Global Conservation Gap Analysis of *Magnolia*

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Global Conservation Consortium Magnolia

Atlanta Botanical Garden

Botanic Gardens Conservation International

magnolia Society International

The **GLOBAL CONSERVATION CONSORTIUM FOR MAGNOLIA (GCCM)** is a coordinated network of institutions and experts who work collaboratively to develop and implement a comprehensive conservation strategy to prevent the extinction of the world's *Magnolia* species. The GCCM is led by the Atlanta Botanical Garden and a steering committee of partners from *Magnolia* biodiversity centers in the USA & Canada, Mexico & Central America, the Caribbean, South America, East Asia and South & Southeast Asia.

The **ATLANTA BOTANICAL GARDEN** has more than 30 years of experience in the conservation and recovery of rare and threatened plant species through research, propagation, collaborative restoration and habitat management. Through its Southeastern Center for Conservation & Research, the Atlanta Botanical Garden advances the science of conservation across the southeastern United States, Caribbean, and Neotropics, protecting the natural heritage of one of North America's most biodiverse regions. Research, collaborations, and native species recovery programs include conservation collections at the Garden and applied conservation activities that support preservation of species in their native habitats. Conservation programs, training, and capacity building derived from the activities of the Southeastern Center for Conservation support the Garden's commitment to serving the needs of the community and making the connection between people and plants.

BOTANIC GARDENS CONSERVATION INTERNATIONAL (BGCI) is the world's largest plant conservation network, comprising more than 500 botanic gardens in over 100 countries, and provides the secretariat to the IUCN/SSC Global Tree Specialist Group. BGCI was established in 1987 and is a registered charity with offices in the UK, US, China, Kenya and Singapore.

The **MAGNOLIA SOCIETY INTERNATIONAL (MSI)** is a non-profit organization devoted to the appreciation and study of Magnolias. Founded in 1963, the mission of the MSI is to inform, educate and inspire people, from backyard gardeners to botanists, to learn more about the cultivation, conservation, taxonomy and propagation of Magnolias. Main activities of the Society include exchanging *Magnolia* plant material, evaluating and promoting *Magnolia* cultivars, educating the garden community, supporting research on Magnolias, and serving as the international registration authority for new *Magnolia* cultivars.

Magnolia lucida (Keming Yang, South China Botanical Garden)

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Acronyms:

BGCI	Botanic Gardens Conservation International
BIEN	Botanical Information and Ecology Network
CBD	Convention on Biological Diversity
FFI	Fauna & Flora International
GBIF	Global Biodiversity Information Facility
GCCM	Global Conservation Consortium for Magnolia
IMLS	Institute of Museum and Library Services
IUCN	International Union for Conservation of Nature
SERNEC	SouthEast Regional Network of Expertise and Collections
USDA	United States Department of Agriculture
WCSP	World Checklist of Selected Plant Families
WDPA	World Database on Protected Areas

Magnolia sinostellata (Yaling Wang)

IUCN Red List Categories

EX	Extinct
EW	Extinct in the Wild
CR	Critically Endangered
EN	Endangered
VU	Vulnerable
NT	Near Threatened
LC	Least Concern
DD	Data Deficient
NE	Not Evaluated

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Executive Summary

The genus *Magnolia* is a globally diverse, iconic and highly threatened tree group. *Magnolia* species are key ecological components of their forest habitats and are of integral economic and cultural importance throughout their ranges in North America and the Neotropical and Indomalayan realms. Widespread efforts to assess the extinction risk of *Magnolia* species and growing contributions by botanic gardens to databases on ex *situ* conservation provide opportunities to synthesize data and prioritize species of concern. This report implements a conservation gap analysis methodology by surveying the *in situ* and *ex situ* status of species as well as conservation activities and needs globally.

This global analysis includes 336 *Magnolia (sensu lato)* species, with taxonomy following the World Checklist of Selected Plant Families and expert input. Diversity centers for *Magnolia* are in China, Vietnam, and Colombia. However, there is still much uncertainty regarding the native distribution of many *Magnolia* species. Global IUCN Red List of Threatened Species Categories and Criteria are used throughout and a summary of current assessment statistics is presented. Over 170 *Magnolia* species are assessed as threatened and over 100 species are currently assessed as Data Deficient on the IUCN Red List.

Records of species present in ex *situ* collections at the taxon- and accession-level were gathered via BGCI's PlantSearch database and surveys. Comparisons to ex *situ* surveys conducted in 2011 and 2016 show a growing number of species under conservation: 168 (50%) species were reported in ex *situ* collections. Species differ in their representation in ex *situ* collections from 100s of gardens and 1000s of individuals (e.g *M. grandiflora*, *M. virginiana* and *M. stellata*) to single institutions and potentially single individuals (40 species). Global distribution of reported collections were investigated and of those species found in at least one institution, 25 species were found not to be held at institutions in the country or countries within their native range. This is the first reporting of global accessions-level information for *Magnolia*. This survey reveals that at least 18,576 individuals of *Magnolia* species (not including cultivars or hybrids) are under cultivation. Data on collection provenance is included, revealing trends and data availability for wild collected material contributing to conservation of the species. A table of the results of the accession-level ex *situ* survey for all species is presented to identify gaps and inform future collections.

A conservation actions questionnaire, literature review, and expert consultation were used to gather data on the vulnerability of and threats facing wild populations as well as current and needed conservation actions for threatened (Critically Endangered, Endangered or Vulnerable) *Magnolia* species. Globally, the most common threats to *Magnolia* are related to agriculture, silviculture and/or ranching. The number of species reported to be impacted by climate change has grown from previous assessments. Data to quantitatively assess vulnerability of wild populations of *Magnolia* was limited, with most assessed using range and endemism information, some using population size, and very few assessed using genetic variation or population decline data. A total of 56 institutions provided information on active and needed conservation actions for 145 threatened species. These highlight occurrence surveys/population monitoring, conservation horticulture, and public awareness/education as frequent activities carried out by botanic gardens, arboreta, and academic institutions. The future conservation actions most recommended for threatened *Magnolia* species are further occurrence surveys/population monitoring, collecting and distributing germplasm, and conservation horticulture.

Geolocated wild provenance data provided in the ex *situ* survey can be used to assess the geographical and ecological coverage of ex *situ* collections with the aim of developing representative collections. Data for the spatial analysis of ex *situ* collections of *Magnolia* were available for 29 species and profiles for these species are included in this publication. Reported ex *situ* collections of three species (*M. zenii*, *M. stellata* and *M. sapaensis*)

cover more than 80% of their geographic range while 17 species' reported *ex situ* collections represent less than 50% of their geographic range. Twenty-eight species are estimated to have *ex situ* collections that represent 50% or more of their ecological range. Along with this spatial analysis the species profiles include the taxonomy, IUCN Red List Category and Criteria, distribution and ecology, vulnerability analysis, threats, and reported and recommended conservation actions for each species.

Finally, using a combination of the metrics gathered within this report; IUCN Red List Category, *ex situ* representation, and spatial analysis of collections, a prioritization activity was carried out to highlight species of concern and priority conservation actions for those species. The species are ranked at a regional level and in total, 93 species were identified in five regions as possible species of concern, largely based on lack of representation in *ex situ* collections and IUCN Red List assessment as Critically Endangered or Endangered. Priorities for focal species and strategies for further conservation action at a regional level are presented.

The global participation in this gap analysis is evidence of the value placed on conserving *Magnolia* world-wide and highlights the importance of collaborations, knowledge and data sharing for their continued conservation. The gap analysis is a contribution to the local knowledge of those working on *Magnolia* conservation with the aim to effectively and efficiently develop strategies to ensure that no wild *Magnolia* species goes extinct.

Magnolia stellata (Matt Lobdell)

Introduction and Objectives

Magnoliaceae is a diverse and iconic family of over 330 species found in temperate and tropical regions of the Americas and eastern and southeast Asia. Two genera belong to Magnoliaceae: *Magnolia*, which comprises all but two species within the family, with wide diversity around the world, and *Liriodendron*, with one species found in North America and one in eastern Asia. With over 50% of *Magnolia* species assessed as threatened on the IUCN Red List from factors including logging and wood harvesting, habitat loss from agriculture, livestock farming and human development as well as increasing impacts from climate change, this widespread and threatened genus is in need of coordinated conservation action (see Box 1). Identifying and prioritizing species of greatest concern as well as undertaking and facilitating research will establish a basis for implementing *ex situ* and *in situ* strategies.

The first major effort to assess the extinction risk of all species within the Magnoliaceae was published by Fauna & Flora International (FFI) in 2007 (Cicuzza *et al.* 2007). A total of 151 taxa (of the then recognized 245) were assessed at that time under the IUCN Red List Categories and Criteria. Providing major information on the extinction risk of these taxa as well as an opportunity to highlight those in need of more research (94 taxa were unable to be evaluated due to lack of distribution data at the time), this publication was a major asset to *Magnolia* conservation. This Red Listing effort led to the production of the *Global Survey of Ex situ Magnoliaceae Collections* (BGCI 2008), an analysis of the presence of highly threatened species in *ex situ* collections around the world, and an assessment of conservation activities focused on genetic diversity analysis of threatened *Magnolia* taxa (Cires *et al.* 2013). In 2016, following the publication of additional information on Not Evaluated species and the description of over 90 new *Magnolia* species, *The Red List of Magnoliaceae - revised and extended*, was published by BGCI (Rivers *et al.* 2016). In this publication, 304 Magnoliaceae species were assessed with at least 48% identified as threatened with extinction. This work also continued to highlight the need for more studies on *Magnolia* species as almost a third of the species were assessed as Data Deficient. An *ex situ* survey of Magnoliaceae species was also conducted, highlighting increases in the number of institutions reporting *Magnolia* species in *ex situ* conservation.

With the wealth of information on the status of *Magnolia* species in the wild, as well as *ex situ* data from global databases and surveys, this publication aims to employ conservation gap analysis methodologies developed by The Morton Arboretum and initially implemented for threatened trees in the *Conservation Gap Analysis of Native U.S. Oaks* (Beckman *et al.* 2019). This publication will use IUCN Red List assessments, *ex situ* data (at both the taxon and accession level), surveys of species vulnerability and threats in the wild as well as on-going conservation activities to:

- characterize current knowledge on vulnerability and threats in the wild for threatened *Magnolia* species as well as current *ex situ* conservation status of all known *Magnolia* species
- identify gaps in global *ex situ* conservation of threatened *Magnolia* species
- highlight on-going and necessary conservation activities for threatened *Magnolia* species
- identify potential species of conservation concern for future conservation actions

This gap analysis also includes species profiles for selected threatened *Magnolia* species that summarize *in situ* and *ex situ* status and needs. The results will help provide information to organizations working on *Magnolia* conservation by identifying on-going efforts and gaps in action and guide next steps for collaborative conservation of the world's *Magnolia* species.

Box 1. The Global Conservation Consortium for *Magnolia*

Global Conservation Consortium
Magnolia

To scale up and accelerate effective conservation of global plant diversity, BGCI is coordinating a suite of Global Conservation Consortia, which catalyse groups of institutions and experts to collaboratively develop and implement comprehensive strategies to prevent the extinction of priority threatened plant groups.

The Global Conservation Consortium for *Magnolia* (GCCM) focuses action in six regions: USA and Canada, Mexico & Central America, the Caribbean, South America, East Asia and South and Southeast Asia. The Consortium coordinates identification of species of conservation priority, knowledge and material sharing for conservation collections and collaboration on research related to genetics, horticulture and taxonomy of *Magnolias* amongst other activities. The consortium is led by Atlanta Botanical Garden and works in a coordinated and collaborative way amongst global partners to achieve the following objectives:

- Foster new and existing networks of *Magnolia* experts
- Identify *Magnolia* species of greatest conservation concern and prioritize conservation action
- Ensure effective *in situ Magnolia* species conservation
- Establish and manage coordinated ex *situ Magnolia* collections of high conservation value
- Foster applied research (e.g. conservation biology, ecology, horticulture, population genetics, taxonomy) to support *Magnolia* species conservation
- Build capacity to empower and mobilize in-country partners in diversity centres and across *Magnolia* species' ranges
- Increase public awareness and engagement with *Magnolia* species conservation issues
- Collaboratively fundraise to scale-up *Magnolia* conservation action

For more information on BGCI's Global Conservation Consortia initiative please visit: www.globalconservationconsortia.org

Magnolia cylindrica (Philippe de Spoelberch)

Magnolia dawsoniana (Philippe de Spoelberch)

Methods

Magnolia Species Richness

A global checklist of *Magnolia* was compiled, focusing at the species level as a basis for analysis. Hybrids and infraspecific taxa are not included unless there was information indicating that the taxon may be accepted as a species for conservation purposes. The taxonomic concept generally follows the World Checklist of Selected Plant Families (WCSP 2020) and expert consultation is followed to include some varieties here recognized as species and exclude some species due to taxonomic uncertainty. Global distribution at the country level was gathered from GlobalTreeSearch (BGCI 2021), The IUCN Red List of Threatened Species (IUCN 2021), from literature review for newly described species, and expert consultation. Where presence in a country was listed as 'Presence Uncertain' in the IUCN Red List publication or other source, it was included in the distribution. This is to highlight the need for further investigation and surveys. Species are categorized and statistics are presented as of September 2021 using the global IUCN Red List categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC) and Data Deficient (DD). Where the species assessment has not yet been published on the IUCN Red List, but has been submitted, a preliminary category is reported.

Ex situ Collections

Taxon- and accession-level surveys to assess the current representation of *Magnolia* species in *ex situ* collections were carried out. The *ex situ* collections assessment methodology used here follows that of Beckman *et al.* (2019). For taxon level analysis, all records for *Magnolia* and its synonyms (see synonym list) were downloaded from BGCI's PlantSearch database in August 2020 (BGCI 2020). In addition, taxon level lists of *ex situ Magnolia* collections not in PlantSearch were gathered from institutions with priority collections. Accession level data was gathered over multiple years through *ex situ* surveys. Requests to institutions with *ex situ* collections to provide *Magnolia* accession level data were distributed in April/May 2018 and July 2019 via email and social media. Further targeted requests for accession level data were sent to priority institutions based on PlantSearch records in August 2020. The communities targeted for the *ex situ* collection surveys were:

- Institutions reporting *Magnolia* collections to BGCI's PlantSearch database
- ArbNet members
- American Public Gardens Association members
- AABGACOL Listserv (an international email listing of botanical gardens and arboreta)
- Center for Plant Conservation
- Plant Conservation Alliance
- Southeast Asia Botanic Gardens Network
- Chinese botanical gardens
- PlantNetwork members
- Global Trees Campaign partners

Alcimandra	*Michelia*
Aromadendron	*Micheliopsis*
Blumia	*Oyama*
Buergeria	*Pachylarnax*
Champaca	*Parakmeria*
Dugandiodendron	*Paramagnolia*
Elmerrillia	*Paramanglietia*
Guillimia	*Paramichelia*
Gwillimia	*Sampacca*
Houpoea	*Santanderia*
Kmeria	*Sinomanglietia*
Kobus	*Sphenocarpus*
Lassonia	*Svenhedinia*
Lirianthe	*Talauma*
Liriopsis	*Tsoongiodendron*
Manglietia	*Tulipastrum*
Manglietiastrum	*Woonyoungia*
Metamagnolia	*Yulania*

Generic synonym list

Magnolia dealbata (Neptali Ramirez Marcial)

The current status of species in ex *situ* collections was compared to two previous surveys, *The Red List of Magnoliaceae: revised and extended* (Rivers *et al.* 2016) and the *Global Survey of Ex situ Magnoliaceae Collections* (BGCI 2008). This allowed for an assessment of progress in ex *situ* conservation of *Magnolia* species and the opportunity to identify gaps in collecting efforts.

Accessions data were requested in standardized, prioritized fields and submissions were manually aligned where necessary. Data with standardized column headers from each survey were compiled using R (R Core Team 2021). The dataset was refined to include records for species and lower taxa only, and to exclude hybrids and records clearly named as cultivars. Data fields that were standardized include: provenance type (wild, cultivated from the wild, horticultural/garden, native or existing on-site, and unknown) and number of individuals. The latitude and longitude of the wild source locations of records were standardized and where only descriptive data was given on the wild source, records were manually geolocated. Where only county-level or equivalent information was provided for the record, a county or equivalent centroid point was used for the source of that record. County level is the coarsest data used in the spatial data analysis.

When providing accession level ex *situ* data, institutions were asked to include the number of individuals in each accession. When such data was unavailable (for example when institutions only reported species presence via PlantSearch), it was assumed that the accession consisted of one individual; therefore, the results on the number of plants in ex *situ* represent a conservative estimate. As some *Magnolia* species can be stored in seed banks, some of the ex *situ* survey results presented here include seed-banked individuals in addition to individuals in living collections.

Vulnerability of Wild Populations

A quantitative assessment of the vulnerability status of wild populations of threatened *Magnolia* species was carried out following the methodology of Beckman et *al.* (2019). A scoring matrix was used to calculate an average vulnerability score for each species (Tables 1 & 2). Demographic factors affecting the vulnerability score of each species as well as gaps in knowledge can be visualized and allow comparison among species in different regions. This analysis draws on data from currently published IUCN Red List assessments (in particular, population size, range and/or endemism, population decline, and fragmentation), literature review (especially for regeneration and recruitment and genetic variation/integrity information) and expert consultation (all demographic information).

Magnolia sinostellata (Yaling Wang)

Table 1. Vulnerability scoring matrix identifying demographic issues affecting threatened *Magnolia* species. A hypothetical species has been used to complete the matrix. Average vulnerability score is calculated using only demographic indicators with sufficient data (i.e. excluding unknown indicators). Descriptions of demographic indicators can be found in Table 2.

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	10
Range/endemism	Extremely small range or 1 location	EOO < 100 km^2 or AOO < 10 km^2 or 2-4 locations	EOO < 5,000 km^2 or AOO < 500 km^2 or 5-9 locations	EOO < 20,000 km^2 or AOO < 2,000 km^2 or 10+ locations	EOO > 20,000 km^2 or AOO > 2,000 km^2	Unknown	5
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	10
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	40
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	20
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
						Average vulnerability score	17

Table 2. Descriptions of demographic indicators contributing to average vulnerability score.

Demographic indicator	Description
Population Size	Number of mature individuals that are reproductively mature (IUCN 2012).
Range/endemism	Three different measures can be used to assess this factor, including extent of occurrence (EOO), area of occupancy (AOO), and number of locations, as defined by IUCN. EOO = "the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon" (IUCN 2012); AOO = the area within a taxon's EOO that is actually occupied by the taxon (IUCN 2012); location = "a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present" (IUCN Standards and Petitions Subcommittee 2017). This indicator is meant to capture the risk of extinction associated with the size and/or spatial characteristics of a species' range; including the likelihood that one threatening event could wipe out all subpopulations.
Population decline	Past, current, or predicted future reduction in population size over ten years or three generations, whichever is longer (IUCN 2012).
Fragmentation	Isolation of subpopulations from each other. Includes genetic isolation either at the pollen or seed level, and/or the likelihood that a nearby subpopulation can recolonize a locally extirpated subpopulation. The IUCN Standards and Petitions Subcommittee (2017) considers a species severely fragmented when "most (>50%) of its total area of occupancy is in habitat patches that are (1) smaller than would be required to support a viable population, and (2) separated from other habitat patches by a large distance.
Regeneration/ recruitment	Reproductive ability of the species. Includes factors such as pollen and seed production, viability, and seedling establishment. Many *Magnolia* species are suffering from a lack of regeneration, establishment, and/or sexual reproduction, which have negative impacts on the demographic structure of a species or population.
Genetic variation/ integrity	Quality and depth of the gene pool. Takes into account issues such as inbreeding and levels of heterozygosity.

Threats to Wild Populations

Threats facing wild *Magnolia* populations were identified and summarized via a review of IUCN Red List assessments, literature review (e.g. González Torres et *al.* 2016), expert consultation, and via the conservation actions questionnaire (see below). Nine categories were used to classify species threats based on conservation gap analyses of other groups including *Juglans* (Beckman et *al.* 2021) and *Quercus* (Beckman et *al.* 2019), and are based on the Threats Classification Scheme (Ver. 3.2) of the IUCN Red List:

- Agriculture, silviculture, and/or ranching
- Climate change
- Development, mining, and/or roads
- Disturbance regime modification
- Inbreeding or introgression
- Invasive species competition
- Pests or pathogens
- Tourism or recreation
- Wild harvesting

The identification of these threats can be used to prioritize conservation actions for specific species and identify regional trends in threat presence, which may be useful in developing conservation strategies for groups of *Magnolia* species.

Conservation Activities

On-going and needed conservation activities for all threatened *Magnolia* species were investigated. Literature review, expert consultation, and a conservation action questionnaire were used to gather this information. Fourteen activity categories were used based on adaptations from the questionnaires developed in the *Conservation Gap analysis of Native U.S. Oaks* (Beckman et *al.* 2019) and the Conservation Gap Analysis of U.S. Trees in Nine Priority Genera project carried out by The Morton Arboretum (e.g. Beckman et *al.* 2021):

- Collect and distribute germplasm
- Pollen and/or seed banking
- Conservation horticulture
- Cryopreservation and/or micropropagation
- Implement protection policies or regulations
- Occurrence surveys or population monitoring
- Population reinforcement or introduction
- Habitat restoration
- Protect and/or manage habitat
- Public awareness or education
- Research: Genetics
- Research: Taxonomy
- Research: Climate Change
- Research: Pests & Pathogens

The conservation actions questionnaire was circulated from September to November 2021 to gather information on current conservation actions, most urgent conservation needs, and the greatest threats facing these species. These questions were asked specifically about globally threatened (CR, EN, VU) *Magnolia* species, however respondents had the option to add additional species that they identified as particularly vulnerable or for which they were carrying out conservation actions. The questionnaire was sent to the same communities targeted for the *ex situ* surveys. The results of the questionnaire and review provide an estimate of the conservation actions being undertaken for threatened *Magnolia* species and will be used to assess species priorities with further expert consultation.

Spatial Analysis of *Ex situ* Collections

Spatial analysis of *ex situ* records was performed to provide information about the potential geographic and ecological coverage of *ex situ* collections in comparison to the known range of the species. The geographical and ecological coverage of *ex situ* collections is used as a proxy for representation of the genetic diversity of the species in *ex situ* collections. Using these proxies, populations and ecological zones that are under-represented in collections can be identified. Methods adapted from Beckman et *al.* (2019) were used to calculate geographic and ecological coverage by comparing known *in situ* occurrences and *ex situ* collection source localities. Circular buffers of 20, 50 and 100 km around each *in situ* and *ex situ* point were used to approximate the habitat, populations and gene flow. When the buffers of the *in situ* and *ex situ* points overlap, that area is considered conserved within the *ex situ* collection. The calculations of geographical and ecological coverage are based on estimations of the range of the species and should be viewed as rough estimations of the coverage of *ex situ* collections and be used for general comparison of species.

For the spatial analysis, accession level *ex situ* records gathered during the 2018, 2019 and 2020 surveys were filtered to include threatened *Magnolia* species and records that either had a given source latitude and longitude or could be manually geolocated with county or locality data.

In situ occurrence points for threatened *Magnolia* species were gathered via the IUCN Red List (IUCN 2021), and through other publicly available data sources including Global Biodiversity Information Facility (GBIF; gbif.org 2021), Botanical Information and Ecology Network (BIEN; bien.nceas.ucsb.edu 2021), U.S. herbarium consortia (e.g., SouthEast Regional Network of Expertise and Collections (SERNEC); Data Portal 2021). These raw data points were manually vetted via literature search and expert consultation and points were removed if they were not within a county of occurrence for each species based on the IUCN Red List or other sources, such as the Atlas of Woody Plants in China (Fang et *al.* 2011). All data processing and mapping were performed in R (R Core Team 2021; Maitner 2020).

Protected areas maps were also created for threatened species included in the spatial analyses. Global protected area data from the World Database on Protected Areas (WDPA) was used as a standardized source of protected area maps (UNEP-WCMC 2021). The vetted *in situ* occurrence points from the spatial analysis mapping (above) were overlaid onto the protected areas layer to highlight the potential protection of species *in situ* via designated protected areas. The use of the WDPA for this analysis is limited for some countries, for example the majority of protected areas in China are not publicly shared (Bingham et *al.* 2019). Therefore, these protected areas are absent from the maps for Chinese species profiled in this report. Results from all spatial analyses, including protected areas and other *in situ* conservation information is summarized from Red List assessments, other published literature, and the conservation actions questionnaire. Both the ex *situ* accession level and protected areas maps are presented in the species profiles.

Magnolia officinalis (Philippe de Spoelberch)

Magnolia pugana (Miguel Á. Muñiz Castro)

Prioritizing Species of Conservation Concern

Prioritized ranking of the many threatened *Magnolia* species helps to guide the focus of resources and conservation actions in creating effective conservation strategies. Prioritization can also highlight various metrics used to identify species as 'of concern' and determine key conservation activities. To identify and prioritize *Magnolia* species of conservation concern, the following metrics were applied to all 336 *Magnolia* species:

- IUCN Red List Category
- *Ex situ* representation based on the ex *situ* collection survey conducted as part of this report
  - Number of ex *situ* collections reporting the species
  - Number of individuals reported in ex *situ* collections
  - Number of wild origin individuals reported in ex *situ* collections
- Spatial analysis of ex *situ* collections
  - Percentage of the geographic range covered by ex *situ* collections
  - Percentage of the ecological range covered by ex *situ* collections

Each species was assigned scores based on the level of severity for each metric (see Table 3) and a total score was calculated for each species across the metrics. Species scores were compared at a regional level to identify species of conservation concern within each region. Species with a score of 19 or higher are recommended for priority action; this highlights all species assessed as CR or EN that are not reported in ex *situ* collections. This process identifies varying numbers of priority species for different regional groups as initial species of focus as well as key actions and themes for the development of conservation strategies.

Table 3. Prioritization scoring matrix identifying *in situ* and *ex situ* metrics measuring conservation of global *Magnolia* species. A hypothetical species has been used as an example to complete the matrix. Coloured cells indicate that the species meets the threshold for that criterion; gray cells indicate no threshold associated with that point level for given criteria.

Criterion	Criterion thresholds						
	5 points	4 points	3 points	2 points	1 points	0 points	Score
IUCN Red List Category (Global)	CR	EN	VU	NT	DD	LC	4
# of *ex situ* collections present in		0	1<5	6<10		>10	0
# of individuals in *ex situ* collections		0<5	6<10	11<15		>15	0
# wild origin accessions in *ex situ* collections			0 or unknown	1 to 3	4-10	>10	1
% of geographic range captured by *ex situ* collections				unknown, 0<20	21<70	>70	2
% of ecological range captured by *ex situ* collections				unknown, 0<40	41<70	>70	1
						Total Score	8

Magnolia odora (Keming Yang, South China Botanical Garden)

Results and Analysis

Magnolia Species Richness

This gap analysis covers *Magnolia* (*sensu lato*) and includes 336 species. This includes the 302 *Magnolia* species assessed in the 2016 Red List of Magnoliaceae. Ten species which were Not Evaluated (NE) in the 2016 report have been included in this analysis (Table 4). All have been assessed as DD on the IUCN Red List due to taxonomic issues and may be synonyms of other species. They have been included here to draw attention to needed further taxonomic research. Since the 2016 report, 23 *Magnolia* species have been described within the genus. These have been assessed using IUCN criteria and are included in this analysis (also in Table 4). As some assessments have been updated since 2016, species are categorized in this report based on their threat status on the IUCN Red List as of September 2021. In this analysis the name *Magnolia arroyoana* Molinari differs from that used in previous analysis of the genera and is used in place of *Magnolia crassifolia* F.Arroyo & Á.J.Pérez in alignment with the current taxonomy for this species (Molinari-Novoa 2016). A summary of the conservation assessment categories of *Magnolia* can be found in Table 5.

Table 4. Species described and assessments published since the Red List of Magnoliaceae - revised and extended in 2016 and included in the current analysis. Those with (preliminary) and (González Torres et *al.* 2016) are not yet published on the IUCN Red List as of September 2021.

