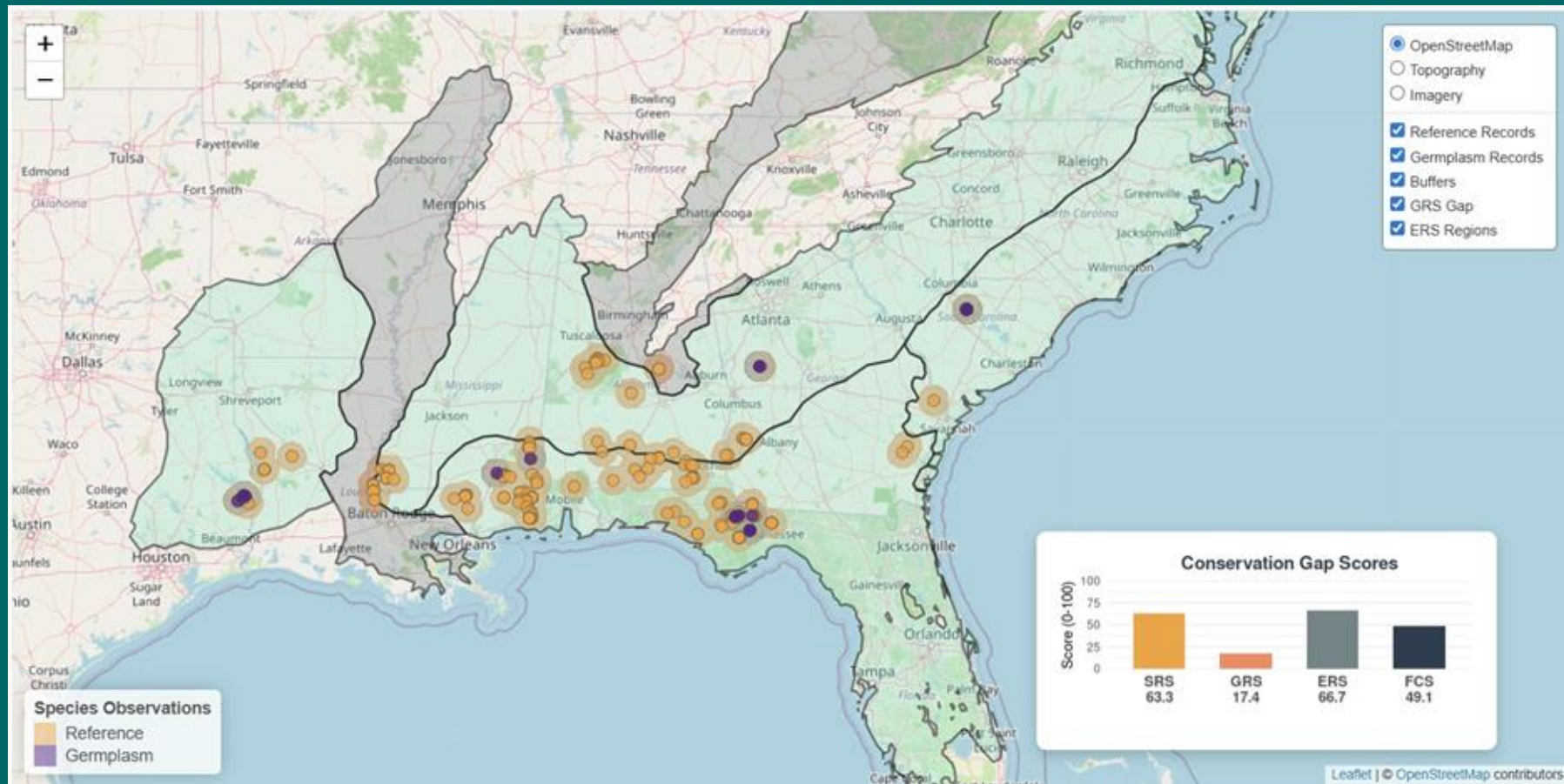
Ex Situ Gap Analysis of *Magnolia pyramidata* (2020)



Collecting (2024) & resurveying gardens (2025)



Output and Results (2026)



Thank you!

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