Not Evaluated in 2016 Red List	
Species	**IUCN Red List Category**
Magnolia carnosa	DD
Magnolia dabieshanensis	DD
Magnolia dimorpha	DD
Magnolia fragarigynandria	DD
Magnolia jianfenglingensis	DD
Magnolia lamdongensis	DD
Magnolia shirenshanensis	DD
Magnolia shizhenii	DD
Magnolia wuzhishangensis	DD
Magnolia xinyangensis	DD

Magnolia lamdongensis (Scott McMahan)

Newly described since 2016 Red List	
Species	**IUCN Red List Category**
Magnolia alejandrae	EN
Magnolia archilana	EN
Magnolia betuliensis	CR
Magnolia brasiliensis	EN
Magnolia chiguila	CR
Magnolia clementinana	CR (preliminary)
Magnolia kachinensis	CR
Magnolia llanganatensis	EN
Magnolia manuensis	EN (preliminary)
Magnolia mashpi	LC
Magnolia mercedesiarum	EN
Magnolia mindoensis	VU
Magnolia montebelloensis	CR (preliminary)
Magnolia napoensis	EN
Magnolia oblongifolia	CR (González Torres et *al.* 2016)
Magnolia orbiculata	VU (González Torres et *al.* 2016)
Magnolia ottoi	CR
Magnolia poqomchi	CR
Magnolia quangninhensis	VU (preliminary)
Magnolia resupinatifolia	CR
Magnolia sonlaensis	CR (preliminary)
Magnolia tribouillierana	CR
Magnolia yajlachhi	CR

Table 5. Summary of conservation assessments for species of *Magnolia*

IUCN Red List Category	Number of species
Extinct	0
Critically Endangered	47
Endangered	97
Vulnerable	30
Data Deficient	102
Near Threatened	13
Least Concern	47
Total	336

Magnolia rzedowskiana (Marisol Gutiérez Lozano)

Magnolia lucida (Keming Yang, South China Botanical Garden)

China has the highest richness of *Magnolia* species (114) followed by Vietnam (56), Colombia (37) and Mexico (35; Figure 1). There are threatened species in 32 countries with the greatest number in Colombia (34), China (33), Mexico (30) and Viet Nam (22; Figure 2). Data deficiency remains a major challenge for understanding the threats to, and conservation of *Magnolia* species globally. Thirty-one countries are home to species assessed as Data Deficient, with the greatest number in Asia: China (49), Indonesia (21), Viet Nam (18) and Malaysia (17; Figure 3). China has the greatest number of endemic species (59) followed by Mexico (32), Colombia (31), Ecuador (14) and Viet Nam (14; Figure 4). A summary list for all countries is found in Appendix C.

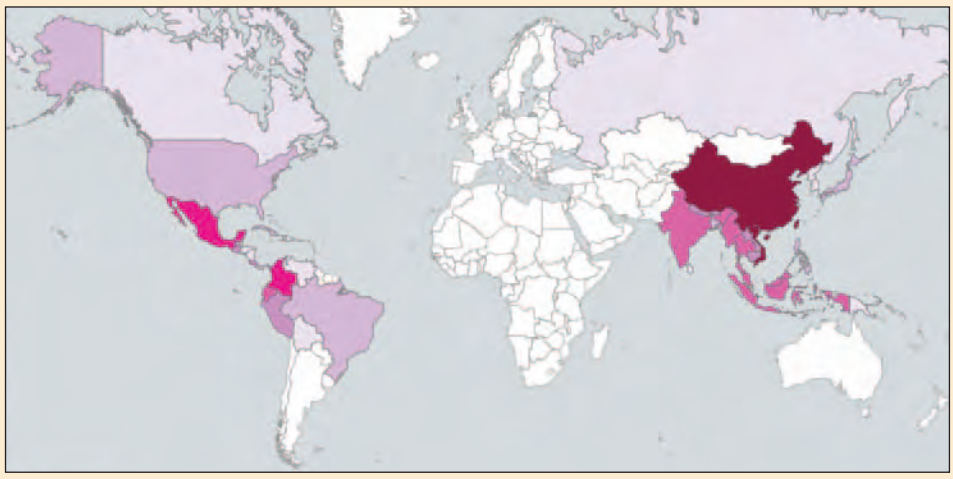


Figure 1. Native *Magnolia* species richness by country or territory (R script for map provided by Emily Beckman Bruns).

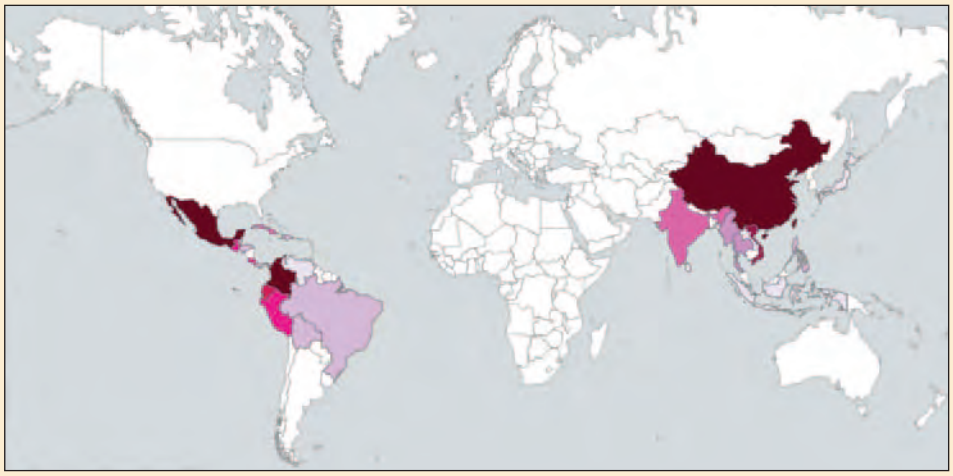


Figure 2. Threatened *Magnolia* richness by country or territory. Threatened *Magnolia* species are those assessed as globally CR, EN or VU on the IUCN Red List (R script for map provided by Emily Beckman Bruns).

Number of native *Magnolia* species

0	10-19
1-5	20-29
6-9	30+

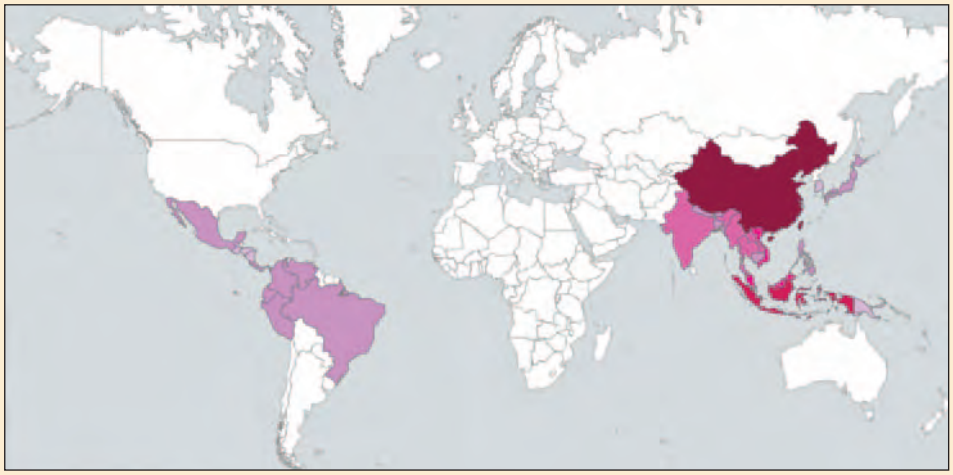


Figure 3. Data Deficient *Magnolia* richness by country or territory (R script for map provided by Emily Beckman Bruns).

Number of native *Magnolia* species

0	10-19
1-5	20-29
6-9	30+

Magnolia decidua (Philippe de Spoelberch)

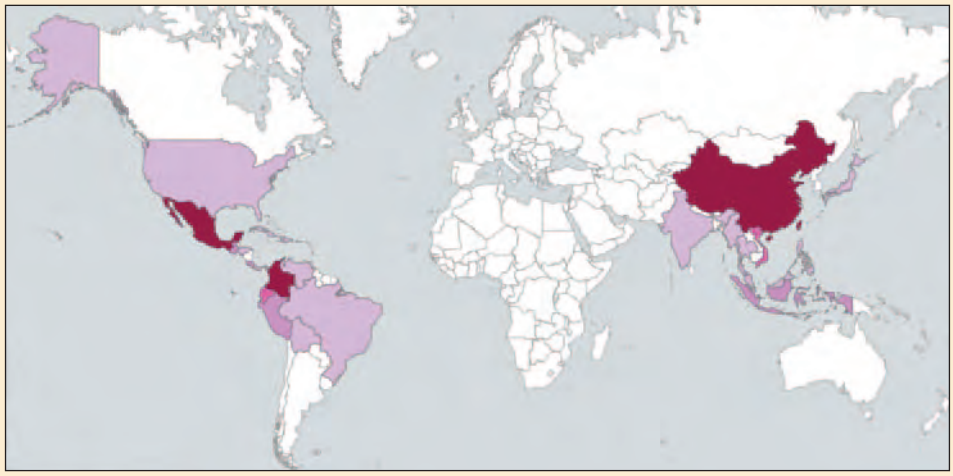


Figure 4. Endemic *Magnolia* richness by country or territory (R script for map provided by Emily Beckman Bruns).

Ex situ Collections

A total of 522 institutions from 65 countries reported *ex situ* collections of *Magnolia* species via PlantSearch and the accession level surveys (Figure 5). See Appendix A for a list of participating institutions. The majority of institutions reporting *Magnolia* collections are located in North America and Europe (418, 80%). Collections reported from diversity centers for Magnolia in Asia and South America represented just 14% (71) of institutions reporting *Magnolia* collections. Some *Magnolia* collections are reported from Oceania (29, 6%) and Africa (4, <1%).

Magnolia foveolata (Scott McMahan)

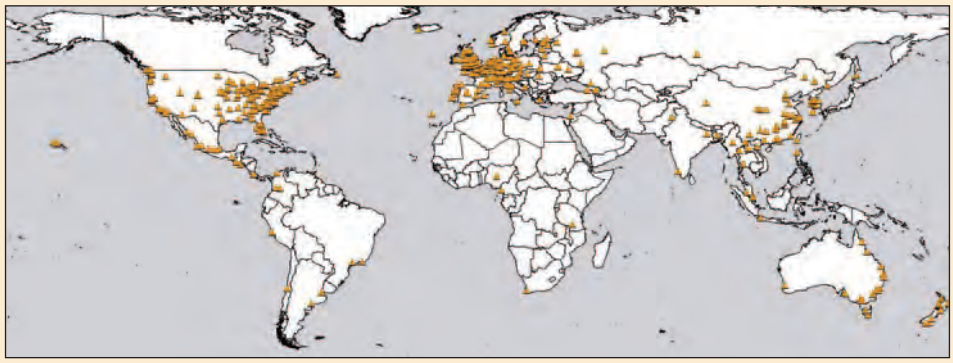


Figure 5. Locations of 522 institutions that provided *ex situ* collections data via PlantSearch and accession-level surveys. Of these gardens, 186 provided accession-level data.

Half of all *Magnolia* species (168) are reported from *ex situ* collections. Just 44% (76 of 174) of threatened (CR, EN, VU) *Magnolia* species are reported in *ex situ* collections (Figure 6). Summary statistics for *ex situ* conservation of *Magnolia* can be compared between the *Global Survey of Ex situ Magnoliaceae Collections* (BGCI 2008), the *ex situ* survey reported in the *Red List of Magnoliaceae - revised and extended* (Rivers et al. 2016) and this report. The number of institutions reporting *Magnolia* species in *ex situ* collections has increased compared to the 2016 *ex situ* survey by 32 institutions. As networks for sharing data grow and capacity to report increases, the utility of global *ex situ* collection data for conservation analyses increases (see Box 2).

Box 2. Comparison with the 2008 *Global Ex situ survey of Magnoliaceae Collections* and 2016 *Ex situ* Survey of Magnoliaceae

	2022	2016	2008
Number of records	11037	9918	2781
Number of institutions	522	490	238
Number of records matching species or synonyms	4948	4476	2274

Magnolia sargentiana (Arboretum Wespelaar)

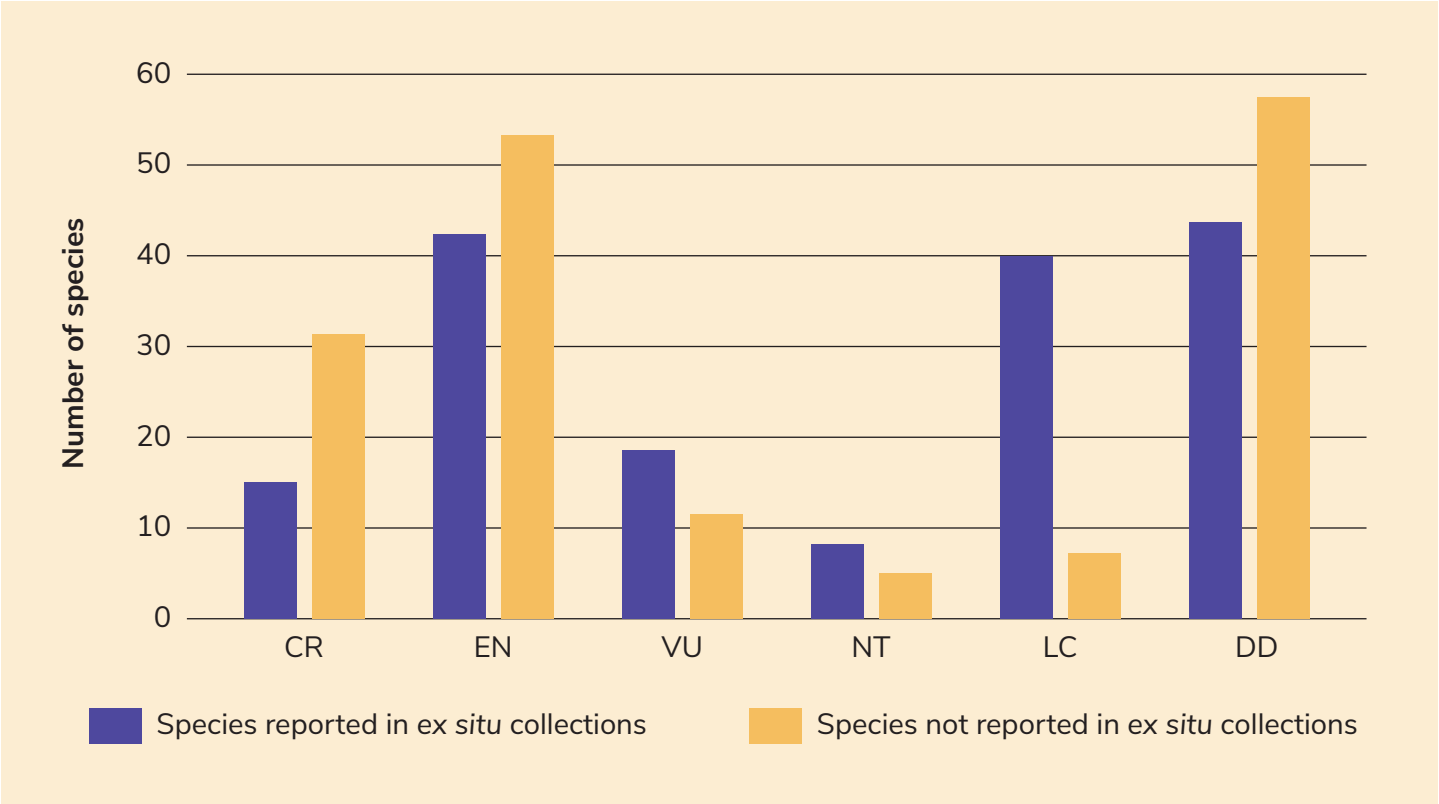


Figure 6. Presence and absence of *Magnolia* species in *ex situ* collections per IUCN Red List Category.

Magnolia odora (Keming Yang, South China Botanical Garden)

Ex situ conservation of *Magnolia* species has also increased, with 17 species previously unreported in *ex situ* collections (as of 2016) now held in *ex situ* collections (Table 6). Two species which were previously reported in *ex situ* collections, *M. arroyana* (as *M. crassifolia*) and *M. duperreana* were not reported during the surveys. This may be due to re-identifications of the individuals held in collections.

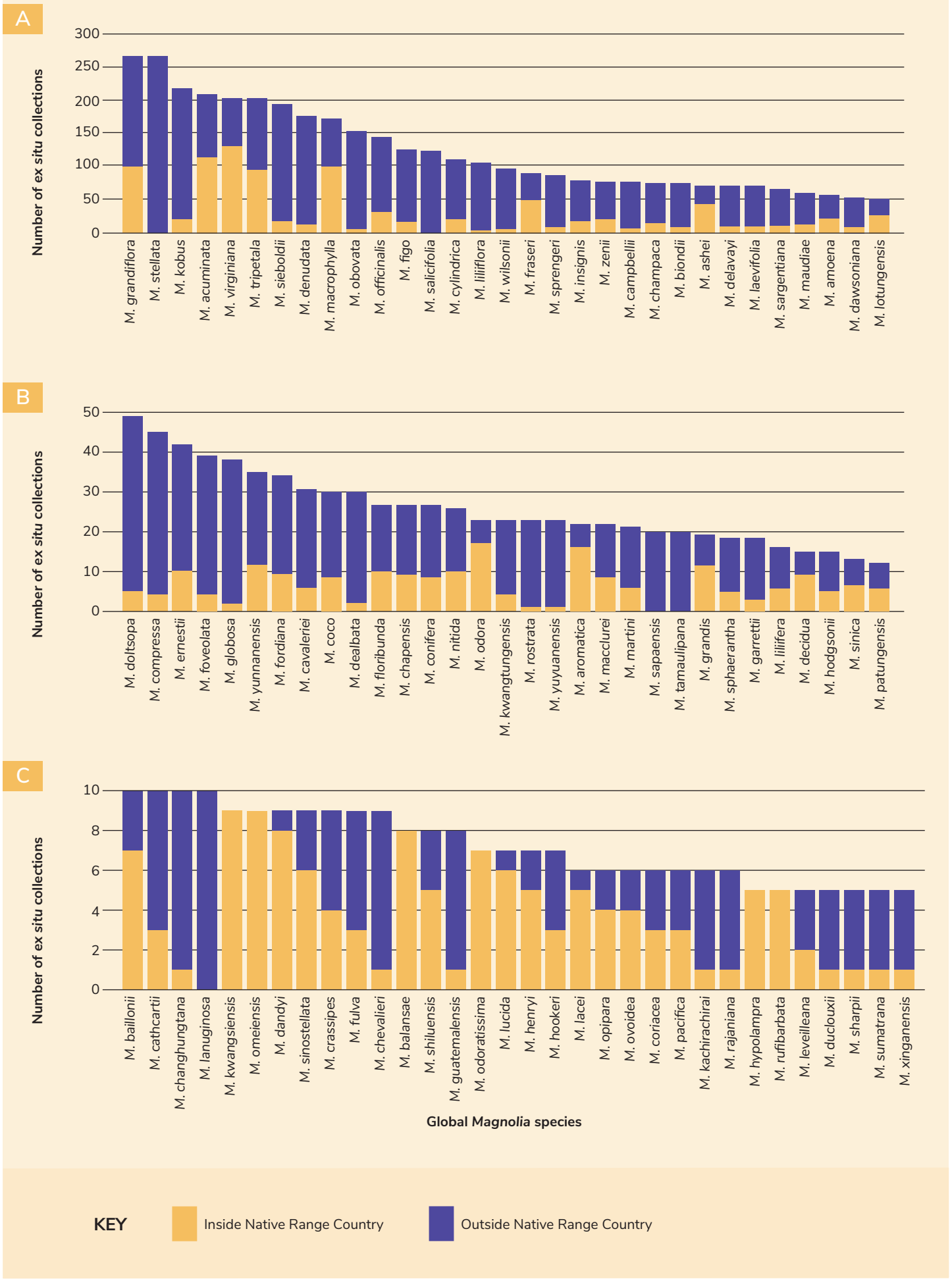
Magnolia species differ greatly in the number of collections they are reported in (Figure 7). Some species, including *M. stellata*, *M. grandiflora*, *M. kobus* and *M. acuminata*, are reported in over 200 collections, while 40 species are reported in a single collection. The majority of species (85) are reported from five or fewer collections. Twenty-five species are not reported from collections in their native countries.

The 168 species of *Magnolia* reported in *ex situ* collections are represented by at least 18,576 individuals. Species range widely in their representation, from over 2,800 individuals to a single individual in collections. Three species are represented by over 1,000 individuals: *M. grandiflora* (2,889), *M. virginiana* (1,659) and *M. stellata* (1,290). The majority of *Magnolia* species in collections are represented by less than 100 individuals (Figure 8). See Appendix B for specific numbers of individuals in *ex situ* collections.

Table 6. Species unreported from *ex situ* collections in 2016 now present in *ex situ* collections

Taxon name	*Ex situ* collections	IUCN Red List Category
Magnolia citrata	1	LC
Magnolia dodecapetala	1	VU
Magnolia iltisiana	2	VU
Magnolia jaliscana	1	EN
Magnolia mannii	1	VU
Magnolia oaxacensis	1	EN
Magnolia ofeliae	2	CR
Magnolia philippinensis	2	DD
Magnolia poasana	1	NT
Magnolia portoricensis	1	EN
Magnolia rzedowskiana	1	EN
Magnolia tarahumara	4	DD
Magnolia vallartensis	2	CR
Magnolia vovidesii	3	EN
Magnolia yoroconte	2	VU

Magnolia ventii (Yang Keming)


A
Number of ex situ collections
300
250
200
150
100
50
0
M. grandiflora
M. stellata
M. kobus
M. acuminata
M. virginiana
M. tripetala
M. sieboldii
M. denudata
M. macrophylla
M. obovata
M. officinalis
M. figo
M. salicifolia
M. cylindrica
M. liliiflora
M. wilsonii
M. fraseri
M. sprengeri
M. insignis
M. zenii
M. campbellii
M. champaca
M. biondii
M. ashei
M. delavayi
M. laevifolia
M. sargentiana
M. maudiae
M. amoena
M. dawsoniana
M. lotungensis
B
Number of ex situ collections
50
40
30
20
10
0
M. doltsopa
M. compressa
M. ernestii
M. foveolata
M. globosa
M. yunnanensis
M. fordiana
M. cavaleriei
M. coco
M. dealbata
M. floribunda
M. chapensis
M. conifera
M. nitida
M. odora
M. kwangtungensis
M. rostrata
M. yuyuanensis
M. aromatica
M. macclurei
M. martini
M. sapaensis
M. tamaulipana
M. grandis
M. sphaerantha
M. garrettii
M. lilifera
M. decidua
M. hodgsonii
M. sinica
M. patungensis
C
Number of ex situ collections
10
8
6
4
2
0
M. baillonii
M. cathcartii
M. changhungtana
M. lanuginosa
M. kwangsiensis
M. omeiensis
M. dandyi
M. sinostellata
M. crassipes
M. fulva
M. chevalieri
M. balansae
M. shiluensis
M. guatemalensis
M. odoratissima
M. lucida
M. henryi
M. hookeri
M. lacei
M. opipara
M. ovoidea
M. coriacea
M. pacifica
M. kachirachirai
M. rajaniana
M. hypolampra
M. ruffibarbata
M. leveilleana
M. duclouxii
M. sharpii
M. sumatrana
M. xinganensis
Global Magnolia species
KEY
Inside Native Range Country
Outside Native Range Country

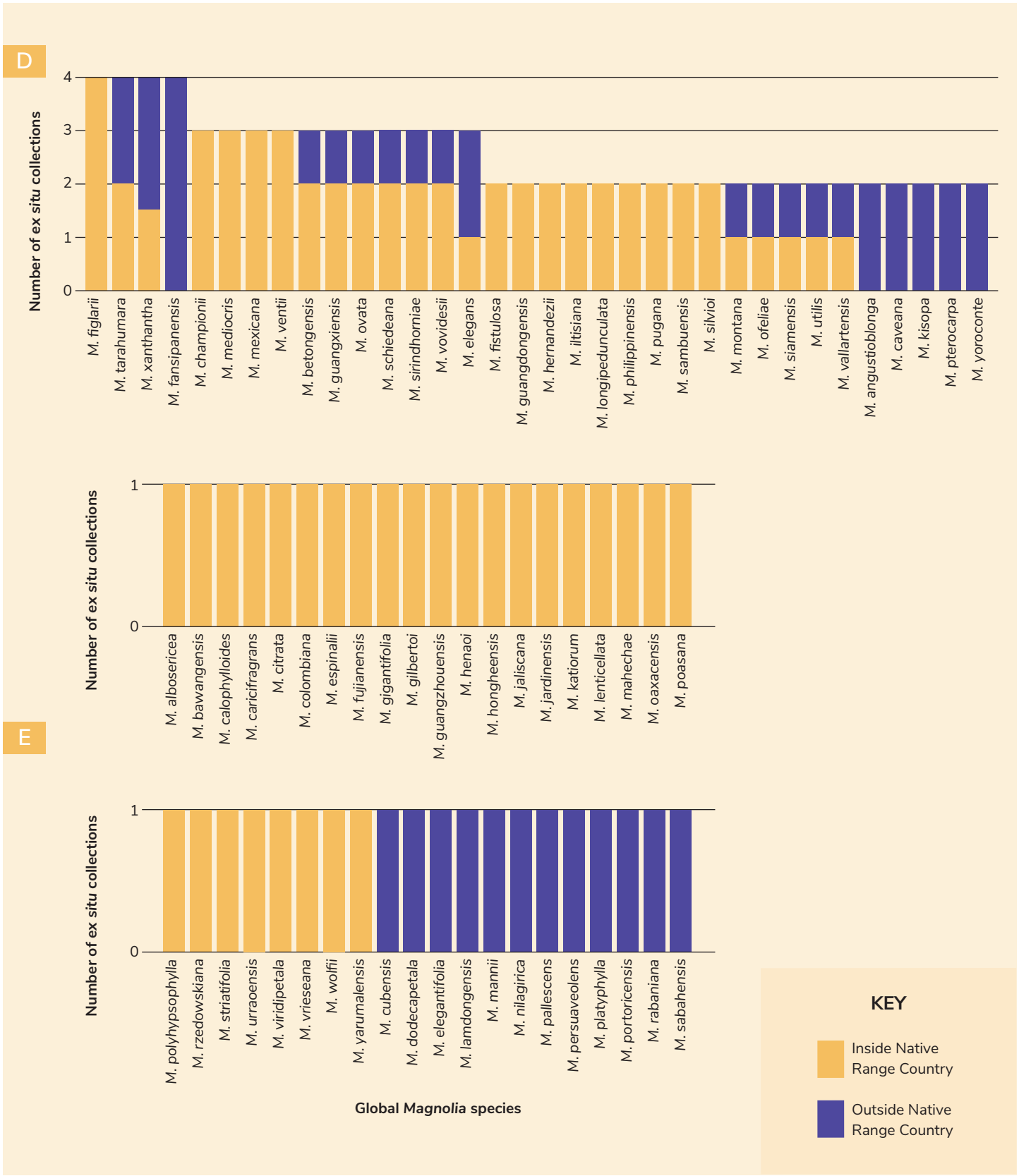
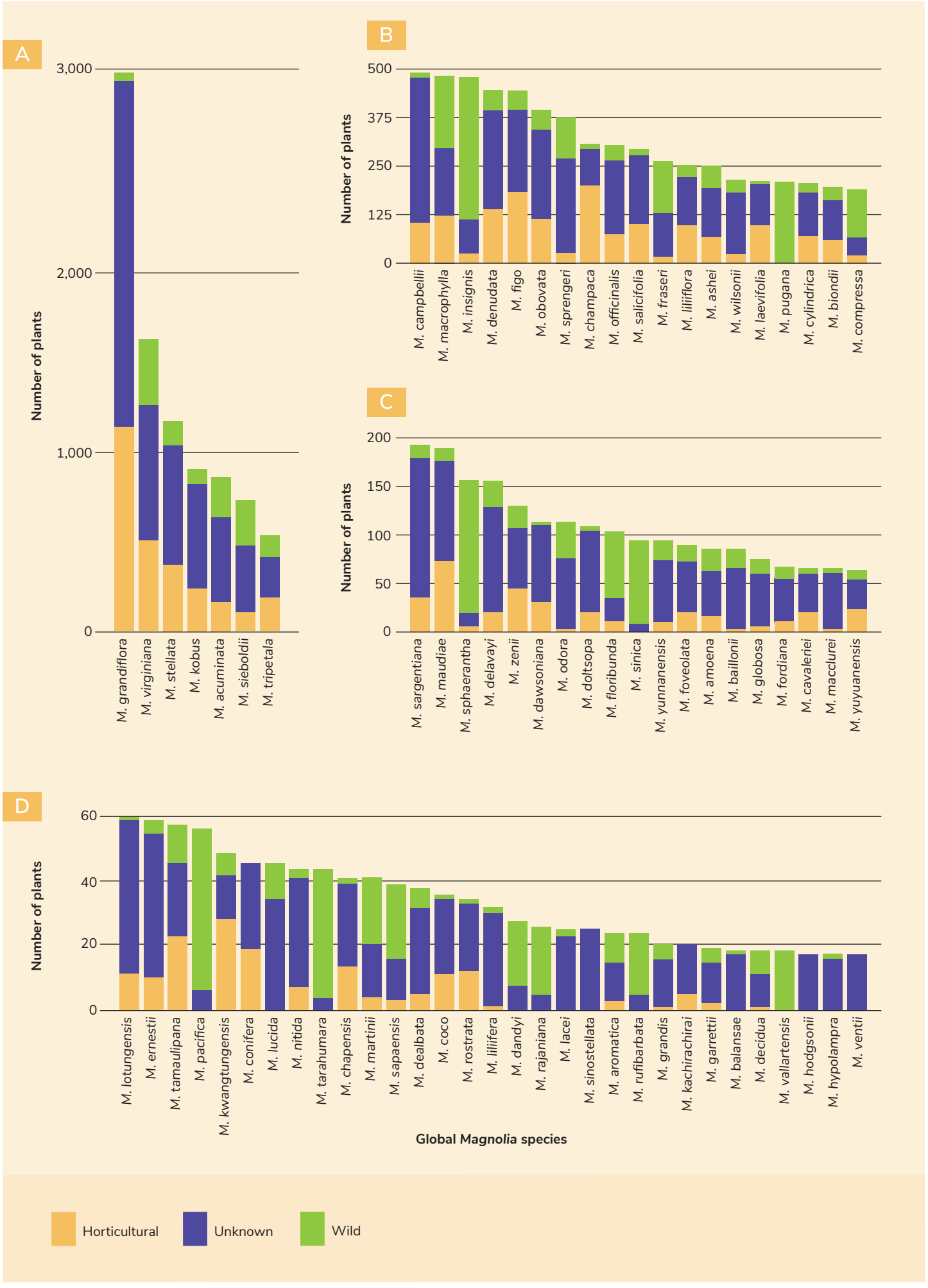


Figure 7. *Ex situ* collections survey results for *Magnolia* species: number of *ex situ* collections per species categorized by *ex situ* collection location. (A) species in more than 50 collections (B) species in 11-49 collections (C) species in 5-10 collections (D) species in 2-4 collections and (E) species in a single collection.


A
3,000
2,000
1,000
0
Number of plants
M. grandiflora
M. virginiana
M. stellata
M. kobus
M. acuminata
M. sieboldii
M. tripetala
B
500
375
250
125
0
Number of plants
M. campbellii
M. macrophylla
M. insignis
M. denudata
M. figo
M. obovata
M. sprengeri
M. champaca
M. officinalis
M. salicifolia
M. fraseri
M. liliiflora
M. ashei
M. wilsonii
M. laevifolia
M. pugana
M. cylindrica
M. biondii
M. compressa
C
200
150
100
50
0
Number of plants
M. sargentiana
M. maudiae
M. sphaerantha
M. delavayi
M. zenii
M. dawsoniana
M. odora
M. doltsopa
M. floribunda
M. sinica
M. yunnanensis
M. foveolata
M. amoena
M. baillonii
M. globosa
M. fordiana
M. cavaleriei
M. macclurei
M. yuyuanensis
D
60
40
20
0
Number of plants
M. lotungensis
M. ernestii
M. tamaulipana
M. pacifica
M. kwangtungensis
M. conifera
M. lucida
M. nitida
M. tarahumara
M. chapensis
M. martinii
M. sapaensis
M. dealbata
M. coco
M. rostrata
M. liliifera
M. dandyi
M. rajaniana
M. lacei
M. sinostellata
M. aromatica
M. rufibarbata
M. grandis
M. kachirachirai
M. garrettii
M. balansae
M. decidua
M. vallartensis
M. hodgsonii
M. hypolampra
M. ventii
Global Magnolia species
Horticultural
Unknown
Wild

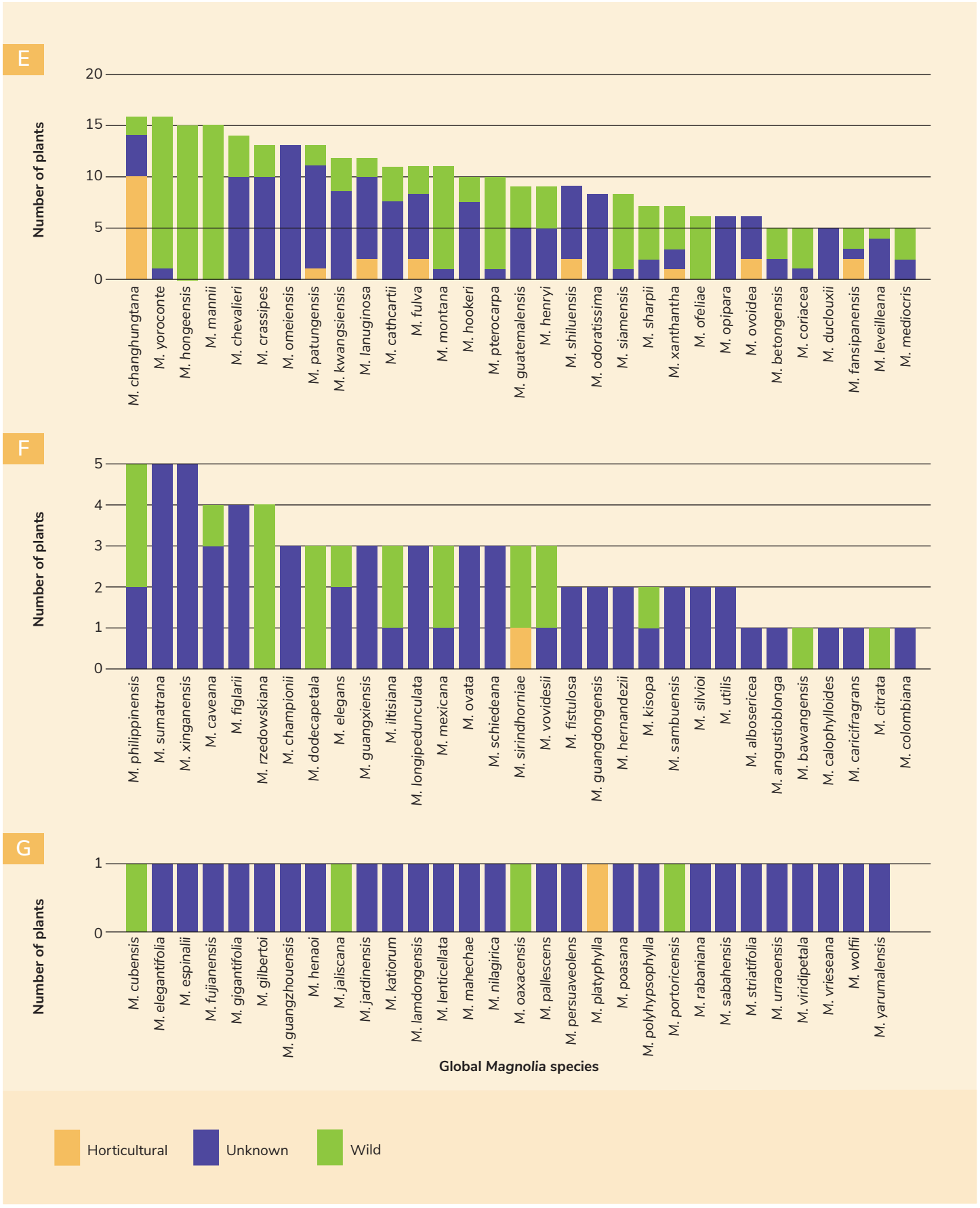


Figure 8. *Ex situ* collections survey results for all *Magnolia* species reported from at least one collection: number of individuals per species in *ex situ* collections, categorized by provenance type. (A) Species with more than 500 individuals in *ex situ* collections. (B) Species with 195-499 individuals in *ex situ* collections. (C) Species with 61-194 individuals in *ex situ* collections. (D) Species with 17-60 individuals in *ex situ* collections. (E) Species with 5-16 individuals in *ex situ* collections. (F) Species with 1-5 individuals in *ex situ* collections. G) Species with 1 individual in *ex situ* collections. Note change in scales. See Appendix B for specific numbers of individuals in *ex situ* collections.

Vulnerability

Twenty-one species had the highest vulnerability ranking (40) largely due to restricted range or population size information (Table 7). In the Caribbean region, *M. emarginata*, a species assessed as CR (Possibly Extinct), is highly vulnerable in Haiti due to rapid decline of forest habitat and restricted range. In Mexico & Central America, six species rank as most vulnerable: *M. faustinomirandae* (Mex. & Guat.), *M. multinervia* (Costa Rica), *M. ottoi* (Guatemala), *M. talamancana* (Costa Rica), *M. tribouillierana* (Guatemala) and *M. wendtii* (Mexico). Little information on demographic factors other than population size and range are known for these species, therefore studies on the regeneration, genetic variation, and fragmentation are needed. Ten species in South America are ranked as most vulnerable: *M. betuliensis* (Colombia), *M. calimaensis* (Colombia), *M. canandeana* (Ecuador), *M. chiguila* (Ecuador), *M. dixonii* (Ecuador), *M. manguillo* (Peru), *M. narinensis* (Colombia), *M. polyhypsophylla* (Colombia), *M. sanchez-vegae* (Peru) and *M. virolinensis* (Colombia). In East Asia, two species are ranked as most vulnerable: *M. ovoidea*, known from Yunnan, China with a very restricted and small population size, and *M. xanthantha*, known from a single location in Yunnan. Similarly, two species in the South & Southeast Asian region are ranked as most vulnerable: *M. kachinensis*, thought to exist in a population of less than 50 individuals in a single county in Myanmar, and *M. tiepii*, known from one location on Khanh Vinh Mountain in Vietnam. For all results of the vulnerability assessment see Appendix D.

Table 7. Species identified as most vulnerable (average score = 40) via vulnerability scoring matrix (see Table 1) for wild populations. Vulnerability scores for each demographic indicator are color coded based on severity; cells with a dash indicate unknown. These scores are used to calculate the average vulnerability score for each species. Full results found in Appendix D.

Taxon name	Population size	Range/ Endemism	Population decline	Fragmentation	Regeneration/ recruitment	Genetic variation/ integrity	IUCN Red List Category
M. betuliensis	40	40	-	-	40	-	CR
M. calimaensis	-	40	-	-	-	-	CR
M. canandeana	-	40	-	-	-	-	CR
M. chiguila	-	40	-	-	-	-	CR
M. dixonii	-	40	-	-	-	-	CR
M. emarginata	-	40	40	-	-	-	CR
M. faustinomirandae	-	40	-	-	-	-	CR
M. kachinensis	40	40	-	-	-	-	CR
M. manguillo	-	40	-	-	-	-	CR
M. multinervia	-	40	-	-	-	-	VU
M. narinensis	-	40	-	-	-	-	CR
M. ottoi	40	40	-	-	-	-	CR
M. ovoidea	40	40	-	-	-	-	CR
M. polyhypsophylla	40	40	-	40	-	-	CR
M. sanchez-vegae	-	40	-	-	-	-	CR
M. talamancana	-	40	-	-	-	-	VU
M. tiepii	-	40	-	-	-	-	CR
M. tribouillierana	40	40	-	-	-	-	CR
M. virolinensis	-	40	-	40	-	-	CR
M. wendtii	-	40	-	-	-	-	CR
M. xanthantha	-	40	-	-	-	-	EN

Globally, most of the 174 threatened species (98%) were ranked using range and endemism information and many fewer were ranked using population size (32%) and fragmentation information (40%). Even fewer have been ranked using regeneration/recruitment (18%), genetic variation/integrity data (16%), and population decline (13%) data (Appendix D.). Research is required on genetic variation of species and populations to provide an understanding of the threat of inbreeding or other genetic issues and inform management of both *in situ* and *ex situ* populations of threatened species. Additionally, longer-term studies providing information on population sizes, regeneration and decline of threatened species are required to fully understand vulnerability in the wild.

Threats to Species

A total of 54 respondents provided threat information for 131 threatened species in the conservation actions questionnaire. Threat information was also gathered from the IUCN Red List assessment for all threatened species. Similar to the *Red List of Magnoliaceae - revised and extended* (Rivers *et al.* 2016), the most common threats to *Magnolia* are related to agriculture, silviculture and/or ranching, with 160 threatened species impacted.

A greater number of threatened species are now reported as impacted by climate change (65; Figure 9) compared to the 2016 analysis (approximately 15). This trend may reflect more studies and greater understanding of impacts of climate change as well as increased impact to the species directly. The greatest number of species reported as impacted by climate change are those in Mexico & Central America (26). Other threats include tourism or recreation (22 species) and pests or pathogens (16 species).

Respondents selected 'unknown' as one of the most significant threats to wild populations of 38 species. This may reflect the lack of clarity surrounding the threats or specific knowledge by the respondents. For *M. longipedunculata* and *M. viridipetala*, 'unknown' was the only information provided about threats from either the IUCN Red List assessment or the questionnaire. Further investigation highlights that for *M. longipedunculata* past instances of logging and climate change are threats to the survival of this species (Rivers 2015). Clearly identifying and investigating the scope and intensity of threats to species is key to developing strategies for their conservation. Appendix E summarizes threats impacting all threatened species and further detail is found within the species profiles (Appendix H).

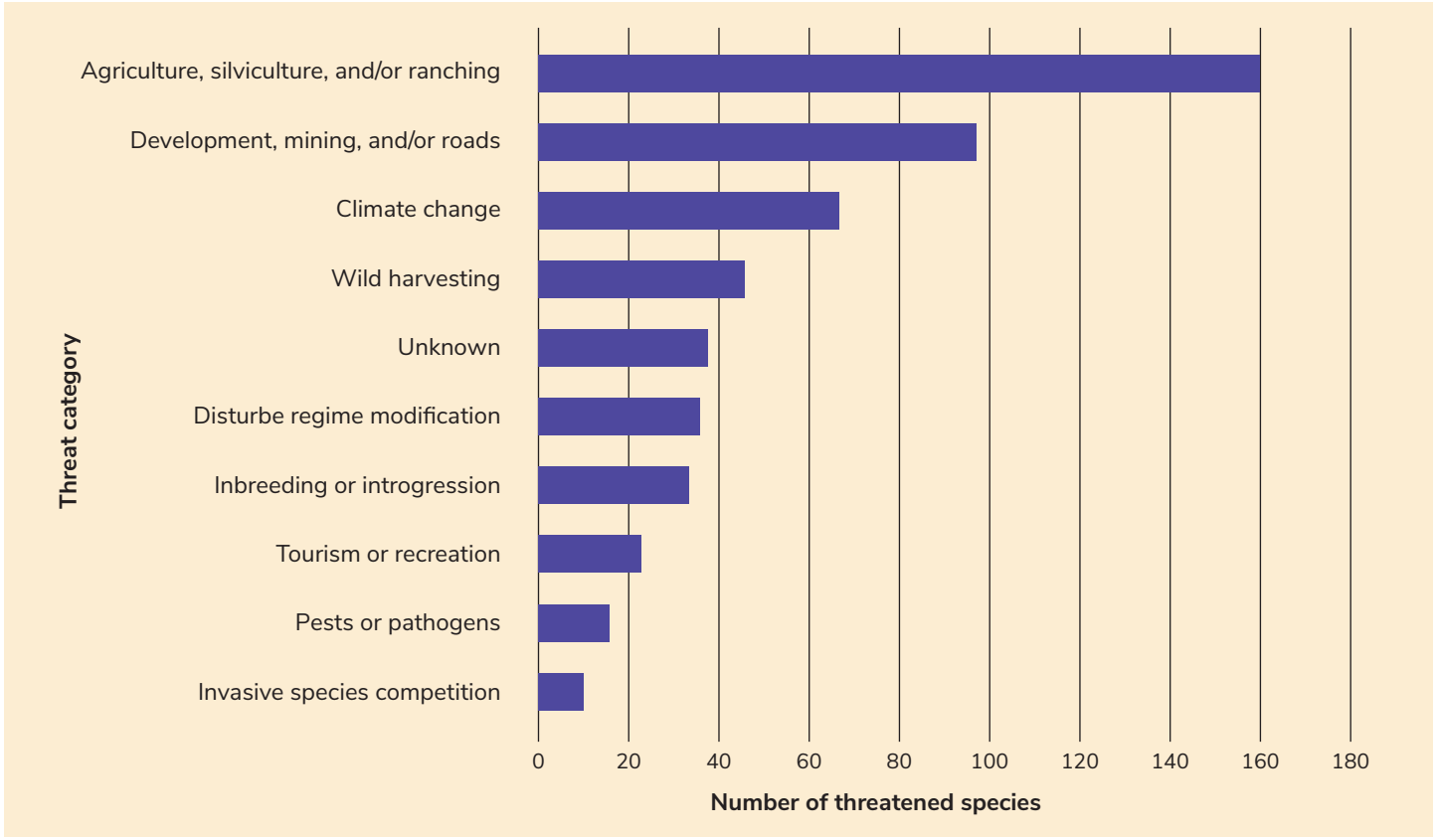


Figure 9. Major threats to threatened *Magnolia* species based on questionnaire results and IUCN Red List assessments.

Conservation Activities

A total of 90 respondents from 77 institutions in 25 countries (Figure 11) responded to the *Magnolia* conservation actions questionnaire, including 56 institutions providing information on 145 threatened species and additional species of concern. Respondents were from seven types of institutions, most commonly from arboreta/botanic gardens (46%) or universities/colleges (27%; Figure 10).

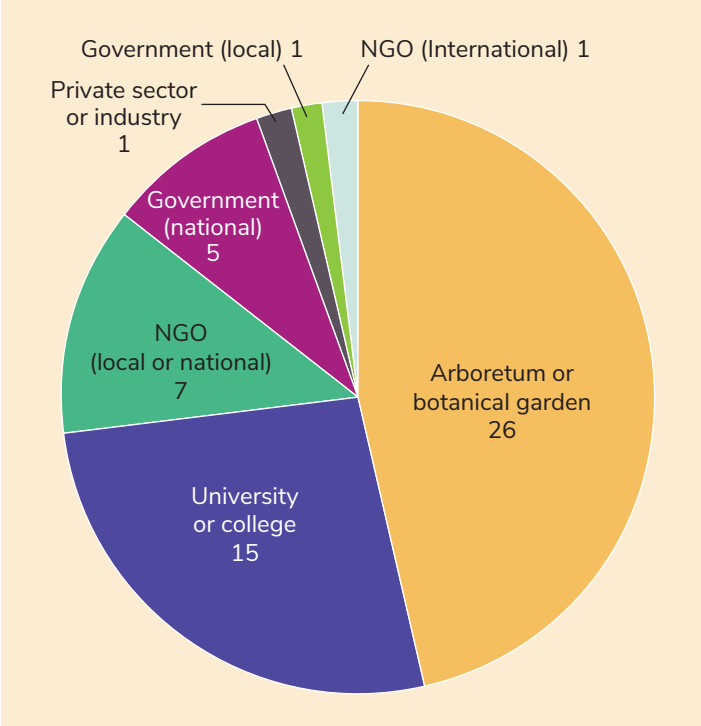


Figure 10. Respondents to the conservation action questionnaire who provided data for target species, by institution type. A total of 56 institutions provided data.

Magnolia dodecapetala (Emily Veltjen)

Respondents from the United States, Mexico, China, and Colombia provided the most conservation action information for threatened species (10, 9, 7 and 6 respondents, respectively). Current conservation actions were reported for 143 of the 174 threatened species (36 CR, 79 EN, and 28 VU), with respondents reporting the most activities for species of moderate to lower vulnerability (e.g. M. *grandis*, *M. stellata* and *M. sinostellata*, *M. odora*, *M. rajaniana* and *M. cylindrica*). Of the 143 species with reported conservation action(s), most are native to South America (44), Mexico & Central America (37), and South & Southeast Asia (32). Of all conservation activities, occurrence surveys/population monitoring (146 instances), conservation horticulture (104 instances), and public awareness/education (102 instances) were the most reported, while cryopreservation (19 instances), research on climate change (17 instances) and pests and pathogens (9 instances) were the least reported (Figure 12). Appendix F shows the full list of conservation activities reported for *Magnolia* species.

Figure 11. Frequency and distribution of respondents to the conservation action questionnaire (R script for map provided by Emily Beckman Bruns).

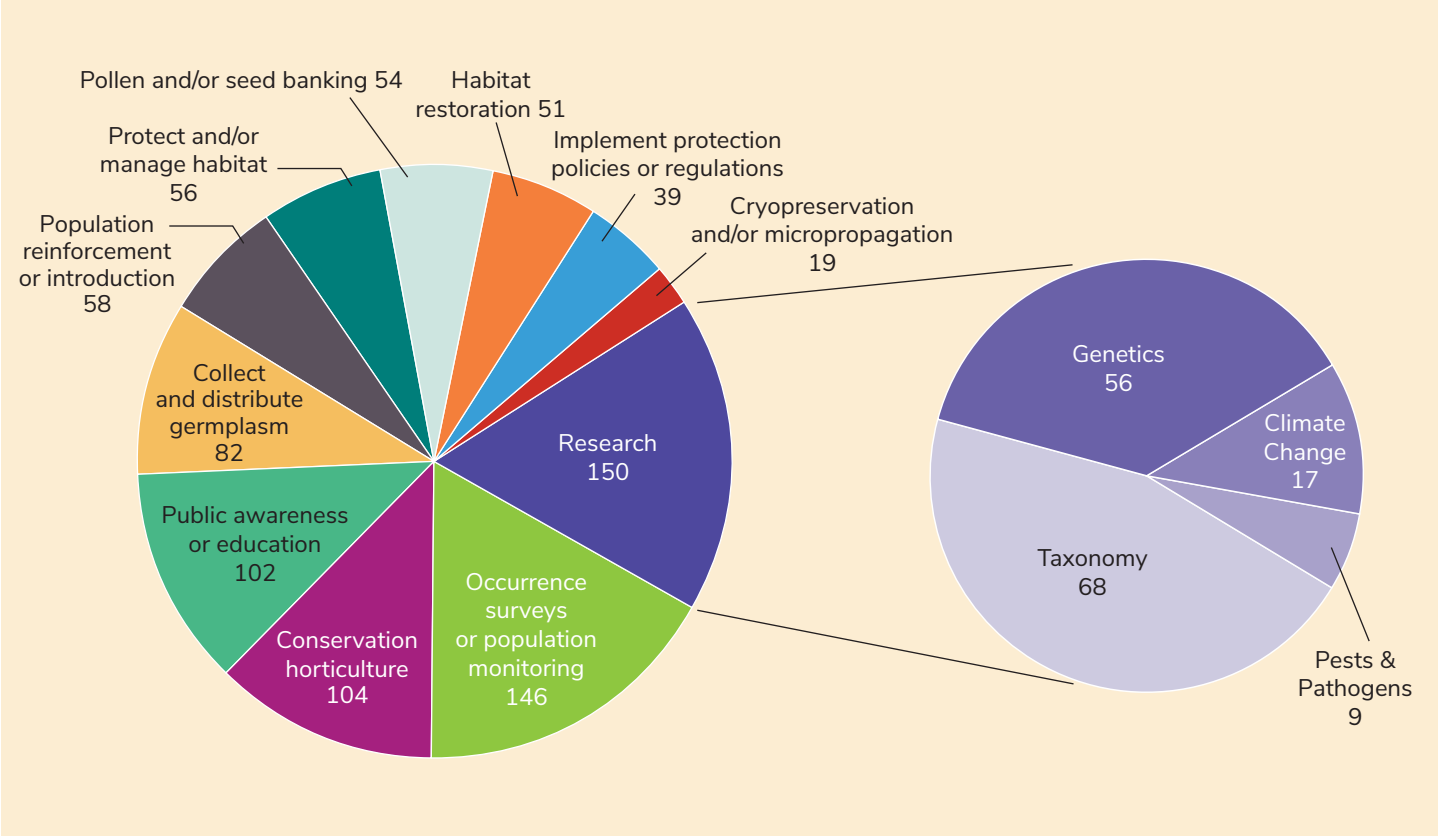


Figure 12. Frequency of current activities reported for *Magnolia* species globally. Detailed chart shows types of research reported by respondents.

Arboreta and botanic gardens report the most activities related to *ex situ* conservation and the public sphere (i.e. collecting and distributing germplasm, conservation horticulture, cryopreservation and public awareness). They also reported the most population reinforcement work and climate change research. This indicates their use of conservation collections and expert knowledge for reintroductions and for studying the impacts of climate change. Respondents from universities or colleges report a mix of both *in situ* and *ex situ* conservation activities, mostly habitat restoration and occurrence survey work as well as protecting and managing habitat. This likely reflects the strong ties and collaboration of these universities with local communities. Universities and colleges also reported the most pollen and seed banking in addition to research on pests and pathogens, reflecting their value as resources for understanding seed biology and storage behavior and the impact of pests on *Magnolia* species. National research institutions and herbaria play a large role in research on the genetics and taxonomy of *Magnolia*, as reported by institutions categorized under government (national).

Magnolia longipedunculata (Ren Hai)

Case Study: *Magnolia ashei* at the US National Arboretum

Authors: Todd Rounsaville & Kevin Conrad

Magnolia ashei (Tia Tyler)

Magnolia ashei is considered the most threatened *Magnolia* in the United States, where it is endemic to approximately ten counties in northern Florida. NatureServe lists *M. ashei* as Vulnerable (G3) and the IUCN Red List treats the taxon as a variety of *M. macrophylla* with Near Threatened (NT) status. The species' habitat specificity within undisturbed bluffs and ravine banks accounts for the highly fragmented state of extant populations. Noted threats to these populations include the ongoing decline in area and quality of habitat, the volatility of hurricanes in the region such as Hurricane Michael (Category 5, October 2018), and poor response to disturbance and competition with more aggressive plants.

Magnolia ashei (Tia Tyler)

The US National Arboretum initiated a genetic study of *M. ashei* in 2013. The goal of the study was to determine the genetic diversity of both wild populations and *ex situ* collections in order to guide long-term conservation strategies. A total of 127 accessions were used for the study, with leaf tissue samples collected from 11 wild populations, 14 cultivated sources, five *M. macrophylla* individuals, and three *M. ashei* × *M. macrophylla* hybrids. SSR markers were developed to characterize genetic diversity, and a total of 18 primer were suitable for use out of 64 that were developed and tested.

For wild-collected *M. ashei* samples, 39% of genetic diversity was attributable to among-population variation. Analysis of all 127 samples revealed that there were two subpopulations for the species which were geographically partitioned into eastern and western groups. The Holmes Creek population occurs directly at the interface between the eastern and western subpopulations and was found to be the most distantly related to all other populations and had the greatest genetic diversity. Among the cultivated samples, both the eastern and western subpopulations were already cultivated *ex situ*, but the Holmes Creek site was not represented.

This study provided several insightful results useful for follow-up *in situ* and *ex situ* conservation efforts. Cultivated specimens lacking provenance data could be ascribed to their respective wild population because of the comprehensive sampling *in situ*. Thus these pre-existing *ex situ* collections can contribute more value as known replicates in conservation efforts. By corollary, the Florida populations lacking *ex situ* representation were identified and prioritized for collecting efforts, with Holmes Creek being the most notable example.

Seed collections were made at Holmes Creek in the summer of 2020, and samples were maintained by maternal line. Following stratification, total seed germination among lines ranged from 0 to 71.4 % (mean = 19.7 ± 23.5). Planned ex situ conservation of the Holmes creek site will include an orchard planting (20-30 trees) at the U.S. National Arboretum and be replicated at two additional arboreta in the Southeast. Seedlings from Holmes Creek will be made available to the public garden community via the Woody Landscape Plant Germplasm Repository.

Magnolia ashei (Tia Tyler)

Magnolia ashei (T. Rounsaville)

The U.S. National Arboretum is also establishing a mixed orchard of all wild *M.* ashei populations at the arboretums research farm in College Park, Maryland. This orchard will act as a propagule source for shoot tips used for cryopreservation, because seeds of this species are desiccation-intolerant. The Arboretum will work with the National Center for Genetic Resources Preservation in Ft. Collins Colorado to ensure shoot tips from these populations are backed up in cold storage, and replaced as necessary over time. Because the study found that most of the genetic diversity (58%) occurred within individuals, this mixed-population planting could also function as a seed orchard more efficiently that devoting space for orchards unique to each population. However, in regard to generating seed *ex situ*; based on this study's finding that several cultivated *M. ashei* contained *M. macrophylla* loci (suggesting admixture) and well documented long-distance pollen dispersal in other *Magnolia* taxa, it would be extremely challenging for any one institution to prevent cross pollination among populations and species.

Spatial Analysis of *Ex situ* Collections

The geographic and ecological coverage of ex situ collections based on the full range of a species is used here as a proxy for the genetic diversity represented within ex situ collections. While molecular genetic studies are lacking for many *Magnolia* species, the collective data of multiple ex situ collections can be used to estimate the genetic and geographic diversity represented within those collections. These geographic and ecological calculations are based on a rough estimation of the range of each species and in some cases ex situ accessions were only able to be geolocated to county level. Additionally, the analysis may show a single plant as adequately representing the genetic diversity of a given species, however in practice optimal collection sizes of 10s to 100s of plants are needed to sufficiently capture genetic diversity ex situ (Hoban et al. 2020). Therefore, the spatial analysis presented here and within the species profiles (Appendix H) should be used as a general guide for future wild collecting efforts.

Magnolia vallartensis (Miguel Á. Muñiz Castro)

Magnolia stellata (Philippe de Spoelberch)

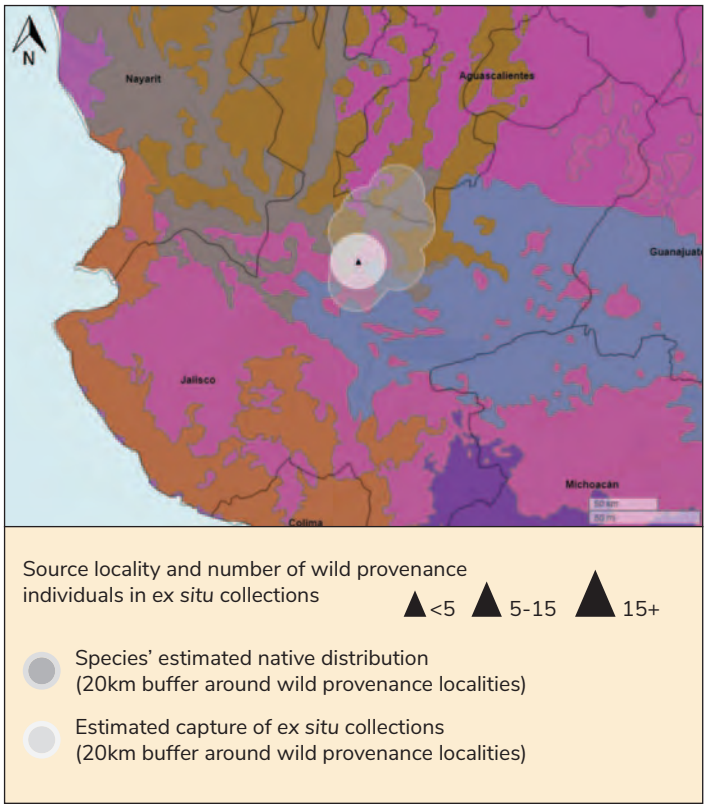


Figure 13. Example of the map created for each of 28 target threatened species. This map shows *Magnolia pugana* with estimated *in situ* distribution and ex situ collection source localities, which are used to estimate geographic and ecological coverage of ex situ collections (R script for map provided by Emily Beckman Bruns).

Accession data was provided for 49 threatened species via the 2021 ex situ survey and collection location data was either provided or geolocated (and therefore spatial analysis could be carried out) for 28 of these species. An example of the maps produced for these species is presented here (Figure 13). Twelve species are estimated to have ex situ collections that represent 50% or more of their geographic range (Figure 14). These are *M. stellata*, *M. zenii*, *M. sapaensis*, *M. vallartensis*, *M. ofeliae*, *M. tamaulipana*, *M. sinica*, *M. portoricensis*, *M. lucida*, *M. sargentiana*, *M. rzedowskiana* and *M. oaxacensis*. These species generally have restricted ranges. Six species have ex situ collections representing less than 25% of their geographic range. All species showed greater ecological coverage than geographical and eight species (*M. stellata*, *M. zenii*, *M. sapaensis*, *M. vallartensis*, *M. ofeliae*, *M. sinica*, *M. lucida*, *M. cylindrica*) have 100% ecological coverage in ex situ collections. See the species profiles in Appendix H for maps of threatened species.

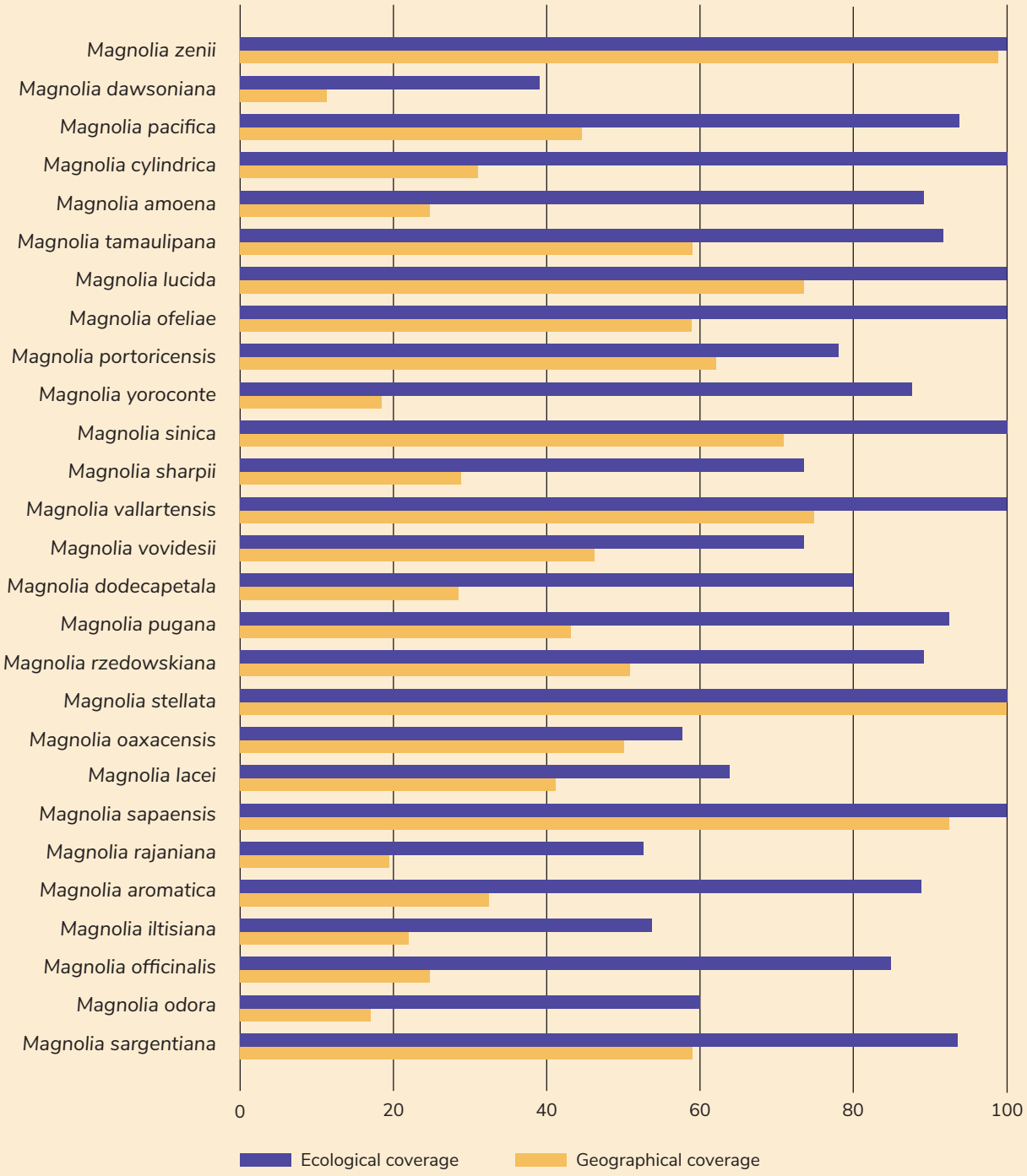


Figure 14. Estimated geographic and ecological coverage of *ex situ* collections for *Magnolia* species. Species are listed by average vulnerability score from highest (*Magnolia zenii*) to lowest (*Magnolia sargentiana*).

Conservation Actions Needed

Respondents to the conservation action questionnaire provided insight into the most urgent conservation actions for threatened species. While multiple activities were suggested for many species and ultimately are important to the conservation of *Magnolia*, recommended activities can guide plans for conservation at the species and regional levels. See Appendix F2 for all responses to the conservation action questionnaire on conservation action needed. More details are also in the species profiles (Appendix H). The conservation actions most suggested for threatened *Magnolia* species are occurrence surveys/population monitoring, collecting and distributing germplasm, conservation horticulture, and protecting and managing habitat. At a regional level, research (climate change, genetics, pests & pathogens, and taxonomy) was the most suggested activity for species in the Caribbean; in Mexico & Central America, habitat restoration was most suggested, while in South America, protecting and/or managing habitat was the most suggested activity. For East Asian species, conservation horticulture was the most suggested activity and for South & Southeast Asian species occurrence surveys and population monitoring of threatened species was most suggested (Figure 15).

In addition to providing information on threatened species, respondents also highlighted other species that have not currently been assessed as threatened, but which are vulnerable to extinction. A number of species currently assessed as DD were identified as requiring further attention in Bangladesh (*M. pterocarpa*), Brazil (*M. paranaensis* and *M. sellowiana*), Brunei Darussalam (*M. ashtonii*, *M. bintuluensis*, *M. gigantifolia* and *M. macklotii*), Indonesia (*M. banghamii*: known only from type locality, which is not a protected area and faces threat from habitat conversion and degradation); Lao PDR (*M. hypolampra*), Philippines (*M. philippinensis*), Thailand and China (*M. henryi*: in Thailand it is distributed in a limited area and in China it has a narrow distribution and sparse population in the wild, and *M. sphaerantha*: limited distribution in China), and Vietnam (*M. lamdongensis*).

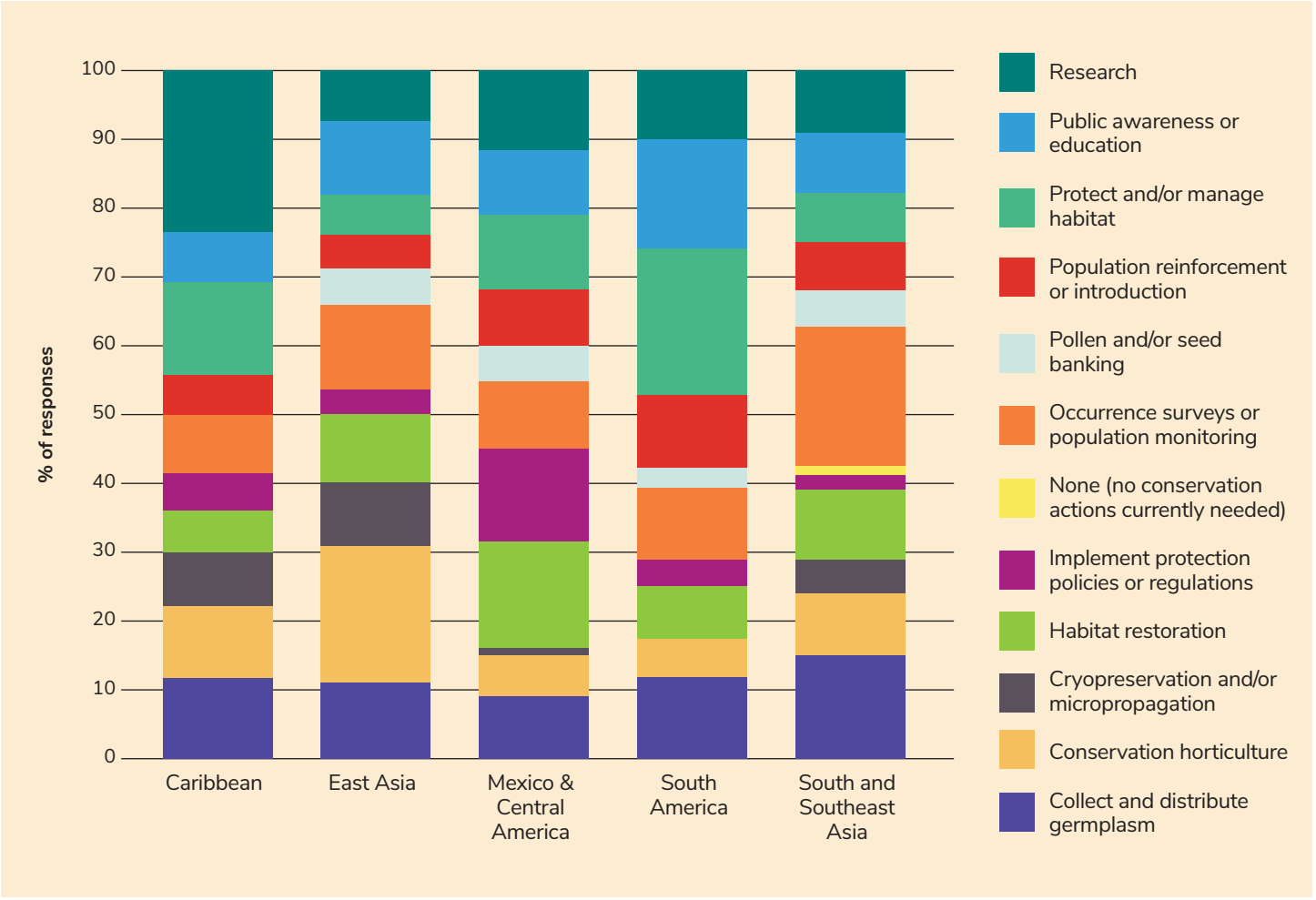


Figure 15. Responses to the conservation actions question 'Select what you see as the most urgent conservation activities for each species' for all threatened species, by region.

Some species assessed as either Least Concern or Near Threatened were highlighted by respondents as requiring conservation attention, indicating a higher degree of threat or that further field surveys may be required to determine a detailed status of the species. In Bangladesh and Lao PDR *M. champaca* is disappearing from the wild due to deforestation of natural habitat and in China *M. denudata* has few individuals remaining in the wild. Also in China, data indicates many *M. sprengeri* are in cultivation but few remain in the wild, *M. fordiana* is rare in the wild throughout its distribution and *M. figlarii* is identified as a species of concern. In Lao PDR *M. foveolata* and *M. chapensis* are also of conservation concern and in China *M. chapensis* is rare throughout its wild distribution. In Vietnam and Lao PDR *M. baillonii* is highlighted as an additional species of concern. In Colombia and Panama, *M. sambuensis*, while reported in protected areas, is scarce. In Brazil *M. amazonica* is identified as a species of conservation concern and in Brunei Darussalam *M. carsonii* was also highlighted in the conservation questionnaire. Respondents also highlighted newly described species which require conservation action. These include species from Colombia (*M. frontinoensis*) and Mexico (*M. granbarrancae*, *M. mixteca*, *M. talpana*, *M. zotictla*).

Prioritizing Species of Conservation Concern

A total of 93 *Magnolia* species were identified as initial species of concern (Appendix G). The number of species of concern identified in each region varied widely, highlighting different conservation priorities: in Mexico & Central America 27 species; the Caribbean region 7 species; South America 47 species; East Asia 1 species; South & Southeast Asia 11 species. Of the 93 globally threatened species of concern 44% are assessed as CR and 55% are assessed as EN.

The CR species of concern identified in Mexico are largely found in Southern Mexico and Guatemala (e.g. *M. faustinomirandae*, *M. lacandonica*, *M. ottoi* and *M. poqomchi*). Those in the Caribbean are located in Haiti and the Dominican Republic as well as Cuba (e.g. *M. domingensis*, *M. ekmanii*, *M. emarginata* and *M. oblongifolia*). Many species in South America were not reported in *ex situ* collections and many of the CR species of concern from that region are found in the diversity center of Colombia (e.g. *M. betuliensis* and *M. coronata*) but some are also found in Ecuador (e.g. *M. dixonii*) and Peru (e.g. *M. manguillo*). The only species of conservation concern identified in East Asia is *M. longipedunculata*, a species endemic to Guangdong, China. A limited number of institutions reported holding this species and no information about provenance was collected. While this species has been subject to conservation action in the past (Ren *et al.* 2016), updated information about its status and coordinated *ex situ* collection management are needed. For other species in East Asia, future activities may focus on filling in gaps and developing genetically representative *ex situ* collections and identifying *in situ* priorities for species of concern. In South & Southeast Asia, 5 CR species of conservation concern were identified from Thailand (*M. gustavii*), Myanmar (*M. kachinensis*), India (*M. pleiocarpa*) and Vietnam (*M. sonlaensis* and *M. tiepii*).

The species profiles (Appendix H) provide detailed information and recommendations for additional species of concern including distribution and ecology, vulnerability of and threats to wild populations, maps of presence in protected areas as well as *ex situ* collection source localities. Finally, ongoing and recommended conservation activities for each of the 28 species is provided. The species profiled are summarized as follows:

- Mexico & Central America
  - Mexico: *M. iltisiana*, *M. mexicana*, *M. oaxacensis*, *M. ofeliae*, *M. pacifica*, *M. pugana*, *M. rzedowskiana*, *M. sharpii*, *M. tamaulipana*, *M. vallartensis*, *M. vovidesii*
  - Honduras: *M. yoroconte*
- Caribbean
  - Puerto Rico: *M. portoricensis*
  - Lesser Antilles: *M. dodecapetala*
- East Asia
  - China: *M. amoena*, *M. aromatica*, *M. cylindrica*, *M. dawsoniana*, *M. lacei*, *M. lucida*, *M. odora*, *M. officinalis*, *M. sargentiana*, *M. sinica*, *M. zenii*
  - Japan: *M. stellata*
- South & Southeast Asia
  - Thailand: *M. rajaniana*
  - Vietnam: *M. sapaensis*

Of these 28 species, 4 are CR, 14 are EN and 10 are VU. These species profiles gather valuable information for developing conservation strategies among collaborative partners for these species and provide guidance for the development of similar profiles for other threatened species in the future.

Case Study: conservation actions in the Tropical Andes in Colombia: safeguarding threatened tree species with local conservationists

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Magnolia jardinensis in the background (A.M. Benavides)

The Andes are the most species-rich diversity ecoregion and one of most threatened ecoregions on Earth. Nearly all of Andean Colombia's 29 Magnolia species, many of which are endemic, are threatened with extinction (M. Serna, pers. Comm., Calderon et *al*. 2007). The forests of the Andes in Colombia in the central region in the department of Antioquia, are severely degraded and fragmented, less than 5% are considered pristine (Gonzalez-Caro and Vasquez 2017). In remnants of forest, generally in inaccessible places with a high slope, on top of mountains or on cliffs, individuals of magnolias persist. They are generally solitary adult trees, emerging from the forest canopy. Thanks to funding from Fondation Franklinia and the collaboration of multiple allies, we have established a route to save these species from extinction in the southwest and west of the department of Antioquia in the Western Cordillera of Colombia in an area of ~ 4169.7 km^2. The project seeks to facilitate species conservation by establishing an effective recovery strategy at the species population level for four threatened species (*Magnolia hernandezii* and *M. jardinensis* and two wax palms, *Ceroxylon alpinum* and *C. quindiuense*) and engaging local communities in conservation actions. Conservation actions include rapid phenology surveys, demographic assessments for each species selected, establishment of local nurseries, plant propagation, and finally, reintroduction of individuals. In addition, we are working on a free online course aimed at the inhabitants of this region or people interested in learning more about threatened species and specific actions they can take to mitigate their extinction. Currently, we are establishing two central nurseries and 6 (small) satellite nurseries in natural reserves. Every day (from November 2020 to 2022), our team in the field (Fabio Alejandro Arango, Kelly Henao and Héctor Gaviria) records the phenological status (production of flowers and seeds) and collects seedlings and seeds to be established in the nurseries. Our preliminary results, which include previous explorations carried out by Fabio Alejandro Arango and Marcela Serna in the study area, indicate us that there are less than ten and 35 adult trees of *M. hernandezii* and *M. jardinensis*, respectively. Hopefully, although scarce we have found regeneration of one to two seedlings or juvenile trees in circular plots established to determine the population structure around each adult tree. Seed production has started in June and seeds will be col-

Germinator beds with *Magnolia hernandezii* seeds (A.M. Benavides)

lected to establish in the central nurseries of both species. Although local and national efforts are being made, the current small and large-scale deforestation in the region has a great impact on species survival. During our inventories, we have seen how sites that we visited, within a few weeks are deforested, for example to widen roads, cutting juvenile magnolias. In the long term, this project will mitigate regional forest loss by encouraging communities to achieve their own conservation initiatives. The current outlook is not encouraging for the survival of the *Magnolia* species, due to the low number of adult trees, scattered and isolated, therefore facilitation processes and active conservation actions are urgent in the region.

Hector Gaviria with juvenile plant *Magnolia jardinensis (A.M. Benavides)*

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Magnolia lotungensis (Keming Yang, South China Botanical Garden)

Conclusions

This gap analysis builds from previously published works including IUCN Red List assessments, *ex situ* surveys and other valuable publications, and will be updated as practical conservation is expanded. This analysis aims to further inspire and guide conservation actions and support policy decisions related to imperiled *Magnolia* species facing continued and new threats. The analyses and recommendations presented here are intended for a wide set of stakeholders including non-governmental organizations, botanical gardens and arboreta, policy makers, land managers, governmental agencies, and others.

A fundamental need highlighted by this analysis is the expansion of research for many of the species of concern. Targeted research is necessary to better inform the development of effective conservation strategies; initiatives including demography studies, climate change modeling, ecological niche modeling, pest and pathogen control methods, population genetic studies, and taxonomy are all critically needed for many threatened *Magnolia* species. Data from these studies are fundamental to the understanding of current and future needs of *in situ Magnolia* populations.

Despite efforts to assess the conservation status of Magnoliaceae taxa since 2007, the extinction risk of a large number of *Magnolia* species remains insufficiently known. Currently 102 species are listed as Data Deficient (DD), meaning there is not sufficient data to assess their conservation status. Prioritizating these taxa for targeted fieldwork and data collection will lead to a greater understanding of the current status of these species and enable required action to be taken. Species experts have highlighted DD species that require further study and additional investigation and communications will continue to identify areas for development of species specific projects.

This analysis also highlights the need to increase well-documented and genetically diverse *ex situ* collections, particularly for species in areas where *in situ* habitat loss and climatic threats are greatest. Focus and collaborative metacollection development is vital for ensuring genetically representative collections and this development relies on prioritizing *ex situ* data gathering for species of conservation concern. Initial action can be taken to fill gaps for those species which have been mapped in this analysis. Additionally, 93 of the most threatened *Magnolia* species are still absent from *ex situ* collections and should be targeted for *ex situ* conservation. With the large number of species housed in one or few collections, the expansion of metacollection sites (Griffith *et al*. 2020) is key, particularly in countries of origin for threatened species. Increased capacity to maintain collections in diversity centers for *Magnolia* is paramount. Continued development of *ex situ* collections and sharing of data also contributes to measuring achievement towards global conservation goals including the Convention on Biological Diversity (CBD) Strategic Plan for Biodiversity.

By identifying gaps in information and action, the continued promotion of cross-sector networking and collaboratiion to ensure species conservation is evident. The development of regional species prioritization lists aims to focus funding, field work, data collection, *ex situ* collections development and other conservation action among stakeholders with related contexts and objectives. This analysis promotes awareness of current and needed activities for *Magnolia* species. It is vital to support communication among stakeholders engaged in *Magnolia* conservation, to address the global scale of threats and collectively advance the conservation actions needed.

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Appendices

Appendix A. List of Contributors

Institutional contributors to PlantSearch, 2018-2020 *ex situ* collections surveys and Conservation Actions Questionnaire:

Adelaide Botanic Gardens; Adkins Arboretum; Agro-Botanical Garden of USAMV Cluj-Napoca; Amani Botanical Garden; Ambler Arboretum of Temple University, The; Annapolis Royal Historic Gardens; Antony Woodland Garden; Arboreto de la Mota, Miraflores de la Sierra, Madrid, Spain; Arboreto di Arco - Parco Arciducale; Arboretum at Kutztown University; Arboretum at Penn State, The; Arboretum at Regis University, The; Arboretum at the University of California, Santa Cruz; Arboretum des Grands-Murcins; Arboretum Freiburg-Günterstal; Arboretum Groenendaal - Flemish Forest Department - Houtvesterij Groenendaal; Arboretum i Jardí Botànic Pius Font i Quer; Arboretum Kirchberg; Arboretum Leśnego Banku Genów Kostrzyca; Arboretum Mustila; Arboretum National des Barres; Arboretum of Guizhou Institute of Forestry Science; Arboretum of Jiangxi Institute of Forestry Science; Arboretum of Nanjing Forestry University; Arboretum of Wuhan University; Arboretum Oudenbosch; Arboretum Střední lesnické školy; Arboretum w Przelewicach;Arboretum Wespelaar; Arboretum Wojslawice – Botanical Garden, University of Wroclaw; Arboretum Zampach; Arboretum-Pinetum Lucus Augusti; Arlington National Cemetery Memorial Arboretum; Arnold Arboretum of Harvard University, The; Asociación Jardin Botanico La Laguna; Atlanta Botanical Garden; Auckland Botanic Gardens; Aullwood Garden MetroPark; Baker Arboretum; Bamboo Brook Outdoor Education Center; Bangladesh Agricultural University Botanic Garden; Baoji Botanical Garden (Shaanxi); Bartlett Tree Research Laboratories Arboretum; Batsford Arboretum; Batumi Botanical Garden; Bayard Cutting Arboretum; Bedgebury National Pinetum & Forest; Beijing (southern) Botanical Garden - Living Plants; Beijing Forestry University Botanic Garden; Beijing Medicinal Garden; Belmonte Arboretum; Bendigo Botanic Gardens, White Hills; Benmore Botanic Garden; Bergen Botanical Garden; Bergius Botanic Garden; Berkshire Botanical Garden; Bhagalpur University Botanical Garden; Bickelhaupt Arboretum; Bicton Park Botanical Gardens; Bidoup Nui Ba National Park Botanic Garden; Birmingham Botanical Gardens and Glasshouses; Birr Castle Demesne; Bishop Museum - Checklist of Cultivated Plants of Hawai'i; Blue Mountains Botanic Garden, Mount Tomah; Boerner Botanical Gardens; Bogor Botanic Gardens (Center for Plant Conservation - Botanic Gardens); Bok Tower Gardens; Bokrijk Arboretum; Bonn University Botanic Gardens; Boone County Arboretum; Borde Hill Garden; Botanic Garden Government College University; Lahore (BGGC); Botanic Garden of Poltava National Pedagogical University; Botanic Garden of Rostock University; Botanic Garden of Smith College, The; Botanic Garden, Delft University of Technology; Botanic Gardens of South Australia; Botanical Garden - Institute of the Volga State Technological University; Botanical Garden of Moscow Palace of Pioneers; Botanical Garden of Pyatigorsk State Pharmaceutical Academy; Botanical Garden of Tartu University; Botanical Garden of the Anhui Institute of Biology; Jardin Botanique de l'Université de Strasbourg; Botanical Garden of the University of Bern; Botanical Garden of Vilnius University; Botanical Garden University of Duesseldorf; Botanical Garden, Natural History Museum of Denmark; Botanical Garden-Institute of the Far Eastern Branch; Russian Academy of Science; Botanische Gärten der Universität Bonn; Botanische Tuin Groningen "Domies Toen"; Botanischer Garten der Carl von Ossietzky-Universitat Oldenburg; Botanischer Garten der Friedrich-Schiller-Universitaet; Botanischer Garten der Justus-Liebig Universität Giessen; Botanischer Garten der Ruhr-Universität Bochum; Botanischer Garten der Technischen Universitaet Darmstadt; Botanischer Garten der Technischen Universitaet Dresden; Botanischer Garten der Universitaet des Saarlandes; Botanischer Garten der Universitaet Zurich; Botanischer Garten der Universität Freiburg; Botanischer Garten der Universitat Kiel; Botanischer Garten der Universitat Osnabruck; Botanischer Garten der Universität Ulm; Botanischer Garten Frankfurt am Main; Botanischer Garten Oldenburg; Botanischer Garten und Botanisches Museum Berlin; Botanischer Versuchs- und Lehrgarten; Bowman's Hill Wildflower Preserve; Brenton Arboretum, The; Brisbane Botanic Gardens; Brookgreen Gardens; Brooklyn Botanic Garden; Brookside Gardens; Bundaberg Botanic Gardens; Caerhays national collection of magnolias; Cambridge University Botanic Garden; Cape Fear Botanical Garden; Catalogue of Medicinal Plants of Ukrainian Botanic Gardens and Parks; Catalogue of Rare Plants of Ukrainian Botanic Gardens and Parks; Center for Plant Conservation (USA); Château Pérouse; Chelsea Physic Garden; Cheryl Kearns, Private garden; Chester M. Alter Arboretum; Chicago Botanic Garden; Chollipo Arboretum Foundation; Cincinnati Zoo and Botanical Gardens; City of Leeds Botanic Gardens; City of Liverpool Botanic Gardens; Cleveland Botanical Garden; Coastal Maine Botanical Gardens; Columbus Botanical Garden; Como Park Zoo and Conservatory; Connecticut College Arboretum; Conservatoire Botanique National du Brest; Conservatoire Botanique Pierre Fabre; Conservatoire et Jardin botaniques de la Ville de Genève; Cooktown Botanic Gardens; Core Facility Botanical Garden;

Cornell Botanic Gardens; Corporacion Salvamontes Colombia; Cox Arboretum; Crosby Arboretum, The; Cuc Phuong Botanic Garden; Darts Hill Garden Park; Dashushan Botanical Garden; Davidson College Arboretum; Dawes Arboretum, The; Dawyck Botanic Garden; Dendrological garden of the Silva Tarouca Research Institute for Landscape and Ornamental Gardening; Denver Botanic Gardens; Denver Zoological Gardens; Descanso Gardens; Dinghushan National Nature Reserve; Dixon Gallery and Gardens, The; Dominion Arboretum and Central Experimental Farm; Donald E. Davis Arboretum; Dongfeng Forest Farm (Guizhou); Dow Gardens; Dr Cecilia Koo Botanic Conservation Center; Dr. Sun Yat-Sen Classical Chinese Garden; Duke Farms; Dunedin Botanic Garden; DuPage Forest: Forest Preserve District of DuPage County; Dyffryn Gardens; Eastwoodhill Arboretum; EcoJardin Instituto Investigaciones en Ecosistemas y Sustentabilidad; Ed Shinn; Eden Project, The; El Colegio de La Frontera Sur (ECOSUR); Elisabeth C. Miller Botanical Garden; Eötvös Loránd University Botanic Garden; Evergreen Burial Park and Arboretum; EW Heier Teaching and Research Greenhouses; Exbury Gardens; Fairchild Tropical Botanic Garden; Fairy Lake Botanical Garden, Shenzhen & Chinese Academy of Sciences; Fauna & Flora International; Fellows Riverside Gardens; Ferme d'Azy at Chassepierre Belgium; Fernwood Botanical Garden and Nature Preserve; Filoli Center; Finnish Museum of Natural History / Helsinki University Botanic Garden; Florida Botanical Gardens; Foellinger-Freimann Botanical Conservatory; Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation (Thailand); Forest Science Institute of Central Highlands and South of Central Vietnam (FSIH); Forstbotanischer Garten der Technischen Universitaet Dresden; Forstbotanischer Garten Eberswalde; Forstbotanischer Garten und Arboretum; FossilPlants; Frances Parker Private Collections; Frank A. Waugh Arboretum; Franklin Park Conservatory; Frederik Meijer Gardens & Sculpture Park; Frelinghuysen Arboretum; The; Fruit Spirit Botanical Garden; Fullerton Arboretum; Fundacion Jardín Botánico Nacional Viña del Mar; Gabis Arboretum at Purdue Northwest; Gainesway Farm; Ganna Walska Lotusland; Gannan Arboretum of Jiangxi; Gardens of the Big Bend: Magnolia Garden; Garvan Woodland Gardens; Germplasm Bank of Wild Species; Ghent University Botanic Garden; Giardino Botanico Friuli "Cormor"; Gibraltar Botanic Gardens; Gifu Academy of Forest Science and Culture; Glasgow Botanic Gardens; Global Biodiversity Conservancy; Gore Public Gardens; Gothenburg Botanical Garden; Government College University, Lahore Botanic Garden (BGGC); Gradina Agro-Botanica din Cluj-Napoca; Grapevine Botanical Gardens at Heritage Park; Green Bay Botanical Garden; Green Spring Gardens; Green-Wood Cemetery; Greenwood Gardens; Grugapark und Botanischer Garten der Stadt Essen; Grupo Ecológico Sierra Gorda; Guangxi Botanical Garden of Medicinal Plants; Hackfalls Arboretum; Hangzhou Botanical Garden; Henry Foundation for Botanical Research, The; Henry Schmieder Arboretum; Hergest Croft Gardens; Hershey Gardens; Hidden Lake Gardens; Historische Tuin Aalsmeer; Hof ter Saksen Arboretum; Holden Arboretum, The; Hollard Garden; Honeysuckle Farm and Gardens; Honolulu Botanical Gardens; Horsholm Arboretum; Hortus Botanicus Amsterdam; Hortus Botanicus Reykjavikensis; Houston Botanic Garden; Hoyt Arboretum; Huay Kaew Arboretum; Hunan Forest Botanical Garden; Hunan Nanyue Arboretum; Hunter Region Botanic Gardens, Huntington Library, Art Museum and Botanical Gardens, Seed Bank & Tissue Culture Lab; Incheon Arboretum; Instituto de Botanica 'Gonçalo Sampaio'; Instituto de Ecología, A.C.; Ioulia & Alexandros Diomidis Botanical Garden (Julia & Alexander N. Diomides Botanic Garden- Seed Bank); Jangheung Natural Arboretum; Jardí Botànic de la Universitat de València; Jardi Botanic de Soller; Jardim Botanico da Madeira; Jardim Botânico da Universidade de Coimbra; Jardim Botânico da Universidade de Lisboa; Jardim Botânico da Universidade de Trás-os-Montes e Alto Douro; Jardim Botânico de Jundiaí - Valmor de Souza; Jardim Botânico do Rio de Janeiro; Jardim Botânico Tropical; Jardín Botánico "Carlos Thays"; Jardín Botánico "Lucien Hauman"; Jardín Botánico Atlántico de Gijón; Jardin Botanico Benjamin F. Johnston; Jardín Botánico CECON-USAC; Jardín Botánico CEPE-Taxco UNAM; Jardin Botanico Culiacán; Jardín Botánico de Bahía Blanca; Jardín Botánico de Bogotá José Celestino Mutis; Jardín Botánico de Cartagena; Jardín Botánico de la ciudad de Buenos Aires "Carlos Thays"; Jardin Botanico de la Instituto de Botánica, Universidad de Guadalajara; Jardin Botanico del Instituto de Biologia (UNAM); Jardin Botanico del Parque de Las Leyendas; Jardin Botanico Dr. Faustino Miranda; Jardín Botánico Francisco Javier Clavijero; Jardín Botánico Haravéri; Jardín Botánico de Medellín; Jardín Botánico Nacional Simón Bolívar - seed bank; Jardin Botanico Universidad Tecnologica de Pereira; Jardin Botanico Universitario BUAP; Jardin Botanique Camifolia; Jardin Botanique Alpin de la Jaÿsinia; Jardin Botanique de la Ville de Caen; Jardin Botanique de la Ville de Lyon; Jardin Botanique de l'Université Angers; Jardin Botanique de l'Université de Strasbourg; Jardin Botanique de Marnay sur Seine; Jardin botanique de Paris; Jardin Botanique et Arboretum Henri Gaussen; Jardin Botanique Exotique "Val Rahmeh"; Jardin Botanique Yves Rocher; Jardin des Plantes; Jardin des Plantes de Paris et Arboretum de Chevreloup; Jardins botaniques du Grand Nancy et de l'Université de Lorraine; Jardins des Plantes de l'Université; JC Raulston Arboretum; Jeju Botanical Garden, Yeomiji; Jerusalem Botanical Gardens; John C. Gifford Arboretum; Kalmthout Arboretum; Kee-chung-san Botanic Garden; Keith Arboretum; The Charles R.; Keum Kang Arboretum; Kings Park and Botanic Garden; Korea Botanic Garden; Kunming Botanical Garden; Kurpark Bad Bellingen; Landis Arboretum; L'Arboretum de Chevreloup; Lauritzen Gardens; Le Jardin Le Vasterival; Les Jardins Suspendus; Leuven Botanic Garden; Lewis Ginter Botanical Garden; Limbe Botanic Garden; Lincoln Park Zoo; Living Desert Zoo and Gardens; Logan Botanic Garden; Longwood Gardens; Los Angeles County Arboretum and Botanic Garden; Lushan Botanical Garden; Lyon Arboretum & Botanical Garden of the University of Hawaii; M.M. Gryshko National Botanical Garden; Magnolia Multi-site Collection - Plant Collections Network; Magnolian Grove Arboretum; Maijishan Arboretum (Gansu); Main Botanical Garden, Russian Academy of Sciences; Malabar Botanical Garden and Institute for Plant Sciences; Maribor University Botanic Garden; Marie Selby Botanical Gardens; Mary M.B. Wakefield Estate & Arboretum; Matthaei Botanical Gardens & Nichols Arboretum; Maymont Foundation; Mead Botanical Garden; Meadowlark Botanical Gardens; Meise Botanic Garden; Memorial University Botanical Garden; Mercer Botanic Gardens Millennium Seed Bank; Milner Gardens and Woodland; Minnesota Landscape Arboretum; Mission Street Parks Conservancy; Missouri Botanical Garden; Missouri State Arboretum;

Montreal Botanical Garden/Jardin botanique de Montréal; Moore Farms Botanical Garden; Morris Arboretum, The; Morton Arboretum, The; Moscow State University Botanical Garden; Mount Auburn Cemetery; Mount Lofty Botanic Garden; Mount Usher Gardens; Mountain Top Arboretum; Mt. Airy Arboretum; Mt. Cuba Center; Museo Orto Botanico di Roma; Museum of Life + Science Magic Wings Butterfly House; Nanjing Botanical Garden Mem. Sun Yat-sen; Nanjing Botanical Garden of Medicinal Plants; Naples Botanical Garden; National Arboretum Canberra; National Botanic Garden of Latvia; National Botanic Garden of Wales; National Botanical Garden of Georgia; National Kandawgyi Botanical Gardens (Maymyo Botanical Garden); National Plant Germplasm System - USDA-ARS-NGRL; National Rhododendron Garden; National Tropical Botanical Garden; National University of Laos; Native Plant Trust - Garden in the Woods; NDSU Dale E. Herman Research Arboretum; Nebraska Statewide Arboretum; Neuer Botanischer Garten der Universität Göttingen; New Brunswick Botanical Garden; New York Botanical Garden, The; Newport Arboretum, The; Niagara Parks; Botanical Gardens and School of Horticulture, The; Nicholas Reis; Norfolk Botanical Garden; North Carolina Arboretum, The; North Carolina Botanical Garden; Northwestern University Ecological Park and Botanic Gardens; Novosibirsk Dendropark; Oekologisch-Botanischer Garten Universitaet Bayreuth; Oklahoma City Zoo and Botanical Garden; Orto Botanico - Università degli Studi di Catania; Orto Botanico "Carmela Cortini" - Università di Camerino; Orto Botanico "Giardino dei Semplici"; Orto Botanico dell'Università degli Studi di Padova; Orto Botanico dell'Università degli studi di Siena; Orto Botanico dell'Universita di Pavia; Orto Botanico di Bergamo "Lorenzo Rota"; Orto Botanico di Perugia; Orto Botanico di Torino; Osa Conservation; Oxford University Botanic Garden & Arboretum; Paignton Zoo Environmental Park; Palmengarten der Stadt Frankfurt am Main; Parco Botanico del Cantone Ticino; Parque Botânico da Tapada da Ajuda; Peter the Great Botanical Garden of the V.L. Komarov Botanical Institute; Pha Tad Ke Botanical Garden; Plant Conservation and Research Foundation; Polly Hill Arboretum; The; Pontificia Universidad Javeriana; Powell Gardens; Pukeiti Garden; Pukekura Park; Purdue Arboretum, The; Pyunggang Botanical Garden; Queen Sirikit Botanic Garden; Queens Botanical Garden; Reading Public Museum and Arboretum, The; Real Jardín Botánico Juan Carlos I; Red Butte Garden and Arboretum; Reiman Gardens, Iowa State University; Research Institute of Subtropical Forestry (Zhejiang); Rhododendron Species Foundation and Botanical Garden; Rimba Ilmu Botanic Garden; Ringve Botanical Garden; Rio Grande Botanic Garden; Riverview Horticultural Centre Society, The; Rogów Arboretum of Warsaw University of Life Sciences; Rotterdam Zoological and Botanical Gardens; Royal Botanic Garden Edinburgh; Royal Botanic Gardens Kew (Wakehurst); Royal Botanic Gardens Sydney; Royal Botanic Gardens, Kew; Royal Botanic Gardens, Victoria - Melbourne Gardens; Royal Botanical Gardens, Ontario; Royal Horticultural Society's Garden, Harlow Carr; Royal Horticultural Society's Garden, Hyde Hall; Royal Horticultural Society's Garden, Rosemoor; Royal Horticultural Society's Garden, Wisley; Royal Roads University Botanical Gardens; Royal Tasmanian Botanical Gardens; Royal Veterinary and Agricultural University Arboretum; Sakhalin Botanical Garden; San Diego Botanic Garden; San Diego Zoo Global; San Francisco Botanical Garden; Sanghyo Botanical Garden; Sarah P. Duke Gardens; Sarius Palmetum and Botanical Garden; Scott Arboretum of Swarthmore College; Shanghai Botanical Garden; Shanghai Chenshan Botanical Garden; Sheffield Botanical Gardens; Sherwood Fox Arboretum; Singapore Botanic Gardens; Sireeruckhachati Nature Learning Park; Sister Mary Grace Burns Arboretum; Smale Riverfront Park; Smith-Gilbert Gardens; Smithsonian Gardens - Tree Collection; Smithsonian National Zoological Park; Sonoma Botanical Garden; South China Botanical Garden, CAS; Southern Institute of Ecology (Vietnam); Spartanburg Community College Arboretum; Spring Grove Cemetery and Arboretum; St. Andrews Botanic Garden; St. Kilda Botanic Garden; Starhill Forest Arboretum; State Arboretum of Virginia (Orland E. White Arboretum); State Botanical Garden of Georgia, The; State Botanical Garden of Kentucky; Stavanger Botanic Garden; Stellenbosch University Botanical Garden; Stichting Belmonte Arboretum; Stichting Botanische Tuin Kerkrade; Stoneleigh: a natural garden; Swansea Botanical Complex; Tallinn Botanic Garden; Tasmanian Arboretum Inc; Tatton Garden Society/The Lovell Quinta Arboretum; Tecnológico de Antioquia-Institución Universitaria; The B.M. Kozo-Polyansky Botanical Garden of Voronezh State University; The Barnes Arboretum at SJU; The Fanshawe College Botanical Gardens; The Garden of Morning Calm; The John Fairey Garden (Peckerwood Garden); The Linnaean Gardens of Uppsala (Uppsala University); The Sir Harold Hillier Gardens; The Tree Register of the British Isles; The Yorkshire Arboretum; Timaru Botanic Garden; Toledo Botanical Garden; Townsville Botanic Gardens; Treborth Botanic Garden; Trees Atlanta; Trompenburg Gardens & Arboretum; Trsteno Arboretum; Tucson Botanical Gardens; Tyler Arboretum; UC Davis Arboretum; UConn Plant Biodiversity Conservatory and Research Center; Ukrainian National Forestry University Botanic Garden; United States Botanic Garden; United States Capitol Grounds and Arboretum; United States National Arboretum; Universidad Estatal Amazonica; University Arboretum; University Botanic Gardens Ljubljana; University of Alabama Arboretum; University of Bergen Botanical Garden; University of British Columbia Botanical Garden; University of California Botanical Garden at Berkeley; University of Connecticut Arboretum; University of Delaware Botanic Gardens; University of Dundee Botanic Garden; University of Exeter Grounds; University of Guelph Arboretum; University of Idaho Arboretum & Botanical Garden; University of Miami; University of Oslo Botanical Garden; University of Tennessee Gardens; University of Turku - Botanic Garden; University of Washington Botanic Gardens; Utrecht University Botanic Garden; Utrecht University Botanic Gardens; Vallarta Botanical Gardens, A.C.; Vanderbilt University Arboretum; VanDusen Botanical Garden; Vietnam National University of Forestry; Village of Riverside (IL); Von Gimborn Arboretum; W. J. Beal Botanical Garden; Waimea Valley Arboretum and Botanical Garden; Wellington Botanic Garden; Wentworth Castle Gardens; Westonbirt; The National Arboretum; Willowwood Arboretum; Winona State University; The Landscape Arboretum at; Wuhan Botanic Garden; Xiamen Botanical Garden; Xi'an Botanical Garden; Xiashi Arboretum; Xishuangbanna Tropical Botanical Garden, CAS; Yew Dell Botanical Gardens; Zhejiang A&F University; Zoo and BG Plzeň

Appendix B. *Ex situ* collections survey of global *Magnolia* species

Data was gathered from 2018 to 2020. A total of 522 institutions from 65 countries reported 18,576 Magnolia plants via PlantSearch and the accession surveys.

**Species for which accession level data was provided during surveys; geolocation was attempted for only accession records of threatened species*

Magnolia species	Number of in ex situ collections	Number of plants in ex situ collections	Number of plants marked as wild origin	Number of plants with given or geolocated wild origin
*Magnolia acuminata**	208	873	213	141
Magnolia albosericea	1	1	0	0
Magnolia alejandrae	0	0	0	0
Magnolia allenii	0	0	0	0
Magnolia amazonica	0	0	0	0
*Magnolia amoena**	55	85	25	7
Magnolia angatensis	0	0	0	0
Magnolia angustioblonga	1	1	0	0
Magnolia annamensis	0	0	0	0
Magnolia arcabucoana	0	0	0	0
Magnolia archilana	0	0	0	0
Magnolia argyrothricha	0	0	0	0
*Magnolia aromatica**	21	24	10	6
Magnolia arroyoana	0	0	0	0
*Magnolia ashei**	69	251	64	50
Magnolia ashtonii	0	0	0	0
Magnolia atlantida	0	0	0	0
Magnolia azulensis	0	0	0	0
*Magnolia baillonii**	10	85	24	0
*Magnolia balansae**	8	18	1	0
Magnolia banghamii	0	0	0	0
Magnolia bankardiorum	0	0	0	0
Magnolia bawangensis	1	1	1	0
Magnolia beccarii	0	0	0	0
*Magnolia betongensis**	3	5	3	0
Magnolia betuliensis	0	0	0	0
Magnolia bidoupensis	0	0	0	0
Magnolia bintuluensis	0	0	0	0
*Magnolia biondii**	74	202	41	30
Magnolia blaoensis	0	0	0	0
Magnolia boliviana	0	0	0	0
Magnolia borneensis	0	0	0	0
Magnolia braianensis	0	0	0	0
Magnolia brasiliensis	0	0	0	0
Magnolia calimaensis	0	0	0	0
Magnolia calophylla	0	0	0	0
Magnolia calophylloides	1	1	0	0
*Magnolia campbellii**	75	495	11	1
Magnolia canandeana	0	0	0	0
Magnolia cararensis	0	0	0	0
Magnolia caricifragrans	1	1	0	0
Magnolia carnosa	0	0	0	0

Magnolia species	Number of in ex situ collections	Number of plants in ex situ collections	Number of plants marked as wild origin	Number of plants with given or geolocated wild origin
Magnolia carsonii	0	0	0	0
*Magnolia cathcartii**	10	11	4	1
Magnolia cattienensis	0	0	0	0
*Magnolia cavaleriei**	31	65	5	1
*Magnolia caveana**	2	4	1	0
Magnolia cespedesii	0	0	0	0
*Magnolia champaca**	75	340	26	0
Magnolia championii	3	3	0	0
*Magnolia changhungtana**	10	16	2	0
*Magnolia chapensis**	27	41	2	0
*Magnolia chevalieri**	9	14	10	0
Magnolia chiguila	0	0	0	0
Magnolia chimantensis	0	0	0	0
Magnolia chiriquiensis	0	0	0	0
Magnolia chocoensis	0	0	0	0
Magnolia citrata	1	1	1	0
Magnolia clemensiorum	0	0	0	0
Magnolia clementinana	0	0	0	0
Magnolia cochranei	0	0	0	0
*Magnolia coco**	30	36	1	0
Magnolia colombiana	1	1	0	0
*Magnolia compressa**	45	195	134	94
*Magnolia conifera**	27	46	0	0
*Magnolia coriacea**	5	5	4	0
Magnolia coronata	0	0	0	0
Magnolia costaricensis	0	0	0	0
*Magnolia crassipes**	9	13	3	3
Magnolia cristalensis	0	0	0	0
*Magnolia cubensis**	1	1	1	0
*Magnolia cylindrica**	110	207	36	18
Magnolia dabieshanensis	0	0	0	0
*Magnolia dandyi**	9	28	20	0
*Magnolia dawsoniana**	51	117	2	1
*Magnolia dealbata**	30	38	6	1
Magnolia decastroi	0	0	0	0
*Magnolia decidua**	14	18	7	0
*Magnolia delavayi**	69	154	24	4
*Magnolia denudata**	179	456	58	9
Magnolia dimorpha	0	0	0	0
Magnolia dixonii	0	0	0	0
*Magnolia dodecapetala**	1	3	3	3
*Magnolia doltsopa**	49	107	3	0
Magnolia domingensis	0	0	0	0
*Magnolia duclouxii**	5	5	0	0
Magnolia duperreana	0	0	0	0
Magnolia ekmanii	0	0	0	0
*Magnolia elegans**	3	3	1	0
*Magnolia elegantifolia**	1	1	0	0
Magnolia elfina	0	0	0	0
Magnolia elliptigemmata	0	0	0	0
Magnolia emarginata	0	0	0	0

Magnolia species	Number of in ex situ collections	Number of plants in ex situ collections	Number of plants marked as wild origin	Number of plants with given or geolocated wild origin
Magnolia equatorialis	0	0	0	0
*Magnolia ernestii**	42	59	5	1
Magnolia espinalii	1	1	0	0
*Magnolia fansipanensis**	4	5	2	0
Magnolia faustinomirandae	0	0	0	0
Magnolia figlarii	4	4	0	0
*Magnolia figo**	125	456	52	4
Magnolia fistulosa	2	2	0	0
Magnolia flaviflora	0	0	0	0
*Magnolia floribunda**	27	103	67	1
*Magnolia fordiana**	34	66	11	8
*Magnolia foveolata**	39	88	22	1
Magnolia fragarigynandria	0	0	0	0
*Magnolia fraseri**	85	260	133	61
Magnolia fujianensis	1	1	0	0
*Magnolia fulva**	9	11	3	0
*Magnolia garrettii**	18	19	3	0
Magnolia gentryi	0	0	0	0
Magnolia georgii	0	0	0	0
Magnolia gigantifolia	1	1	0	0
Magnolia gilbertoi	1	1	0	0
*Magnolia globosa**	38	75	14	8
Magnolia gloriensis	0	0	0	0
*Magnolia grandiflora**	270	2889	42	11
*Magnolia grandis**	18	20	4	0
Magnolia griffithii	0	0	0	0
Magnolia guanacastensis	0	0	0	0
Magnolia guangdongensis	2	2	0	0
*Magnolia guangxiensis**	3	3	0	0
Magnolia guangzhouensis	1	1	0	0
Magnolia guatapensis	0	0	0	0
*Magnolia guatemalensis**	7	9	5	0
Magnolia guerrerensis	0	0	0	0
Magnolia gustavii	0	0	0	0
Magnolia hamorii	0	0	0	0
Magnolia henaoi	1	1	0	0
*Magnolia henryi**	7	9	4	0
Magnolia hernandezii	2	2	0	0
*Magnolia hodgsonii**	15	17	0	0
Magnolia hongheensis	1	15	15	0
*Magnolia hookeri**	7	10	3	0
*Magnolia hypolampra**	5	17	1	0
*Magnolia iltisiana**	2	3	2	2
Magnolia inbioana	0	0	0	0
*Magnolia insignis**	76	486	370	7
Magnolia irwiniana	0	0	0	0
Magnolia iteophylla	0	0	0	0
Magnolia jaenensis	0	0	0	0
Magnolia jaliscana	1	1	1	0
Magnolia jardinensis	1	1	0	0
Magnolia jianfenglingensis	0	0	0	0

Magnolia species	Number of in ex situ collections	Number of plants in ex situ collections	Number of plants marked as wild origin	Number of plants with given or geolocated wild origin
Magnolia juninensis	0	0	0	0
Magnolia kachinensis	0	0	0	0
*Magnolia kachirachirai**	6	20	0	0
Magnolia kaifui	0	0	0	0
Magnolia katiorum	1	1	0	0
Magnolia kichuana	0	0	0	0
Magnolia kingii	0	0	0	0
*Magnolia kisopa**	2	2	1	1
*Magnolia kobus**	219	930	138	81
Magnolia koordersiana	0	0	0	0
Magnolia krusei	0	0	0	0
*Magnolia kwangsiensis**	9	12	4	0
*Magnolia kwangtungensis**	23	49	7	1
Magnolia lacandonica	0	0	0	0
*Magnolia lacei**	6	25	23	23
*Magnolia laevifolia**	69	210	6	2
Magnolia lamdongensis	1	1	0	0
*Magnolia lanuginosa**	10	12	2	0
Magnolia lanuginosoides	0	0	0	0
Magnolia lasia	0	0	0	0
Magnolia lawii	0	0	0	0
Magnolia lenticellata	1	1	0	0
*Magnolia leveilleana**	5	5	1	0
*Magnolia liliifera**	16	32	2	1
*Magnolia liliiflora**	103	252	35	29
Magnolia llanganatensis	0	0	0	0
Magnolia longipedunculata	2	3	0	0
Magnolia lopezobradorii	0	0	0	0
*Magnolia lotungensis**	49	60	1	1
Magnolia lozanoi	0	0	0	0
*Magnolia lucida**	7	46	12	12
*Magnolia macclurei**	22	65	4	0
Magnolia macklottii	0	0	0	0
Magnolia macrocarpa	0	0	0	0
*Magnolia macrophylla**	173	489	199	94
Magnolia madidiensis	0	0	0	0
Magnolia mahechae	1	1	0	0
Magnolia manguillo	0	0	0	0
*Magnolia mannii**	1	15	15	0
Magnolia manuensis	0	0	0	0
Magnolia mariusjacobsia	0	0	0	0
*Magnolia martinii**	21	41	21	0
Magnolia mashpi	0	0	0	0
Magnolia masticata	0	0	0	0
*Magnolia maudiae**	58	187	17	7
Magnolia mayae	0	0	0	0
Magnolia mediocris	3	5	3	0
Magnolia mercedesiarum	0	0	0	0
*Magnolia mexicana**	3	3	2	2
Magnolia mindoensis	0	0	0	0
Magnolia minor	0	0	0	0

Magnolia species	Number of in ex situ collections	Number of plants in ex situ collections	Number of plants marked as wild origin	Number of plants with given or geolocated wild origin
Magnolia mirifolia	0	0	0	0
*Magnolia montana**	2	11	10	0
Magnolia montebelloensis	0	0	0	0
Magnolia morii	0	0	0	0
Magnolia multinervia	0	0	0	0
Magnolia nana	0	0	0	0
Magnolia napoensis	0	0	0	0
Magnolia narinensis	0	0	0	0
Magnolia neillii	0	0	0	0
Magnolia neomagnifolia	0	0	0	0
*Magnolia nilagirica**	1	1	0	0
*Magnolia nitida**	22	44	3	0
Magnolia nuevoleonensis	0	0	0	0
*Magnolia oaxacensis**	1	1	1	1
Magnolia oblonga	0	0	0	0
Magnolia oblongifolia	0	0	0	0
Magnolia obovalifolia	0	0	0	0
*Magnolia obovata**	153	418	63	50
*Magnolia odora**	22	117	43	35
*Magnolia odoratissima**	7	8	0	0
*Magnolia ofeliae**	2	6	6	4
*Magnolia officinalis**	141	337	70	36
*Magnolia omeiensis**	9	13	0	0
*Magnolia opipara**	6	6	0	0
Magnolia orbiculata	0	0	0	0
Magnolia ottoi	0	0	0	0
Magnolia ovata	3	3	0	0
*Magnolia ovoidea**	5	6	0	0
*Magnolia pacifica**	6	56	50	47
Magnolia pahangensis	0	0	0	0
Magnolia palandana	0	0	0	0
Magnolia pallescens	1	1	0	0
Magnolia panamensis	0	0	0	0
Magnolia paranaensis	0	0	0	0
Magnolia pastazaensis	0	0	0	0
*Magnolia patungensis**	12	13	2	0
Magnolia pealiana	0	0	0	0
Magnolia pedrazae	0	0	0	0
Magnolia perezfarrerae	0	0	0	0
Magnolia persuaveolens	1	1	0	0
Magnolia peruviana	0	0	0	0
Magnolia philippinensis	2	5	3	0
*Magnolia platyphylla**	1	1	0	0
Magnolia pleiocarpa	0	0	0	0
Magnolia poasana	1	1	0	0
Magnolia polyhypsophylla	1	1	0	0
Magnolia poqomchi	0	0	0	0
*Magnolia portoricensis**	1	2	2	2
Magnolia praecalva	0	0	0	0
Magnolia ptaritepuiana	0	0	0	0
*Magnolia pterocarpa**	2	10	9	0

Magnolia species	Number of in ex situ collections	Number of plants in ex situ collections	Number of plants marked as wild origin	Number of plants with given or geolocated wild origin
Magnolia pubescens	0	0	0	0
*Magnolia pugana**	2	208	208	3
Magnolia punduana	0	0	0	0
Magnolia quangninhensis	0	0	0	0
Magnolia quetzal	0	0	0	0
Magnolia rabaniana	1	1	0	0
*Magnolia rajaniana**	6	26	20	2
Magnolia resupinatifolia	0	0	0	0
Magnolia rimachii	0	0	0	0
*Magnolia rostrata**	22	35	1	0
*Magnolia rufibarbata**	5	24	20	20
*Magnolia rzedowskiana**	1	4	4	4
Magnolia sabahensis	1	1	0	0
*Magnolia salicifolia**	121	297	22	14
Magnolia sambuensis	2	2	0	0
Magnolia sanchez-vegae	0	0	0	0
Magnolia santanderiana	0	0	0	0
*Magnolia sapaensis**	20	39	24	20
Magnolia sarawakensis	0	0	0	0
*Magnolia sargentiana**	64	193	14	8
Magnolia savegrensis	0	0	0	0
Magnolia schiedeana	3	3	0	0
Magnolia scortechinii	0	0	0	0
Magnolia sellowiana	0	0	0	0
*Magnolia sharpii**	4	7	5	5
*Magnolia shiluensis**	7	9	0	0
Magnolia shirenshanensis	0	0	0	0
Magnolia shizhenii	0	0	0	0
Magnolia shuarorum	0	0	0	0
Magnolia siamensis	2	8	7	0
*Magnolia sieboldii**	194	719	210	76
Magnolia silvioi	2	2	0	0
Magnolia sinacacolinii	0	0	0	0
Magnolia singapurensis	0	0	0	0
*Magnolia sinica**	12	95	87	82
*Magnolia sinostellata**	9	25	0	0
*Magnolia sirindhorniae**	3	3	2	0
Magnolia sonlaensis	0	0	0	0
Magnolia sororum	0	0	0	0
*Magnolia sphaerantha**	18	155	136	2
Magnolia splendens	0	0	0	0
*Magnolia sprengeri**	81	374	91	91
*Magnolia stellata**	271	1290	390	269
Magnolia steyermarkii	0	0	0	0
Magnolia striatifolia	1	1	0	0
Magnolia sulawesiana	0	0	0	0
Magnolia sumatrae	0	0	0	0
Magnolia sumatrana	5	5	0	0
Magnolia talamancana	0	0	0	0
*Magnolia tamaulipana**	20	57	12	8
*Magnolia tarahumara**	4	44	40	39

Magnolia species	Number of in ex situ collections	Number of plants in ex situ collections	Number of plants marked as wild origin	Number of plants with given or geolocated wild origin
Magnolia thailandica	0	0	0	0
Magnolia tiepii	0	0	0	0
Magnolia tribouillierana	0	0	0	0
*Magnolia tripetala**	202	572	113	28
Magnolia tsiampacca	0	0	0	0
Magnolia urraoensis	1	1	0	0
Magnolia utilis	2	2	1	0
*Magnolia vallartensis**	2	18	18	4
Magnolia vargasiana	0	0	0	0
Magnolia vazquezii	0	0	0	0
Magnolia venezuelensis	0	0	0	0
Magnolia ventii	3	17	0	0
Magnolia villosa	0	0	0	0
*Magnolia virginiana**	202	1659	329	148
Magnolia viridipetala	1	1	0	0
Magnolia virolinensis	0	0	0	0
*Magnolia vovidesii**	3	3	2	1
Magnolia vrieseana	1	1	0	0
Magnolia wendtii	0	0	0	0
Magnolia wetteri	0	0	0	0
*Magnolia wilsonii**	93	215	41	0
Magnolia wolfii	1	1	0	0
Magnolia wuzhishangensis	0	0	0	0
*Magnolia xanthantha**	4	7	4	4
Magnolia xiana	0	0	0	0
Magnolia xianianhei	0	0	0	0
*Magnolia xinganensis**	5	5	0	0
Magnolia xinyangensis	0	0	0	0
Magnolia yajlachhi	0	0	0	0
Magnolia yantzazana	0	0	0	0
Magnolia yarumalensis	1	1	0	0
*Magnolia yoroconte**	2	16	15	15
*Magnolia yunnanensis**	35	95	28	0
*Magnolia yuyuanensis**	23	63	9	0
Magnolia zamorana	0	0	0	0
Magnolia zamudioi	0	0	0	0
*Magnolia zenii**	75	132	19	10
Magnolia zhengyiana	0	0	0	0
Magnolia zoquepopolucae	0	0	0	0

Appendix C. *Magnolia* Species Richness by country or territory.

Threatened and DD status based on global IUCN Red List Category.

Country/Territory	All species	Threatened species	DD species	Endemic species
Bangladesh	5	0	3	0
Belize	1	1	0	0
Bhutan	10	0	5	0
Bolivia	4	2	0	2
Brazil	6	2	2	5
Brunei Darussalam	7	0	4	0
Cambodia	10	0	5	0
Canada	1	0	0	0
China	114	33	49	59
Colombia	37	34	2	31
Costa Rica	11	6	2	7
Cuba	6	5	0	5
Dominica	1	1	0	0
Dominican Republic	3	3	0	2
Ecuador	23	16	2	14
El Salvador	1	0	0	0
Guadeloupe	1	1	0	0
Guatemala	10	8	1	6
Haiti	3	3	0	2
Honduras	4	2	1	3
Hong Kong	5	1	1	0
India	25	5	10	4
Indonesia	28	1	21	6
Japan	6	1	2	2
Korea, Democratic People's Republic of	1	0	0	0
Korea, Republic of	4	0	1	0
Lao People's Democratic Republic	13	1	7	0
Malaysia	25	0	17	3
Martinique	1	1	0	0
Mexico	35	30	4	32
Myanmar	20	4	9	1
Nepal	10	0	4	0
Nicaragua	2	0	1	0
Panama	8	2	2	3
Papua New Guinea	2	0	1	0
Peru	15	9	3	9
Philippines	7	2	3	2
Puerto Rico	2	2	0	2
Russian Federation	1	0	0	0
Saint Vincent and the Grenadines	1	1	0	0
Singapore	3	0	2	0
Sri Lanka	1	1	0	0
Taiwan	3	1	2	1
Thailand	27	4	12	3
United States	7	0	0	5
Venezuela	3	1	2	2
Vietnam	56	22	18	14

Appendix D. Results from the vulnerability scoring matrix for wild populations of threatened *Magnolia* species by region

Each demographic indicator is color coded based on severity (See Table 1).
These scores are used to calculate the average vulnerability score for each species.

Magnolia species	Demographic Factors						Average Vulnerability score
	Population size	Range/ Endemism	Population decline	Fragmentation	Regeneration/ recruitment	Genetic variation/ integrity	
Caribbean							
Magnolia emarginata	-	40	40	-	-	-	40
Magnolia oblongifolia	20	40	-	40	-	-	33
Magnolia ekmanii	-	20	40	-	-	-	30
Magnolia cristalensis	-	10	-	40	-	-	25
Magnolia hamorii	-	10	-	40	-	-	25
Magnolia splendens	-	10	-	40	-	-	25
Magnolia portoricensis	10	5	10	40	20	-	17
Magnolia domingensis	-	10	20	-	-	-	15
Magnolia dodecapetala	10	10	-	20	-	10	13
Magnolia minor	-	10	-	-	-	-	10
Magnolia pallescens	-	10	-	-	-	-	10
Magnolia cubensis	-	5	-	-	10	10	8
Magnolia orbiculata	5	10	-	-	-	-	8
East Asia							
Magnolia ovoidea	40	40	-	-	-	-	40
Magnolia xanthantha	-	40	-	-	-	-	40
Magnolia rostrata	-	20	40	40	-	-	33
Magnolia viridipetala	20	40	-	-	-	-	30
Magnolia zenii	40	40	-	0	40	-	30
Magnolia dawsoniana	-	10	-	40	-	-	25
Magnolia kachirachirai	-	10	-	40	-	-	25
Magnolia decidua	10	40	-	-	-	20	23
Magnolia cylindrica	-	5	-	40	-	-	23
Magnolia amoena	-	5	-	40	-	20	22
Magnolia lacei	20	-	-	-	-	-	20
Magnolia lucida	-	20	-	-	-	-	20
Magnolia omeiensis	20	20	-	-	-	-	20
Magnolia rufibarbata	-	20	-	-	-	-	20
Magnolia patungensis	20	5	-	40	-	10	19
Magnolia grandis	20	20	-	20	-	10	18
Magnolia longipedunculata	40	20	-	0	10	-	18
Magnolia crassipes	10	40	-	0	-	-	17
Magnolia sinica	40	10	0	5	40	5	17
Magnolia coriacea	10	10	-	40	-	5	16
Magnolia angustioblonga	20	10	-	-	-	-	15
Magnolia kwangsiensis	-	20	-	-	-	10	15

Magnolia species	Demographic Factors						Average Vulnerability score
	Population size	Range/ Endemism	Population decline	Fragmentation	Regeneration/ recruitment	Genetic variation/ integrity	
East Asia (cont)							
Magnolia lotungensis	10	0	10	40	-	-	15
Magnolia sinostellata	10	20	-	-	-	-	15
Magnolia ventii	20	10	-	-	-	-	15
Magnolia odoratissima	20	10	-	-	5	-	12
Magnolia stellata	10	10	10	20	10	10	12
Magnolia albosericea	10	10	-	-	-	-	10
Magnolia shiluensis	-	10	10	-	-	5	8
Magnolia aromatica	10	0	-	10	10	-	8
Magnolia nitida	-	-	5	-	10	-	8
Magnolia officinalis	-	0	10	10	10	5	7
Magnolia odora	5	0	5	-	10	10	6
Magnolia sargentiana	0	5	0	10	-	-	4
Magnolia hongheensis	-	5	-	0	-	-	3
Mexico & Central America							
Magnolia faustinomirandae	-	40	-	-	-	-	40
Magnolia multinervia	-	40	-	-	-	-	40
Magnolia ottoi	40	40	-	-	-	-	40
Magnolia talamancana	-	40	-	-	-	-	40
Magnolia tribouillierana	40	40	-	-	-	-	40
Magnolia wendtii	-	40	-	-	-	-	40
Magnolia montebelloensis	40	20	-	40	-	-	33
Magnolia mayae	40	10	-	-	-	-	25
Magnolia pacifica	-	10	-	20	40	20	23
Magnolia pugana	-	10	-	20	20	40	23
Magnolia lacandonica	20	5	-	40	-	-	22
Magnolia archilana	20	20	-	20	-	-	20
Magnolia guerrerensis	-	20	-	-	-	-	20
Magnolia jaliscana	-	20	-	20	-	-	20
Magnolia ofeliae	-	20	-	-	-	-	20
Magnolia pedrazae	-	20	-	-	-	-	20
Magnolia poqomchi	-	20	-	-	-	-	20
Magnolia tamaulipana	-	10	-	-	40	10	20
Magnolia vazquezii	10	40	-	-	10	-	20
Magnolia yajlachhi	20	20	-	-	-	-	20
Magnolia zoquepopolucae	10	20	10	-	40	20	20
Magnolia yoroconte	-	5	5	40	-	-	17
Magnolia sharpii	-	10	-	40	5	10	16
Magnolia perezfarrerae	-	20	-	-	10	-	15
Magnolia sinacacolinii	20	20	10	-	-	10	15
Magnolia vallartensis	-	10	-	20	5	20	14
Magnolia nuevoleonensis	10	20	-	-	-	10	13
Magnolia vovidesii	20	20	5	-	10	10	13
Magnolia mexicana	-	5	-	10	-	20	12
Magnolia rzedowskiana	-	20	-	-	5	10	12
Magnolia alejandrae	5	20	-	-	10	10	11

Magnolia species	Demographic Factors						Average Vulnerability score
	Population size	Range/ Endemism	Population decline	Fragmentation	Regeneration/ recruitment	Genetic variation/ integrity	
Mexico & Central America (cont)							
Magnolia cochranei	-	10	-	-	-	-	10
Magnolia decastroi	-	10	-	-	-	-	10
Magnolia guanacastensis	-	10	-	-	-	-	10
Magnolia inbioana	-	10	-	-	-	-	10
Magnolia krusei	-	20	-	0	-	-	10
Magnolia morii	-	10	-	-	-	-	10
Magnolia oaxacensis	-	10	-	-	10	-	10
Magnolia quetzal	-	10	-	-	-	-	10
Magnolia wetteri	-	10	-	-	-	-	10
Magnolia schiedeana	-	10	-	-	5	5	7
Magnolia iltisiana	-	5	-	5	10	-	7
Magnolia allenii	-	10	-	0	-	-	5
Magnolia costaricensis	-	5	-	-	-	-	5
South & Southeast Asia							
Magnolia kachinensis	40	40	-	-	-	-	40
Magnolia tiepii	-	40	-	-	-	-	40
Magnolia cattienensis	20	40	-	-	-	-	30
Magnolia fansipanensis	40	10	-	-	-	-	25
Magnolia blaoensis	-	5	-	40	-	-	23
Magnolia bidoupensis	-	20	-	-	-	-	20
Magnolia platyphylla	-	20	-	-	-	-	20
Magnolia pleiocarpa	-	40	-	0	-	-	20
Magnolia pubescens	-	20	-	-	-	-	20
Magnolia sirindhorniae	-	20	-	-	-	-	20
Magnolia sulawesiana	-	20	-	-	-	-	20
Magnolia thailandica	-	20	-	-	-	-	20
Magnolia gustavii	20	0	-	40	10	-	18
Magnolia annamensis	-	20	-	0	-	-	10
Magnolia pealiana	-	10	-	-	-	-	10
Magnolia sapaensis	-	10	-	-	-	-	10
Magnolia quangninhensis	10	-	-	-	5	-	8
Magnolia rajaniana	-	5	-	10	-	-	8
Magnolia mannii	-	5	-	-	-	-	5
Magnolia nana	-	10	-	0	-	-	5
Magnolia nilagirica	-	0	5	-	-	-	3

Magnolia species	Demographic Factors						Average Vulnerability score
	Population size	Range/ Endemism	Population decline	Fragmentation	Regeneration/ recruitment	Genetic variation/ integrity	
South America							
Magnolia betuliensis	40	40	-	-	40	-	40
Magnolia calimaensis	-	40	-	-	-	-	40
Magnolia canandeana	-	40	-	-	-	-	40
Magnolia chiguilia	-	40	-	-	-	-	40
Magnolia dixonii	-	40	-	-	-	-	40
Magnolia manguillo	-	40	-	-	-	-	40
Magnolia narinensis	-	40	-	-	-	-	40
Magnolia polyhypsophylla	40	40	-	40	-	-	40
Magnolia sanchez-vegae	-	40	-	-	-	-	40
Magnolia virolinensis	-	40	-	40	-	-	40
Magnolia argyrothricha	-	20	-	40	-	-	30
Magnolia chimantensis	40	20	-	-	-	-	30
Magnolia colombiana	-	20	-	40	-	-	30
Magnolia wolfii	40	40	-	0	40	-	30
Magnolia arroyoana	40	40	-	0	-	-	27
Magnolia jardinensis	40	40	-	0	-	-	27
Magnolia cespedesii	-	40	-	10	-	-	25
Magnolia gilbertoi	-	10	-	40	-	-	25
Magnolia neillii	-	10	-	40	-	-	25
Magnolia silvioi	-	10	-	40	-	-	25
Magnolia llanganatensis	40	20	-	-	10	-	23
Magnolia coronata	-	10	20	40	-	-	23
Magnolia bankardiorum	-	20	-	-	-	-	20
Magnolia cararensis	-	40	-	0	-	-	20
Magnolia chocoensis	-	20	-	-	-	-	20
Magnolia clementinana	-	20	-	-	-	-	20
Magnolia gentryi	20	20	-	-	-	-	20
Magnolia georgii	-	20	-	-	-	-	20
Magnolia jaenensis	20	20	-	-	-	-	20
Magnolia juninensis	-	20	-	-	-	-	20
Magnolia katiorum	-	40	-	0	-	-	20
Magnolia madidiensis	-	20	-	-	-	-	20
Magnolia manuensis	-	20	-	-	-	-	20
Magnolia mercedesiarum	-	20	-	-	-	-	20
Magnolia palandana	-	20	-	-	-	-	20
Magnolia resupinatifolia	-	20	-	-	-	-	20
Magnolia santanderiana	-	20	-	-	-	-	20
Magnolia striatifolia	-	20	-	-	-	-	20
Magnolia espinalii	40	5	10	40	10	5	18
Magnolia caricifragrans	-	5	10	40	-	-	18
Magnolia hernandezii	-	5	10	40	-	-	18
Magnolia arcabucoana	-	20	-	10	-	-	15
Magnolia guatapensis	-	20	-	10	-	-	15
Magnolia henaoi	-	20	-	-	10	-	15
Magnolia shuarorum	10	20	-	-	-	-	15
Magnolia yarumalensis	-	5	10	40	-	5	15

Magnolia species	Demographic Factors						Average Vulnerability score
	Population size	Range/ Endemism	Population decline	Fragmentation	Regeneration/ recruitment	Genetic variation/ integrity	
South America (cont)							
Magnolia boliviana	-	10	-	-	-	-	10
Magnolia brasiliensis	-	10	-	-	-	-	10
Magnolia calophylla	-	20	-	0	-	-	10
Magnolia kichuana	-	10	-	-	-	-	10
Magnolia lenticellata	-	20	-	0	-	-	10
Magnolia mahechae	-	20	-	0	-	-	10
Magnolia mindoensis	-	10	-	-	-	-	10
Magnolia napoensis	-	10	-	-	-	-	10
Magnolia neomagnifolia	-	20	-	0	-	-	10
Magnolia pastazaensis	-	10	-	-	-	-	10
Magnolia vargasiana	10	10	-	10	-	-	10
Magnolia yantzazana	-	10	-	-	-	-	10
Magnolia irwiniana	-	10	-	0	-	-	5
Magnolia urraoensis	-	10	-	0	-	-	5

Magnolia aromatica (Philippe de Spoelberch)

Magnolia dodecapetala (Emily Veltjen)

Appendix E. Threats to wild *Magnolia* populations from Red List assessments and conservation actions questionnaire

Species are listed by region and by average vulnerability score from highest to lowest. The numbers in each cell indicate the number of instances that the threat category was selected for each species. Darker cell color indicates a higher number of responses for that threat category.

Species (Average vulnerability score) *information was provided from questionnaire	Agriculture, silviculture, and/or ranching	Climate change	Development, mining, and/or roads	Disturbance regime modification	Inbreeding or introgression	Invasive species competition	Pests or pathogens	Tourism or recreation	Wild harvesting	Unknown
Caribbean										
Magnolia emarginata (40)*	1	1								1
Magnolia oblongifolia (33)			1						1	
Magnolia ekmanii (30)*	2	2							1	
Magnolia cristalensis (25)	1		1						1	
Magnolia hamorii (25)*	3	2	2	2						
Magnolia splendens (25)*	2	1								
Magnolia portoricensis (18)*	2	1	1					1	1	
Magnolia domingensis (15)*	3	1					1		1	
Magnolia dodecapetala (13)	1	1	1					1		
Magnolia minor (10)	1									
Magnolia pallescens (10)*	3	1	1			1	1	1	2	
Magnolia cubensis (8)	1					1				
Magnolia orbiculata (8)									1	
East Asia										
Magnolia ovoidea (40)*	2									1
Magnolia xanthantha (40)*	1		1							
Magnolia rostrata (33)*	2		1	1					1	
Magnolia viridipetala (30)*										2
Magnolia zenii (30)*	1	1	1		2			1		3
Magnolia dawsoniana (25)*	3	2		2	1					1
Magnolia kachirachirai (25)*	1		2							1
Magnolia cylindrica (23)*	4	2	1	1	1				2	2
Magnolia decidua (23)*	2			1						
Magnolia amoena (22)*	1			1	1				1	2
Magnolia lucida (20)*	4	1	1							
Magnolia omeiensis (20)*	2					1		1		
Magnolia rufibarbata (20)*	3		1	1				1		
Magnolia patungensis (19)*	1								1	
Magnolia grandis (18)*	5		2	1		1			1	3
Magnolia longipedunculata (18)										1
Magnolia crassipes (17)*	1			1					1	1
Magnolia sinica (17)*	3	1	1	1			1		1	
Magnolia coriacea (16)*	1	1	1							4
Magnolia angustioblonga (15)									1	
Magnolia kwangsiensis (15)*	3	1	1					1	1	1
Magnolia lotungensis (15)*	2									1

Magnolia species	Agriculture, silviculture, and/or ranching	Climate change	Development, mining, and/or roads	Disturbance regime modification	Inbreeding or introgression	Invasive species competition	Pests or pathogens	Tourism or recreation	Wild harvesting	Unknown
East Asia (cont)										
Magnolia sinostellata (15)*	4		1	1	1		1	1	1	
Magnolia ventii (15)*	2		1							1
Magnolia odoratissima (12)*	2		1							
Magnolia stellata (12)*	2	2	2	2	1					2
Magnolia albosericea (10)*	4	1	4	1				1	1	
Magnolia lacei (10)*	1							1		2
Magnolia aromatica (8)*	3	1	1		1					1
Magnolia nitida (8)*	4	1	3		1					
Magnolia shiluensis (8)*	2		2	1	1				1	1
Magnolia officinalis (7)*	2	1	2	1					1	2
Magnolia odora (6)*	5	1	3							1
Magnolia sargentiana (4)*	3	1			1				2	1
Magnolia hongheensis (3)*	2									
Mexico & Central America										
Magnolia faustinomirandae (40)*	3	1	1							2
Magnolia multinervia (40)*	1		1							1
Magnolia ottoi (40)	1									
Magnolia talamancana (40)*			1							1
Magnolia tribouillierana (40)			1							
Magnolia wendtii (40)*	2	1								
Magnolia montebelloensis (33)*	2	2								2
Magnolia mayae (25)*	3	2								
Magnolia pacifica (23)*	4		1					1		
Magnolia pugana (23)*	2	1	2		1					
Magnolia lacandonica (22)*	3	1	1							
Magnolia archilana (20)	1									
Magnolia guerrerensis (20)	1	1	1							
Magnolia jaliscana (20)*	2	1	1		1	1				
Magnolia ofeliae (20)*	2				1					
Magnolia pedrazae (20)*	2	1		1						
Magnolia poqomchi (20)	1									
Magnolia tamaulipana (20)*	2	4	2	1		1	1			1
Magnolia vazquezii (20)							1			
Magnolia yajlachhi (20)	1	1	1						1	
Magnolia zoquepopolucae (20)*	2	2	1				1			
Magnolia yoroconte (17)	1	1								
Magnolia sharpii (16)*	2	1								
Magnolia perezfarrerae (15)*	3	1					1			
Magnolia sinacacolinii (15)*	2	2	1							
Magnolia vallartensis (14)*	2	2	1		1	1		1		
Magnolia nuevoleonensis (13)*	1	1					1			
Magnolia vovidesii (13)*	4	2	1	2	1		1		2	
Magnolia mexicana (12)*	3	2		2	1		1		1	
Magnolia alejandrae (11)*		2					2			
Magnolia rzedowskiana (11)*	3	2		2	1				3	

Magnolia species	Agriculture, silviculture, and/or ranching	Climate change	Development, mining, and/or roads	Disturbance regime modification	Inbreeding or introgression	Invasive species competition	Pests or pathogens	Tourism or recreation	Wild harvesting	Unknown
Mexico & Central America (cont)										
Magnolia cochranei (10)	1									
Magnolia decastroi (10)	1	1	1	1						
Magnolia guanacastensis (10)*	1									1
Magnolia inbioana (10)*	1									1
Magnolia krusei (10)	1									
Magnolia morii (10)*	3		1						1	
Magnolia oaxacensis (10)*	2	1	1							
Magnolia quetzal (10)*	1		1							1
Magnolia wetteri (10)*	2	1								1
Magnolia iltisiana (7)*	2		1							
Magnolia schiedeana (7)*	3	2		1					1	
Magnolia allenii (5)	1		1						1	
Magnolia costaricensis (5)*	1									1
South & Southeast Asia										
Magnolia kachinensis (40)	1								1	
Magnolia tiepii (40)*	4	1	1						1	
Magnolia cattienensis (30)*	4		1		1				2	
Magnolia fansipanensis (25)*								1		1
Magnolia blaoensis (23)*	2	1	1					1	3	
Magnolia bidoupensis (20)*	4	2	1	2	2			1		1
Magnolia platyphylla (20)*	1		1							1
Magnolia pleiocarpa (20)*	2	1	1	1					2	
Magnolia pubescens (20)	1		1							
Magnolia sirindhorniae (20)*	3	1	1	1						
Magnolia sulawesiana (20)*	3		1							
Magnolia thailandica (20)*	2	1	1	2				1		
Magnolia gustavii (18)*	1	1	2		1		1	1		
Magnolia annamensis (10)*	3		1					1	2	
Magnolia pealiana (10)*	1		1							
Magnolia sapaensis (10)*	2	1		1				1		
Magnolia quangninhensis (8)*								1		1
Magnolia rajaniana (8)*	2	3	2	2	1				2	1
Magnolia mannii (5)*	3	1	1	1					1	
Magnolia nana (5)*	4	1	1					1	1	
Magnolia nilagirica (3)	1		1							

Magnolia species	Agriculture, silviculture, and/or ranching	Climate change	Development, mining, and/or roads	Disturbance regime modification	Inbreeding or introgression	Invasive species competition	Pests or pathogens	Tourism or recreation	Wild harvesting	Unknown
South America										
*Magnolia betuliensis** (40)	2				1					
*Magnolia calimaensis** (40)	1			1	1				1	
*Magnolia canandeana** (40)	2		1							
*Magnolia chiguila** (40)	2		1						1	
*Magnolia dixonii** (40)	2		1							
*Magnolia manguillo** (40)	1			1					1	
Magnolia narinensis (40)	1									
*Magnolia polyhypsophylla** (40)	3				2					
*Magnolia sanchez-vegae** (40)	2									
*Magnolia virolinensis** (40)	2		1		1					
*Magnolia argyrothricha** (30)	2		1		1					
Magnolia chimantensis (30)	1									
Magnolia colombiana (30)	1									
*Magnolia wolfii** (30)	2				1					
Magnolia arroyoana (27)	1		1							
*Magnolia jardinensis** (27)	3		2		1				1	
Magnolia cespedesii (25)	1									
*Magnolia gilbertoi** (25)	2		1							
*Magnolia neillii** (25)	2		1							
*Magnolia silvioi** (25)	2		1		1					
*Magnolia coronata** (23)	2				1					
*Magnolia llanganatensis** (23)	2		2				1			
*Magnolia bankardiorum** (20)	1		2							1
Magnolia cararensis (20)	1									
*Magnolia chocoensis** (20)	2									
Magnolia clementinana (20)			1							
*Magnolia gentryi** (20)	2	1				1				
*Magnolia georgii** (20)	2		1							
*Magnolia jaenensis** (20)	1		1	1					1	
*Magnolia juninensis** (20)	2	1	1	1		1				
*Magnolia katiorum** (20)	2		1	1						
Magnolia madidiensis (20)	1							1		
Magnolia manuensis (20)	1		1							
*Magnolia mercedesiarum** (20)	1	1	1				1			
*Magnolia palandana** (20)	2		2			1				
*Magnolia resupinatifolia** (20)	2								1	
*Magnolia santanderiana** (20)	2		1		1					
*Magnolia striatifolia** (20)	2		1							
Magnolia caricifragrans (18)	1									
*Magnolia espinalii** (18)	2		1							
*Magnolia hernandezii** (18)	5	1	2		1					
Magnolia arcabucoana (15)	1									
*Magnolia guatapensis** (15)	2									
Magnolia henaoi (15)	1									
*Magnolia shuarorum** (15)	1	1	2							
*Magnolia yarumalensis** (15)	3		1		1				1	

Magnolia species	Agriculture, silviculture, and/or ranching	Climate change	Development, mining, and/or roads	Disturbance regime modification	Inbreeding or introgression	Invasive species competition	Pests or pathogens	Tourism or recreation	Wild harvesting	Unknown
South America (cont)										
Magnolia boliviana (10)	1	1								
Magnolia brasiliensis (10)			1							
Magnolia calophylla (10)	1									
Magnolia kichuana (10)*	2		2							
Magnolia lenticellata (10)	1									
Magnolia mahechae (10)	1									
Magnolia mindoensis (10)*	2		1							
Magnolia napoensis (10)*	2		1							
Magnolia neomagnifolia (10)	1									
Magnolia pastazaensis (10)*	2		1							
Magnolia vargasiana (10)*	3		2				2			
Magnolia yantzazana (10)*	2		2							
Magnolia irwiniana (5)	1									
Magnolia urraoensis (5)*	1			1						

Magnolia vovidesii
(Dulce Maria Galván-Hernández)

Magnolia stellata (Arboretum Wespelaar)

Appendix F. Results of *Magnolia* conservation actions questionnaire

Data were gathered September-November, 2021. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* conservation actions questionnaire, including 56 institutions providing information on 145 threatened species.

F1a. *Ex situ*

Conservation actions reported Results from the *Magnolia* conservation actions questionnaire to the question 'Select all conservation activities your institution participates in for each species'. To receive contact information for a specific respondent and target species, please email GCC@bgci.org.

Magnolia species	*Insitution Reporting conservation activities*	Collect and distribute germplasm	Conservation horticulture	Cryopreservation and/or micropropagation	Pollen and/or seed banking	Public awareness or education	Research (T= Taxonomy; G= Genetics, C= Climate change; P= Pests & Pathogens)
Magnolia albosericea	Name not shared, China		X				
	Shenzhen Fairy Lake Botanical Garden, China	X			X	X	
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia alejandrae	Name not shared, Mexico	X	X		X	X	P
	Universidad de Guadalajara, Mexico						G, T
Magnolia allenii	Universidad de Guadalajara, Mexico						T
Magnolia amoena	Gardens of the Big Bend at University of Florida, USA		X			X	
	Gifu Academy of Forest Science and Culture, Japan						G
	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	
	Zhejiang A&F University, China					X	
Magnolia annamensis	Name not shared, Viet Nam		X				G, T
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia archilana	Universidad de Guadalajara, Mexico						T
Magnolia aromatica	Name not shared, Hong Kong SAR, China		X				
	University of British Columbia Botanical Garden, Canada		X		X		
Magnolia arroyana	Universidad Estatal Amazonica, Ecuador					X	
Magnolia bankardiorum	Name not shared, Peru					X	
	Universidad Estatal Amazonica, Ecuador					X	
Magnolia bidoupensis	Atlanta Botanical Garden, USA	X					
	Forest Science Institute of Central Highlands and South of Central Vietnam (FSIH), Viet Nam		X				
	Name not shared, Viet Nam		X				G, T
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia blaoensis	Name not shared, Viet Nam	X					G, T
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia brasiliensis	Name not shared, Brazil						C, G, T
Magnolia calimaensis	Name not shared, UK	X					G
Magnolia canandeana	Universidad Estatal Amazonica, Ecuador					X	
Magnolia cattienensis	Name not shared, Viet Nam		X				G, T
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia chiguila	Universidad Estatal Amazonica, Ecuador					X	
Magnolia chocoensis	Universidad Tecnológica de Pereira, Colombia	X	X			X	
Magnolia cochranei	Universidad de Guadalajara, Mexico						T

Magnolia species	Insitution Reporting conservation activities	Collect and distribute germplasm	Conservation horticulture	Cryopreservation and/or micropropagation	Pollen and/or seed banking	Public awareness or education	Research (T= Taxonomy; G= Genetics, C= Climate change; P= Pests & Pathogens)
Magnolia coriacea	Name not shared, Rep. of Korea					X	C
	Shenzhen Fairy Lake Botanical Garden, China	X				X	
	The Huntington, USA			X			
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia coronata	Tecnológico de Antioquia-Institución Universitaria, Colombia						G, T
Magnolia costaricensis	Name not shared, Costa Rica						T
	Universidad de Guadalajara, Mexico						T
Magnolia crassipes	Name not shared, Hong Kong SAR, China		X				
	Name not shared, China		X				
	Shenzhen Fairy Lake Botanical Garden, China	X			X	X	
Magnolia cristalensis	Instituto de Ecología, A.C., Mexico						G, T
Magnolia cubensis	Instituto de Ecología, A.C., Mexico						G, T
Magnolia cylindrica	Filoli Center, USA		X				
	Name not shared, China		X				
	Name not shared, Rep. of Korea					X	C
	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	
	The Huntington, USA			X			
	University of British Columbia Botanical Garden, Canada		X		X		
	Zhejiang A&F University, China		X				
Magnolia dawsoniana	Filoli Center, USA		X				
	Name not shared, Rep. of Korea					X	C
	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	
	The Huntington, USA		X	X			
	University of British Columbia Botanical Garden, Canada		X		X		
Magnolia decastroi	Universidad de Guadalajara, Mexico						T
Magnolia decidua	Shenzhen Fairy Lake Botanical Garden, China	X			X	X	
Magnolia dixonii	Universidad Estatal Amazonica, Ecuador					X	
Magnolia dodecapetala	Instituto de Ecología, A.C., Mexico						G, T
Magnolia domingensis	Instituto de Ecología, A.C., Mexico						G, T
	Name not shared, República Dominicana	X	X			X	
Magnolia ekmanii	Instituto de Ecología, A.C., Mexico						G, T
	Name not shared, República Dominicana	X	X				
Magnolia emarginata	Instituto de Ecología, A.C., Mexico						G, T
Magnolia espinalii	Universidad Tecnológica de Pereira, Colombia	X	X			X	
Magnolia fansipanensis	Vietnam National University of Forestry, Viet Nam				X		
Magnolia faustinomirandae	Atlanta Botanical Garden, USA						G
	Instituto de Ecología, A.C., Mexico						G, T
	The Huntington, USA			X			
	Universidad de Guadalajara, Mexico	X	X	X		X	C, G, T
Magnolia gentryi	Name not shared, Peru	X	X				
Magnolia gilbertoi	Universidad Tecnológica de Pereira, Colombia	X	X			X	
Magnolia grandis	Fauna & Flora International, Viet Nam					X	
	Name not shared, Hong Kong SAR, China		X				
	Name not shared, Lao PDR	X				X	G, T

Magnolia species	Insitution Reporting conservation activities	Collect and distribute germplasm	Conservation horticulture	Cryopreservation and/or micropropagation	Pollen and/or seed banking	Public awareness or education	Research (T= Taxonomy; G= Genetics, C= Climate change; P= Pests & Pathogens)
Magnolia grandis (Cont)	Shenzhen Fairy Lake Botanical Garden, China	X			X	X	
	The Huntington, USA		X	X			
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia guanacastensis	Name not shared, Costa Rica						T
	Universidad de Guadalajara, Mexico						T
Magnolia guatapensis	Corporacion Salvamontes Colombia	X				X	P
Magnolia guerrerensis	Universidad de Guadalajara, Mexico						T
Magnolia gustavii	Global Biodiversity Conservancy, Thailand		X				
	Queen Sirikit Botanic Garden, Thailand	X				X	
Magnolia hamorii	Instituto de Ecología, A.C., Mexico						G, T
	Name not shared, Mexico	X					
	Name not shared, Lao PDR						T
	Name not shared, República Dominicana	X	X			X	
Magnolia hernandezii	Jardín Botánico de Medellín, Colombia		X			X	
	Pontificia Universidad Javeriana, Colombia					X	G
	Universidad Tecnológica de Pereira, Colombia	X	X			X	
Magnolia hongheensis	Vietnam National University of Forestry, Viet Nam				X		
Magnolia iltisiana	Universidad de Guadalajara, Mexico						G, T
Magnolia inbioana	Name not shared, Costa Rica						T
	Universidad de Guadalajara, Mexico						T
Magnolia irwiniana	Name not shared, Brazil						C, G, T
Magnolia jaenensis	Instituto de Ecología, A.C., Mexico						G, T
	Name not shared, Peru	X	X			X	
Magnolia jaliscana	Universidad de Guadalajara, Mexico	X	X			X	T
Magnolia jardinensis	Jardín Botánico de Medellín, Colombia	X				X	P
	Tecnológico de Antioquia-Institución Universitaria, Colombia						
Magnolia juninensis	Name not shared, USA				X		
	Name not shared, Peru	X	X			X	
	Name not shared, Peru	X					
Magnolia kachirachirai	Atlanta Botanical Garden, USA	X					
	Gardens of the Big Bend at University of Florida, USA		X			X	
Magnolia kichuana	Universidad Estatal Amazonica, Ecuador					X	
Magnolia kwangsiensis	Atlanta Botanical Garden, USA	X					
	Name not shared, Hong Kong SAR, China		X				C
	Name not shared, Rep. of Korea					X	
	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	
	Vietnam National University of Forestry, Viet Nam				X		G, T
Magnolia lacandonica	Instituto de Ecología, A.C., Mexico						
Magnolia lacei	Name not shared, Hong Kong SAR, China		X				
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia llanganatensis	Universidad Estatal Amazonica, Ecuador					X	T
	University of Miami, USA						
Magnolia lotungensis	Name not shared, China		X				
	Shenzhen Fairy Lake Botanical Garden, China	X			X	X	

Magnolia species	Insitution Reporting conservation activities	Collect and distribute germplasm	Conservation horticulture	Cryopreservation and/or micropropagation	Pollen and/or seed banking	Public awareness or education	Research (T= Taxonomy; G= Genetics, C= Climate change; P= Pests & Pathogens)
Magnolia lotungensis (cond)	The Huntington, USA			X			
Magnolia lucida	Vietnam National University of Forestry, Viet Nam				X		
	Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences		X			X	
Magnolia manguillo	Instituto de Ecología, A.C., Mexico						G, T
	Name not shared, Peru	X	X			X	
Magnolia mannii	Name not shared, Bangladesh	X	X			X	C
	Plant Conservation and Research Foundation, Bangladesh	X				X	
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia mayae	Instituto de Ecología, A.C., Mexico						G, T
Magnolia mercedesiarum	Universidad Estatal Amazonica, Ecuador					X	
Magnolia mexicana	Instituto de Ecología, A.C., Mexico						G, T
	Name not shared, Mexico	X	X		X	X	P
Magnolia minor	Instituto de Ecología, A.C., Mexico						G, T
Magnolia montebelloensis	Atlanta Botanical Garden, USA						G
	Instituto de Ecología, A.C., Mexico						G, T
Magnolia morii	Instituto de Ecología, A.C., Mexico						G, T
	Name not shared, Lao PDR						G, T
Magnolia multinervia	Name not shared, Costa Rica						T
Magnolia nana	Name not shared, Viet Nam	X					G, T
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia napoensis	Universidad Estatal Amazonica, Ecuador					X	
Magnolia nitida	Name not shared, Viet Nam		X				G, T
	Shenzhen Fairy Lake Botanical Garden, China	X				X	
	University of British Columbia Botanical Garden, Canada		X		X		
Magnolia nuevoleonensis	Name not shared, Mexico	X					P
Magnolia oaxacensis	Instituto de Ecología, A.C., Mexico						G, T
Magnolia oblongifolia	Instituto de Ecología, A.C., Mexico						G, T
Magnolia odora	Name not shared, Hong Kong SAR, China		X				
	Name not shared, China		X				
	Name not shared, Rep. of Korea					X	C
	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	
	Vietnam National University of Forestry, Viet Nam				X		
	Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences		X			X	C
Magnolia odoratissima	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	
Magnolia ofeliae	Universidad de Guadalajara, Mexico	X					T
Magnolia officinalis	Atlanta Botanical Garden, USA	X					
	Gardens of the Big Bend at University of Florida, USA		X			X	
	Name not shared, China		X				
	Name not shared, Rep. of Korea					X	C
	Shenzhen Fairy Lake Botanical Garden, China	X			X	X	
	South China Botanical Garden, Chinese Academy of Sciences					X	

Magnolia species	Insitution Reporting conservation activities	Collect and distribute germplasm	Conservation horticulture	Cryopreservation and/or micropropagation	Pollen and/or seed banking	Public awareness or education	Research (T= Taxonomy; G= Genetics, C= Climate change; P= Pests & Pathogens)
Magnolia officinalis (cont)	The Huntington, USA		X	X			
Magnolia omeiensis	Name not shared, USA			X			
	Name not shared, China	X		X		X	
	Name not shared, China		X				
Magnolia orbiculata	Instituto de Ecología, A.C., Mexico						G, T
Magnolia ovoidea	Name not shared, Hong Kong SAR, China		X				
Magnolia pacifica	The Huntington, USA	X	X	X			
	Universidad de Guadalajara, Mexico	X					G, T
Magnolia pallescens	Instituto de Ecología, A.C., Mexico						G, T
	Name not shared, República Dominicana	X	X			X	
Magnolia perezfarrerae	ECOSUR, Mexico	X					
	Instituto de Ecología, A.C., Mexico						G, T
Magnolia platyphylla	Shenzhen Fairy Lake Botanical Garden, China		X				
Magnolia pleiocarpa	Name not shared, USA			X			
	Name not shared, India					X	
Magnolia polyhypsophylla	Corporacion Salvamontes Colombia	X				X	P
Magnolia portoricensis	Instituto de Ecología, A.C., Mexico						G, T
	The Huntington, USA	X	X	X			
Magnolia pugana	Universidad de Guadalajara, Mexico	X	X			X	G, T
Magnolia quangninhensis	Vietnam National University of Forestry, Viet Nam				X		
Magnolia quetzal	Atlanta Botanical Garden, USA						G
Magnolia rajaniana	Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, Thailand					X	
	Gardens of the Big Bend at University of Florida, USA		X			X	
	Global Biodiversity Conservancy, Thailand		X				
	Name not shared, India					X	C, T
	Queen Sirikit Botanic Garden, Thailand	X	X			X	
Magnolia rostrata	Name not shared, Lao PDR	X	X			X	T
Magnolia rufibarbata	National University of Laos, Lao PDR					X	
	Shenzhen Fairy Lake Botanical Garden, China	X	X				
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia rzedowskiana	Name not shared, Peru	X					
Magnolia sanchez-vegae	Instituto de Ecología, A.C., Mexico						G, T
	Name not shared, Peru	X	X			X	
Magnolia sapaensis	University of British Columbia Botanical Garden, Canada		X		X		
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia sargentiana	Name not shared, China		X				
	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	
	The Huntington, USA		X	X			
	University of British Columbia Botanical Garden, Canada		X		X		
Magnolia schiedeana	Name not shared, Peru	X					
Magnolia sharpii	ECOSUR, Mexico					X	G
Magnolia shiluensis	Name not shared, Hong Kong SAR, China		X				
	Name not shared, China		X				
	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	

Magnolia species	Insitution Reporting conservation activities	Collect and distribute germplasm	Conservation horticulture	Cryopreservation and/or micropropagation	Pollen and/or seed banking	Public awareness or education	Research (T= Taxonomy; G= Genetics, C= Climate change; P= Pests & Pathogens)
Magnolia shiluensis (cont)	South China Botanical Garden, Chinese Academy of Sciences					X	
Magnolia silvioi	Tecnológico de Antioquia-Institución Universitaria, Colombia	X					
Magnolia sinacacolinii	Instituto de Ecología, A.C., Mexico						G, T
Magnolia sinica	Name not shared, Rep. of Korea					X	C
	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	
	South China Botanical Garden, Chinese Academy of Sciences					X	
Magnolia sinostellata	Gifu Academy of Forest Science and Culture, Japan						G
	Name not shared, China		X				
	Shenzhen Fairy Lake Botanical Garden, China	X	X	X	X	X	
	Zhejiang A&F University, China	X	X	X	X	X	
Magnolia sirindhorniae	Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, Thailand					X	
	Global Biodiversity Conservancy, Thailand		X				
	Queen Sirikit Botanic Garden, Thailand	X	X			X	
Magnolia splendens	Instituto de Ecología, A.C., Mexico						G, T
	The Huntington, USA	X					
Magnolia stellata	Filoli Center, USA		X				
	Gifu Academy of Forest Science and Culture, Japan					X	G
	Lewis Ginter Botanical Garden, USA	X	X			X	
	Name not shared, China		X				
	Name not shared, Rep. of Korea					X	C
	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	
	University of British Columbia Botanical Garden, Canada		X		X		
	Zhejiang A&F University, China			X			
Magnolia striatifolia	Name not shared, Brazil						C, G, T
Magnolia sulawesiana	Name not shared, Indonesia					X	
Magnolia talamancana	Name not shared, Costa Rica						T
Magnolia tamaulipana	Gardens of the Big Bend at University of Florida, USA		X				
	Houston Botanic Garden, USA		X			X	
	Name not shared, Mexico	X	X		X	X	P
	The Huntington, USA	X	X	X			
Magnolia thailandica	Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, Thailand					X	
	Name not shared, Lao PDR	X				X	T
	Queen Sirikit Botanic Garden, Thailand	X					
Magnolia tiepii	Name not shared, Viet Nam		X				G, T
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia urraoensis	Universidad Tecnológica de Pereira, Colombia	X	X			X	
Magnolia vallartensis	Universidad de Guadalajara, Mexico	X	X				G, T
Magnolia vargasiana	Universidad Estatal Amazonica, Ecuador					X	
	University of Miami, USA						T
Magnolia ventii	Name not shared, China	X			X		

Magnolia species	Insitution Reporting conservation activities	Collect and distribute germplasm	Conservation horticulture	Cryopreservation and/or micropropagation	Pollen and/or seed banking	Public awareness or education	Research (T= Taxonomy; G= Genetics, C= Climate change; P= Pests & Pathogens)
Magnolia ventii (cont)	Shenzhen Fairy Lake Botanical Garden, China	X					
	Vietnam National University of Forestry, Viet Nam				X		
Magnolia viridipetala	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	
Magnolia vovidesii	Name not shared, Peru	X					
	Name not shared, Mexico	X	X	X	X	X	P
	The Huntington, USA						
Magnolia wendtii	Instituto de Ecología, A.C., Mexico						G, T
Magnolia wetteri	Name not shared, Costa Rica						T
	Osa Conservation, Costa Rica					X	
Magnolia wolfii	Universidad Tecnológica de Pereira, Colombia	X	X			X	
Magnolia yantzazana	Universidad Estatal Amazonica, Ecuador					X	
Magnolia yarumalensis	Corporacion Salvamontes Colombia	X				X	P
	Tecnológico de Antioquia-Institución Universitaria, Colombia						C
Magnolia zenii	Gardens of the Big Bend at University of Florida, USA		X			X	
	Gifu Academy of Forest Science and Culture, Japan						G
	Name not shared, Rep. of Korea					X	C
	Shenzhen Fairy Lake Botanical Garden, China	X	X		X	X	
	University of British Columbia Botanical Garden, Canada		X		X		
	Zhejiang A&F University, China	X					
Magnolia zoquepopolucae	Instituto de Ecología, A.C., Mexico						G, T

Magnolia crassipes (Keming Yang, South China Botanical Garden)

Magnolia officinalis (Philippe de Spoelberch)

Appendix F. Results of *Magnolia* conservation actions questionnaire

Data were gathered September-November, 2021. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* conservation actions questionnaire, including 56 institutions providing information on 145 threatened species.

F1b. *In situ*

Conservation actions reported Results from the *Magnolia* conservation actions questionnaire to the question 'Select all conservation activities your institution participates in for each species'. To receive contact information for a specific respondent and target species, please email GCC@bgci.org.

Magnolia species	*Insitution Reporting conservation activities*	Habitat restoration	Implement protection policies or regulations	Occurrence surveys or population monitoring	Population reinforcement or introduction	Protect and/or manage habitat
Magnolia albosericea	Forest Science Institute of Central Highlands and South of Central Vietnam (FSIH), Viet Nam			X		
	Shenzhen Fairy Lake Botanical Garden, China		X	X		X
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia alejandrae	Name not shared, Mexico	X		X	X	X
	Universidad de Guadalajara, Mexico			X		
Magnolia allenii	Universidad de Guadalajara, Mexico			X		
Magnolia amoena	Name not shared, USA	X	X			
	Shenzhen Fairy Lake Botanical Garden, China			X		X
	Zhejiang A&F University, China	X				
Magnolia annamensis	Forest Science Institute of Central Highlands and South of Central Vietnam (FSIH), Viet Nam			X		
	Name not shared, Viet Nam	X		X		X
	Southern Institute of Ecology, Viet Nam			X		
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia archilana	Universidad de Guadalajara, Mexico			X		
Magnolia argyrothricha	Tecnológico de Antioquia-Institución Universitaria, Colombia			X		
Magnolia arroyana	Universidad Estatal Amazonica, Ecuador			X		
Magnolia bankardiorum	Universidad Estatal Amazonica, Ecuador			X		X
Magnolia betuliensis	Tecnológico de Antioquia-Institución Universitaria, Colombia			X		
Magnolia bidoupensis	Forest Science Institute of Central Highlands and South of Central Vietnam (FSIH), Viet Nam			X		
	Name not shared, Viet Nam	X	X	X		X
	Southern Institute of Ecology, Viet Nam			X		
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia blaoensis	Forest Science Institute of Central Highlands and South of Central Vietnam (FSIH), Viet Nam			X		
	Name not shared, Viet Nam	X		X		X
	Southern Institute of Ecology, Viet Nam			X		
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia calimaensis	Name not shared, UK	X	X		X	
Magnolia canandeana	Universidad Estatal Amazonica, Ecuador			X		X

Magnolia species	Insitution Reporting conservation activities	Habitat restoration	Implement protection policies or regulations	Occurrence surveys or population monitoring	Population reinforcement or introduction	Protect and/or manage habitat
Magnolia cattienensis	Forest Science Institute of Central Highlands and South of Central Vietnam (FSIH), Viet Nam			X		
	Name not shared, Viet Nam	X		X		X
	Southern Institute of Ecology, Viet Nam			X		
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia chiguila	Universidad Estatal Amazonica, Ecuador			X		
Magnolia chocoensis	Universidad Tecnológica de Pereira, Colombia		X		X	
Magnolia cochranei	Universidad de Guadalajara, Mexico			X		
Magnolia coriacea	Name not shared, Rep. of Korea				X	
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia costaricensis	Universidad de Guadalajara, Mexico			X		
Magnolia crassipes	Shenzhen Fairy Lake Botanical Garden, China		X	X		
Magnolia cylindrica	Name not shared, Rep. of Korea				X	
	Shenzhen Fairy Lake Botanical Garden, China		X	X		X
	Zhejiang A&F University, China	X			X	
Magnolia dawsoniana	Name not shared, Rep. of Korea				X	
	Shenzhen Fairy Lake Botanical Garden, China	X	X	X		X
Magnolia decastroi	Universidad de Guadalajara, Mexico			X		
Magnolia decidua	Shenzhen Fairy Lake Botanical Garden, China		X	X		
Magnolia dixonii	Universidad Estatal Amazonica, Ecuador			X		
Magnolia domingensis	Name not shared, República Dominicana	X		X	X	X
Magnolia ekmanii	Name not shared, República Dominicana			X		
Magnolia espinalii	Universidad Tecnológica de Pereira, Colombia		X		X	
Magnolia fansipanensis	Vietnam National University of Forestry, Viet Nam			X		
Magnolia faustinomirandae	ECOSUR, Mexico			X		
	Instituto de Ecología, A.C., Mexico				X	
	Universidad de Guadalajara, Mexico	X		X	X	X
Magnolia gentryi	Name not shared, Peru	X				
Magnolia georgii	Tecnológico de Antioquia-Institución Universitaria, Colombia			X		
Magnolia gilbertoi	Universidad Tecnológica de Pereira, Colombia		X		X	
Magnolia grandis	Fauna & Flora International, Viet Nam	X	X	X	X	X
	Name not shared, Lao PDR	X		X		X
	Shenzhen Fairy Lake Botanical Garden, China		X	X		
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia guanacastensis	Universidad de Guadalajara, Mexico			X		
Magnolia guatapensis	Corporacion Salvamontes Colombia	X		X	X	X
Magnolia guerrerensis	Universidad de Guadalajara, Mexico			X		
Magnolia hamorii	Name not shared, Mexico				X	
	Name not shared, Lao PDR	X		X	X	
	Name not shared, República Dominicana	X		X	X	X
Magnolia hernandezii	Jardín Botánico de Medellín, Colombia			X		
	Pontificia Universidad Javeriana, Colombia		X	X		
	Tecnológico de Antioquia-Institución Universitaria, Colombia			X	X	
	Universidad Tecnológica de Pereira, Colombia		X		X	
Magnolia hongheensis	Vietnam National University of Forestry, Viet Nam			X		

Magnolia species	Insitution Reporting conservation activities	Habitat restoration	Implement protection policies or regulations	Occurrence surveys or population monitoring	Population reinforcement or introduction	Protect and/or manage habitat
Magnolia iltisiana	Universidad de Guadalajara, Mexico			X		X
Magnolia inbioana	Universidad de Guadalajara, Mexico			X		
Magnolia jaenensis	Universidad Estatal Amazonica, Ecuador			X		
Magnolia jaliscana	Universidad de Guadalajara, Mexico				X	
Magnolia jardinensis	Jardín Botánico de Medellín, Colombia			X		
	Tecnológico de Antioquia-Institución Universitaria, Colombia			X		X
Magnolia juninensis	Name not shared, Peru	X				
Magnolia katiorum	Tecnológico de Antioquia-Institución Universitaria, Colombia			X		
Magnolia kichuana	Universidad Estatal Amazonica, Ecuador			X		
Magnolia kwangsiensis	Name not shared, Rep. of Korea				X	
	Shenzhen Fairy Lake Botanical Garden, China		X	X		
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia lacandonica	ECOSUR, Mexico			X		
	Instituto de Ecología, A.C., Mexico				X	
Magnolia lacei	Vietnam National University of Forestry, Viet Nam			X		
Magnolia llanganatensis	Universidad Estatal Amazonica, Ecuador			X		X
	University of Miami, USA			X		X
Magnolia lotungensis	Shenzhen Fairy Lake Botanical Garden, China		X	X		
Magnolia lucida	Vietnam National University of Forestry, Viet Nam			X		
	Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences				X	X
Magnolia mannii	Name not shared, Bangladesh			X	X	
	Plant Conservation and Research Foundation, Bangladesh			X		
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia mayae	ECOSUR, Mexico			X		
	Instituto de Ecología, A.C., Mexico				X	
Magnolia mercedesiarum	Universidad Estatal Amazonica, Ecuador			X		
Magnolia mexicana	Name not shared, Mexico			X		
	Name not shared, Mexico	X		X	X	X
Magnolia mindoensis	Universidad Estatal Amazonica, Ecuador			X		
Magnolia montebelloensis	Instituto de Ecología, A.C., Mexico				X	
Magnolia morii	Name not shared, Lao PDR	X	X		X	
Magnolia nana	Forest Science Institute of Central Highlands and South of Central Vietnam (FSIH), Viet Nam			X		
	Name not shared, Viet Nam	X		X		X
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia napoensis	Universidad Estatal Amazonica, Ecuador			X		X
Magnolia neillii	Universidad Estatal Amazonica, Ecuador			X		
Magnolia nitida	Name not shared, Viet Nam	X		X		
Magnolia odora	Name not shared, Rep. of Korea				X	
	Shenzhen Fairy Lake Botanical Garden, China	X	X	X		X
	Vietnam National University of Forestry, Viet Nam			X		
	Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences				X	X
Magnolia odoratissima	Shenzhen Fairy Lake Botanical Garden, China	X	X	X		X

Magnolia species	Insitution Reporting conservation activities	Habitat restoration	Implement protection policies or regulations	Occurrence surveys or population monitoring	Population reinforcement or introduction	Protect and/or manage habitat
Magnolia officinalis	Name not shared, Rep. of Korea				X	
	Shenzhen Fairy Lake Botanical Garden, China		X	X		X
	South China Botanical Garden, Chinese Academy of Sciences				X	
Magnolia omeiensis	Name not shared, China	X	X	X	X	X
Magnolia palandana	Name not shared, USA		X			
	Universidad Estatal Amazonica, Ecuador			X		
Magnolia pallescens	Name not shared, República Dominicana	X		X	X	X
Magnolia pastazaensis	Universidad Estatal Amazonica, Ecuador			X		
Magnolia pealiana	Name not shared, USA	X				
Magnolia pedrazae	Grupo Ecológico Sierra Gorda, Mexico	X	X	X		X
Magnolia perezfarrerae	ECOSUR, Mexico	X		X	X	X
Magnolia pleiocarpa	Name not shared, India			X		
Magnolia polyhypsophylla	Corporacion Salvamontes Colombia	X		X	X	X
	Tecnológico de Antioquia-Institución Universitaria, Colombia			X		
Magnolia portoricensis	The Huntington, USA			X		
Magnolia pugana	Universidad de Guadalajara, Mexico	X		X		
Magnolia quangninhensis	Vietnam National University of Forestry, Viet Nam			X		
Magnolia rajaniana	Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, Thailand	X	X	X	X	X
	Name not shared, India			X		
	Queen Sirikit Botanic Garden, Thailand	X		X	X	X
Magnolia resupinatifolia	Tecnológico de Antioquia-Institución Universitaria, Colombia			X		
Magnolia rostrata	Name not shared, Lao PDR			X	X	X
Magnolia rufibarbata	Vietnam National University of Forestry, Viet Nam			X		
Magnolia rzedowskiana	Grupo Ecológico Sierra Gorda, Mexico	X	X	X		X
	Name not shared, Mexico			X		
Magnolia santanderiana	Tecnológico de Antioquia-Institución Universitaria, Colombia			X		
Magnolia sapaensis	Vietnam National University of Forestry, Viet Nam			X		
Magnolia sargentiana	Shenzhen Fairy Lake Botanical Garden, China	X	X	X		X
Magnolia schiedeana	Name not shared, Mexico			X		
Magnolia sharpii	ECOSUR, Mexico	X		X	X	X
Magnolia shiluensis	Shenzhen Fairy Lake Botanical Garden, China		X	X		X
	South China Botanical Garden, Chinese Academy of Sciences				X	
Magnolia shuariorum	Universidad Estatal Amazonica, Ecuador			X		
Magnolia silvioi	Tecnológico de Antioquia-Institución Universitaria, Colombia			X		
Magnolia sinacacolinii	Instituto de Ecología, A.C., Mexico				X	
Magnolia sinica	Name not shared, Rep. of Korea				X	
	Shenzhen Fairy Lake Botanical Garden, China	X	X	X		X
	South China Botanical Garden, Chinese Academy of Sciences			X	X	
Magnolia sinostellata	Shenzhen Fairy Lake Botanical Garden, China	X	X	X	X	X
	Zhejiang A&F University, China	X	X	X	X	X
Magnolia sirindhorniae	Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, Thailand	X	X	X	X	X
Magnolia splendens	The Huntington, USA			X		
Magnolia stellata	Gifu Academy of Forest Science and Culture, Japan	X		X	X	X

Magnolia species	Insitution Reporting conservation activities	Habitat restoration	Implement protection policies or regulations	Occurrence surveys or population monitoring	Population reinforcement or introduction	Protect and/or manage habitat
Magnolia stellata (cont)	Name not shared, Rep. of Korea				X	
	Shenzhen Fairy Lake Botanical Garden, China		X	X		
Magnolia striatifolia	Universidad Estatal Amazonica, Ecuador			X		
Magnolia tamaulipana	Grupo Ecológico Sierra Gorda, Mexico	X	X			X
	Name not shared, Mexico	X		X		
Magnolia thailandica	Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, Thailand	X	X	X	X	X
	Name not shared, Lao PDR	X				X
	Queen Sirikit Botanic Garden, Thailand			X		
Magnolia tiepii	Forest Science Institute of Central Highlands and South of Central Vietnam (FSIH), Viet Nam			X		
	Name not shared, Viet Nam	X		X		
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia urraoensis	Universidad Tecnológica de Pereira, Colombia		X		X	
Magnolia vallartensis	The Huntington, USA			X		
Magnolia vargasiana	Universidad Estatal Amazonica, Ecuador			X		X
	University of Miami, USA			X		X
Magnolia ventii	Name not shared, China					X
	Vietnam National University of Forestry, Viet Nam			X		
Magnolia viridipetala	Shenzhen Fairy Lake Botanical Garden, China		X	X		
Magnolia virolinensis	Tecnológico de Antioquia-Institución Universitaria, Colombia			X		
Magnolia vovidesii	Name not shared, Mexico			X		
	Name not shared, Mexico	X		X	X	X
Magnolia wendtii	Instituto de Ecología, A.C., Mexico				X	
Magnolia wetteri	Osa Conservation, Costa Rica	X		X		
Magnolia wolfii	Universidad Tecnológica de Pereira, Colombia		X		X	
Magnolia yantzazana	Universidad Estatal Amazonica, Ecuador			X		X
Magnolia yarumalensis	Corporacion Salvamontes Colombia	X		X	X	X
	Tecnológico de Antioquia-Institución Universitaria, Colombia				X	
Magnolia zenii	Name not shared, Rep. of Korea				X	
	Shenzhen Fairy Lake Botanical Garden, China	X	X	X		X
Magnolia zoquepopolucae	Instituto de Ecología, A.C., Mexico				X	

Magnolia tamaulipana (Sergio Ignacio Gallardo Yobal)

Magnolia siamensis (Piya Chalermglin)

Appendix F. Results of *Magnolia* conservation actions questionnaire

F2.

Conservation actions needed

Results from the *Magnolia* conservation actions questionnaire to the question 'Select what you see as the most urgent conservation activities for each species'. The numbers in each cell indicate the number of instances that the activity was selected for each species. Darker cell color indicates a higher number of responses for that activity.

Magnolia species	Collect and distribute germplasm	Conservation horticulture	Cryopreservation and/or micropropagation	Habitat restoration	Implement protection policies or regulations	Occurrence surveys or population monitoring	Pollen and/or seed banking	Population reinforcement or introduction	Protect and/or manage habitat	Public awareness or education	Research (T= Taxonomy; G= Genetics, C= Climate change; P= Pests & Pathogens)
Caribbean											
Magnolia domingensis	2	2	2	1	1	1		1	2	1	C, G, P
Magnolia ekmanii	1	1		1	1	1		1	1	1	C, G
Magnolia emarginata	1	1			1	1		1	1	1	C, G
Magnolia hamorii	2	2	1	2	1	2		1	4	1	C, G, T
Magnolia pallescens	2	2	1	1	1	1		1	2	1	C, G, P
Magnolia portoricensis	2	2	2	1	1	1		1	2	1	C, G, T
Magnolia splendens	2	2	2			1			1	1	C, G, T
East Asia											
Magnolia amoena	2			4		2		1		2	
Magnolia crassipes		2									
Magnolia cylindrica	2	3	2	2	1	1	1	1		1	G, P
Magnolia dawsoniana	2	2	2	1	1	1	1			1	G, P
Magnolia decidua		1		1				1		1	
Magnolia grandis	3	4	1	1	1	3		1	2	3	G, T
Magnolia hongheensis						1					
Magnolia kachirachirai	2					1			1	1	
Magnolia kwangsiensis	1	1				2			1	2	P
Magnolia lotungensis	1	1	1								G
Magnolia lucida	1	1	1			2	1				
Magnolia nitida	2	2	1	2	1	2	1			1	
Magnolia odoratissima	1	1								1	
Magnolia officinalis	1	2	1	1				1	2	4	G, P
Magnolia omeiensis		1	2						1		
Magnolia ovoidea		2									
Magnolia patungensis		1									
Magnolia rostrata	2	1				1			1		T

Magnolia species	Collect and distribute germplasm	Conservation horticulture	Cryopreservation and/or micropropagation	Habitat restoration	Implement protection policies or regulations	Occurrence surveys or population monitoring	Pollen and/or seed banking	Population reinforcement or introduction	Protect and/or manage habitat	Public awareness or education	Research (T= Taxonomy; G= Genetics, C= Climate change; P= Pests & Pathogens)
East Asia (cont)											
Magnolia sargentiana	2	3	2	1	1	1	1			1	G
Magnolia shiluensis		2		1			1	1	1	2	
Magnolia sinica	1	2	1	2	1	1	2	2	2	3	P
Magnolia sinostellata	2	2	2	3	2	3	2	2	2	2	
Magnolia stellata	1	1	2	3	1	2	1	1	1	2	P
Magnolia ventii	2		1	1		1				1	
Magnolia viridipetala						1					
Magnolia zenii	5	1	1	1	1	2	1	1	1	2	P
Magnolia albosericea	3	3	1	1		4	1	2	2	2	
Magnolia aromatica	2	3	1	1	1	1	1				
Magnolia coriacea	2	2	1			2				2	G, P
Magnolia lacei	1	2				1					
Magnolia odora	2	2	1			1	1			2	P
Magnolia rufibarbata		2		1		1			1	1	
Mexico & Central America											
Magnolia alejandrae	1	1					1				P
Magnolia costaricensis						1					C
Magnolia faustinomirandae	1		1	2	3	2		1	2	2	G, T
Magnolia guanacastensis						1					C
Magnolia iltisiana	1	1		1				1			G
Magnolia inbioana						1					C
Magnolia jaliscana	1	1		1	1			1	1		G
Magnolia lacandonica				1	1				2	1	
Magnolia mayae				1	1				2	1	
Magnolia mexicana	1	1		3	1	1	2	1	1	2	P
Magnolia montebelloensis	1			1	2	2		1	3	1	G, T
Magnolia morii	1			1	1	1			2	2	T
Magnolia multinervia						1					C
Magnolia nuevoleonensis	1	1					1				P
Magnolia oaxacensis				1	1	1			1	1	
Magnolia ofeliae	1	1		1	1			1	1		G
Magnolia pacifica	2	1	1	2	3	1		2	2	1	G
Magnolia pedrazae				1	1	1			1	1	
Magnolia perezfarrerae				1	2				1	1	
Magnolia pugana	1	1		1	1			1	1		C, G
Magnolia quetzal	1				1	1			1		G, T
Magnolia rzedowskiana	1	1		3	1	2	2	1	1	2	
Magnolia schiedeana	1	1		1		1	1				
Magnolia sharpii					1						
Magnolia sinacacolinii				1	1				1	1	
Magnolia talamancana						1					C
Magnolia tamaulipana	2	2	1	3	3	1	2	1	2	2	P

Magnolia species	Collect and distribute germplasm	Conservation horticulture	Cryopreservation and/or micropropagation	Habitat restoration	Implement protection policies or regulations	Occurrence surveys or population monitoring	Pollen and/or seed banking	Population reinforcement or introduction	Protect and/or manage habitat	Public awareness or education	Research (T= Taxonomy; G= Genetics, C= Climate change; P= Pests & Pathogens)
Mexico & Central America (cont)											
Magnolia vallartensis	2	1		2	2	1		1	2		G
Magnolia vovidesii	2	2	1	4	1	1	3	2		1	P
Magnolia wendtii				1	1	1			1	1	
Magnolia wetteri				1		2		1		1	C, G
Magnolia zoquepopolucae				1	1				1	1	
South & Southeast Asia											
Magnolia annamensis	1	2		1		4		2	2		G
Magnolia bidoupensis	2	2	2	1		5		1	2	1	G
Magnolia blaoensis	1	2		2		4		2	1		G
Magnolia cattienensis	1	2	1	2		4		1	2		G
Magnolia fansipanensis						1					
Magnolia gustavii	2	1	1			2	1	2		1	C
Magnolia mannii	2			1		2	1	1		1	C
Magnolia nana	1	2		1		3			1		
Magnolia pealiana				1							
Magnolia pleiocarpa				2	1	1		1		1	C
Magnolia rajaniana	1		1	2	1	2		1		2	C
Magnolia sapaensis	1	1	1	1	1	1	2				
Magnolia sirindhorniae			1	2		2		1		1	C, G
Magnolia sulawesiana	2	1				1	1		1	1	G
Magnolia thailandica	2	1	1	1		2	1	1		2	C, G, T
Magnolia tiepii		2		1		3			2		
South America											
Magnolia argyrothricha	1								1	1	
Magnolia arroyoana									1		
Magnolia bankardiorum	1	1							1		
Magnolia betuliensis										1	
Magnolia brasiliensis				1	1	1	1				G, T
Magnolia calimaensis	1							1			G
Magnolia canandeana									1	1	
Magnolia chiguila									1		
Magnolia chocoensis	1					1		1		1	
Magnolia coronata	1										
Magnolia dixonii									1		
Magnolia espinalii	1					1		1		1	
Magnolia gentryi	1	1									
Magnolia georgii										1	
Magnolia gilbertoi	1					1		1		1	
Magnolia guatapensis						1		1	1		
Magnolia hernandezii	1	1		2		3		3	2	2	
Magnolia irwiniana				1	1	1	1	1			G, T

Magnolia species	Collect and distribute germplasm	Conservation horticulture	Cryopreservation and/or micropropagation	Habitat restoration	Implement protection policies or regulations	Occurrence surveys or population monitoring	Pollen and/or seed banking	Population reinforcement or introduction	Protect and/or manage habitat	Public awareness or education	Research (T= Taxonomy; G= Genetics, C= Climate change; P= Pests & Pathogens)
South America (cont)											
Magnolia jaenensis	1	1		1					1		
Magnolia jardinensis				1					1	1	
Magnolia juninensis	2	2									
Magnolia kichuana									1	1	
Magnolia llanganatensis						1			2	1	C, G, P
Magnolia manguillo	1	1		1							
Magnolia mercedesiarum									1	1	
Magnolia mindoensis									1		
Magnolia napoensis									1	1	
Magnolia neillii									1		
Magnolia palandana									1		
Magnolia pastazaensis									1	1	
Magnolia polyhypsophylla						1		1	1		
Magnolia resupinatifolia										1	
Magnolia sanchez-vegae	1	1		1	1				1		
Magnolia santanderiana										1	
Magnolia shuariorum									1		
Magnolia silvioi										1	
Magnolia striatifolia				1	1	1	1	1	1		G, T
Magnolia urraoensis	1					1		1		1	
Magnolia vargasiana									2	1	C, G, P
Magnolia virolinensis										1	
Magnolia wolfii	1			1	1	1		1	1	1	G
Magnolia yantzazana									1	1	
Magnolia yarumalensis	1					1	1	2	1		
Magnolia quangninhensis							1				

Magnolia pacifica (Miguel À. Muñiz Castro)

Magnolia portoricensis (Emily Veltjen)

Appendix G. Process for identifying species of conservation concern

Three main metrics were used to rank species: 1) IUCN Red List category, 2) *ex situ* representation based on *ex situ* collection survey conducted for this gap analysis, 3) spatial analysis of *ex situ* collections. Species with an overall concern score of 19 or higher were recommended as 'species of concern'. Species are displayed in regional groups.

5 points | 4 points | 3 points | 2 points | 1 points | 0 points

Species name	Concern Score	IUCN Red List Category	Number of ex situ collections	Number of individuals in ex situ	Number of wild origin accessions	Percentage of Geographic range represented ex situ	Percentage of Ecological range represented ex situ
Caribbean							
Magnolia domingensis	20	CR	0	0	0	0	0
Magnolia ekmanii	20	CR	0	0	0	0	0
Magnolia emarginata	20	CR	0	0	0	0	0
Magnolia oblongifolia	20	CR	0	0	0	0	0
Magnolia cristalensis	19	EN	0	0	0	0	0
Magnolia hamorii	19	EN	0	0	0	0	0
Magnolia splendens	19	EN	0	0	0	0	0
Magnolia minor	18	VU	0	0	0	0	0
Magnolia orbiculata	18	VU	0	0	0	0	0
Magnolia pallescens	18	EN	1	1	0	unknown	unknown
Magnolia cubensis	16	VU	1	1	1	unknown	unknown
Magnolia portoricensis	14	EN	1	2	2	62	78
Magnolia dodecapetala	13	VU	1	3	3	28	80

Magnolia rostrata (Philippe de Spoelberch)

Magnolia rzedowskiana (Marisol Gutiérrez Lozano and Arturo Sánchez González)

Species name	Concern Score	IUCN Red List Category	Number of ex situ collections	Number of individuals in ex situ	Number of wild origin accessions	Percentage of Geographic range represented ex situ	Percentage of Ecological range represented ex situ
East Asia							
Magnolia longipedunculata	19	CR	2	3	0	unknown	unknown
Magnolia angustioblonga	18	EN	1	1	0	unknown	unknown
Magnolia ovoidea	18	CR	5	6	0	unknown	unknown
Magnolia viridipetala	18	EN	1	1	0	0	0
Magnolia albosericea	17	VU	1	1	0	unknown	unknown
Magnolia elliptigemmata	17	NT	0	0	0	0	0
Magnolia flaviflora	17	NT	0	0	0	0	0
Magnolia obovalifolia	17	NT	0	0	0	0	0
Magnolia carnosa	16	DD	0	0	0	0	0
Magnolia coriacea	16	EN	5	5	4	unknown	unknown
Magnolia dabieshanensis	16	DD	0	0	0	0	0
Magnolia dimorpha	16	DD	0	0	0	0	0
Magnolia figlarii	16	NT	4	4	0	unknown	unknown
Magnolia fragarigynandria	16	DD	0	0	0	0	0
Magnolia fujianensis	16	NT	1	1	0	unknown	unknown
Magnolia guangxiensis	16	NT	3	3	0	unknown	unknown
Magnolia iteophylla	16	DD	0	0	0	0	0
Magnolia jianfenglingensis	16	DD	0	0	0	0	0
Magnolia kaifui	16	DD	0	0	0	0	0
Magnolia lawii	16	DD	0	0	0	0	0
Magnolia masticata	16	DD	0	0	0	0	0
Magnolia mirifolia	16	DD	0	0	0	0	0
Magnolia odoratissima	16	EN	7	8	0	unknown	unknown
Magnolia omeiensis	16	CR	9	13	0	unknown	unknown
Magnolia praecalva	16	DD	0	0	0	0	0
Magnolia shiluensis	16	EN	7	9	0	unknown	unknown
Magnolia shirenshanensis	16	DD	0	0	0	0	0
Magnolia shizhenii	16	DD	0	0	0	0	0
Magnolia wuzhishangensis	16	DD	0	0	0	0	0
Magnolia xiana	16	DD	0	0	0	0	0
Magnolia xinyangensis	16	DD	0	0	0	0	0
Magnolia zhengyiana	16	DD	0	0	0	0	0
Magnolia championii	15	DD	3	3	0	unknown	unknown
Magnolia duclouxii	15	DD	5	5	0	unknown	unknown
Magnolia elegantifolia	15	DD	1	1	0	unknown	unknown
Magnolia fistulosa	15	DD	2	2	0	unknown	unknown
Magnolia guangdongensis	15	DD	2	2	0	unknown	unknown
Magnolia guangzhouensis	15	DD	1	1	0	unknown	unknown
Magnolia xinganensis	15	DD	5	5	0	unknown	unknown
Magnolia bawangensis	14	DD	1	1	1	0	0
Magnolia caveana	14	DD	2	4	1	unknown	unknown
Magnolia crassipes	14	EN	9	13	3	unknown	unknown
Magnolia kisopa	14	DD	2	2	1	unknown	unknown
Magnolia leveilleana	14	DD	5	5	1	unknown	unknown
Magnolia ventii	14	EN	3	17	0	unknown	unknown
Magnolia betongensis	13	LC	3	5	3	unknown	unknown

Species name	Concern Score	IUCN Red List Category	Number of ex situ collections	Number of individuals in ex situ	Number of wild origin accessions	Percentage of Geographic range represented ex situ	Percentage of Ecological range represented ex situ
East Asia (cont)							
Magnolia kachirachirai	13	EN	6	20	0	unknown	unknown
Magnolia mediocris	13	LC	3	5	3	unknown	unknown
Magnolia opipara	13	DD	6	6	0	unknown	unknown
Magnolia sinostellata	13	EN	9	25	0	unknown	unknown
Magnolia hongheensis	12	VU	1	15	15	0	0
Magnolia hookeri	12	DD	7	10	3	unknown	unknown
Magnolia kwangsiensis	12	VU	9	12	4	unknown	unknown
Magnolia patungensis	12	EN	12	13	2	unknown	unknown
Magnolia xanthantha	12	EN	4	7	4	31	100
Magnolia fulva	11	DD	9	11	3	unknown	unknown
Magnolia henryi	11	DD	7	9	4	unknown	unknown
Magnolia lanuginosa	11	DD	10	12	2	unknown	unknown
Magnolia rufibarbata	11	EN	5	24	20	unknown	unknown
Magnolia chevalieri	10	DD	9	14	10	unknown	unknown
Magnolia dawsoniana	10	EN	51	117	2	12	39
Magnolia grandis	10	CR	18	20	4	unknown	unknown
Magnolia hypolampra	10	DD	5	17	1	unknown	unknown
Magnolia lotungensis	10	EN	49	60	1	unknown	unknown
Magnolia rostrata	10	EN	22	35	1	unknown	unknown
Magnolia balansae	9	DD	8	18	1	unknown	unknown
Magnolia cathcartii	9	LC	10	11	4	unknown	unknown
Magnolia changhungtana	9	DD	10	16	2	unknown	unknown
Magnolia decidua	9	EN	14	18	7	unknown	unknown
Magnolia nitida	9	VU	22	44	3	unknown	unknown
Magnolia lacei	8	EN	6	25	23	42	64
Magnolia coco	7	DD	30	36	1	unknown	unknown
Magnolia conifera	7	LC	27	46	0	unknown	unknown
Magnolia doltsopa	7	DD	49	107	3	unknown	unknown
Magnolia garrettii	7	DD	18	19	3	unknown	unknown
Magnolia hodgsonii	7	LC	15	17	0	unknown	unknown
Magnolia lucida	7	EN	7	46	12	59	100
Magnolia aromatica	6	EN	22	24	10	33	88
Magnolia odora	6	VU	22	117	43	17	60
Magnolia baillonii	6	LC	10	85	24	unknown	unknown
Magnolia chapensis	6	LC	27	41	2	unknown	unknown
Magnolia dandyi	6	LC	9	28	20	unknown	unknown
Magnolia ernestii	6	DD	42	59	5	unknown	unknown
Magnolia kwangtungensis	6	DD	23	49	7	unknown	unknown
Magnolia laevifolia	6	DD	69	210	6	unknown	unknown
Magnolia liliifera	6	LC	16	32	2	unknown	unknown
Magnolia wilsonii	6	NT	93	215	41	unknown	unknown
Magnolia yuyuanensis	6	DD	23	63	9	unknown	unknown
Magnolia officinalis	5	EN	141	337	70	25	85
Magnolia sinica	5	CR	12	95	87	71	100
Magnolia cavaleriei	5	LC	31	65	5	unknown	unknown
Magnolia compressa	5	DD	45	195	134	unknown	unknown

Species name	Concern Score	IUCN Red List Category	Number of ex situ collections	Number of individuals in ex situ	Number of wild origin accessions	Percentage of Geographic range represented ex situ	Percentage of Ecological range represented ex situ
East Asia (cont)							
Magnolia floribunda	5	DD	27	103	67	unknown	unknown
Magnolia kobus	5	DD	219	930	138	unknown	unknown
Magnolia liliiflora	5	DD	103	252	35	unknown	unknown
Magnolia macclurei	5	LC	22	65	4	unknown	unknown
Magnolia sphaerantha	5	DD	18	155	136	unknown	unknown
Magnolia yunnanensis	5	DD	35	95	28	unknown	unknown
Magnolia zenii	5	CR	75	132	19	99	100
Magnolia sargentiana	4	VU	64	193	14	59	94
Magnolia cylindrica	4	VU	110	207	36	31	100
Magnolia amoena	4	VU	55	85	25	24	89
Magnolia biondii	4	LC	74	202	41	unknown	unknown
Magnolia campbellii	4	LC	75	495	11	unknown	unknown
Magnolia champaca	4	LC	75	340	26	unknown	unknown
Magnolia delavayi	4	LC	69	154	24	unknown	unknown
Magnolia denudata	4	LC	179	456	58	unknown	unknown
Magnolia figo	4	LC	125	456	52	unknown	unknown
Magnolia fordiana	4	LC	34	66	11	unknown	unknown
Magnolia foveolata	4	LC	39	88	22	unknown	unknown
Magnolia globosa	4	LC	38	75	14	unknown	unknown
Magnolia insignis	4	LC	76	486	370	unknown	unknown
Magnolia martinii	4	LC	21	41	21	unknown	unknown
Magnolia maudiae	4	LC	58	187	17	unknown	unknown
Magnolia obovata	4	LC	153	418	63	unknown	unknown
Magnolia salicifolia	4	LC	121	297	22	unknown	unknown
Magnolia sieboldii	4	LC	194	719	210	unknown	unknown
Magnolia sprengeri	4	LC	81	374	91	unknown	unknown
Magnolia stellata	4	EN	271	1290	390	100	100

Magnolia amoena (Arboretum Wespelaar)

Magnolia zenii (Fu Yanru)

Species name	Concern Score	IUCN Red List Category	Number of ex situ collections	Number of individuals in ex situ	Number of wild origin accessions	Percentage of Geographic range represented ex situ	Percentage of Ecological range represented ex situ
Mexico & Central America							
Magnolia faustinomirandae	20	CR	0	0	0	0	0
Magnolia lacandonica	20	CR	0	0	0	0	0
Magnolia mayae	20	CR	0	0	0	0	0
Magnolia montebelloensis	20	CR	0	0	0	0	0
Magnolia ottoi	20	CR	0	0	0	0	0
Magnolia poqomchi	20	CR	0	0	0	0	0
Magnolia tribouillierana	20	CR	0	0	0	0	0
Magnolia wendtii	20	CR	0	0	0	0	0
Magnolia yajlachhi	20	CR	0	0	0	0	0
Magnolia alejandrae	19	EN	0	0	0	0	0
Magnolia allenii	19	EN	0	0	0	0	0
Magnolia archilana	19	EN	0	0	0	0	0
Magnolia cochranei	19	EN	0	0	0	0	0
Magnolia decastroi	19	EN	0	0	0	0	0
Magnolia guanacastensis	19	EN	0	0	0	0	0
Magnolia guerrerensis	19	EN	0	0	0	0	0
Magnolia inbioana	19	EN	0	0	0	0	0
Magnolia krusei	19	EN	0	0	0	0	0
Magnolia morii	19	EN	0	0	0	0	0
Magnolia nuevoleonensis	19	EN	0	0	0	0	0
Magnolia pedrazae	19	EN	0	0	0	0	0
Magnolia perezfarrerae	19	EN	0	0	0	0	0
Magnolia quetzal	19	EN	0	0	0	0	0
Magnolia sinacacolinii	19	EN	0	0	0	0	0
Magnolia vazquezii	19	EN	0	0	0	0	0
Magnolia wetteri	19	EN	0	0	0	0	0
Magnolia zoquepopolucae	19	EN	0	0	0	0	0
Magnolia costaricensis	18	VU	0	0	0	0	0
Magnolia multinervia	18	VU	0	0	0	0	0
Magnolia talamancana	18	VU	0	0	0	0	0
Magnolia jaliscana	17	EN	1	1	1	0	0
Magnolia schiedeana	17	VU	3	3	0	unknown	unknown
Magnolia sororum	17	NT	0	0	0	0	0
Magnolia atlantida	16	DD	0	0	0	0	0
Magnolia chiriquiensis	16	DD	0	0	0	0	0
Magnolia gloriensis	16	DD	0	0	0	0	0
Magnolia lopezobradorii	16	DD	0	0	0	0	0
Magnolia macrocarpa	16	DD	0	0	0	0	0
Magnolia poasana	16	NT	1	1	0	unknown	unknown
Magnolia sambuensis	16	NT	2	2	0	unknown	unknown
Magnolia savegrensis	16	DD	0	0	0	0	0
Magnolia steyermarkii	16	DD	0	0	0	0	0
Magnolia zamudioi	16	DD	0	0	0	0	0

Species name	Concern Score	IUCN Red List Category	Number of ex situ collections	Number of individuals in ex situ	Number of wild origin accessions	Percentage of Geographic range represented ex situ	Percentage of Ecological range represented ex situ
Mexico & Central America (cont)							
Magnolia mexicana	16	VU	3	3	2	unknown	unknown
Magnolia oaxacensis	15	EN	1	1	1	50	57
Magnolia panamensis	15	LC	0	0	0	0	0
Magnolia iltisiana	14	VU	2	3	2	22	54
Magnolia vovidesii	14	EN	3	3	2	46	74
Magnolia rzedowskiana	13	EN	1	4	4	51	89
Magnolia ofeliae	12	CR	2	6	6	75	100
Magnolia sharpii	12	EN	4	7	5	29	74
Magnolia guatemalensis	10	LC	7	9	5	unknown	unknown
Magnolia pugana	8	EN	2	208	208	43	93
Magnolia tarahumara	8	DD	4	44	40	unknown	unknown
Magnolia vallartensis	8	CR	2	18	18	75	100
Magnolia yoroconte	8	VU	2	16	15	18	87
Magnolia dealbata	7	NT	30	38	6	unknown	unknown
Magnolia pacifica	7	EN	6	73	50	44	94
Magnolia tamaulipana	4	EN	20	57	12	74	92

Magnolia mexicana (Marisol Gutiérrez Lozano)

Species name	Concern Score	IUCN Red List Category	Number of ex situ collections	Number of individuals in ex situ	Number of wild origin accessions	Percentage of Geographic range represented ex situ	Percentage of Ecological range represented ex situ
South & Southeast Asia							
Magnolia gustavii	20	CR	0	0	0	0	0
Magnolia kachinensis	20	CR	0	0	0	0	0
Magnolia pleiocarpa	20	CR	0	0	0	0	0
Magnolia sonlaensis	20	CR	0	0	0	0	0
Magnolia tiepii	20	CR	0	0	0	0	0
Magnolia bidoupensis	19	EN	0	0	0	0	0
Magnolia cattienensis	19	EN	0	0	0	0	0
Magnolia nana	19	EN	0	0	0	0	0
Magnolia pealiana	19	EN	0	0	0	0	0
Magnolia pubescens	19	EN	0	0	0	0	0
Magnolia sulawesiana	19	EN	0	0	0	0	0
Magnolia annamensis	18	VU	0	0	0	0	0
Magnolia blaoensis	18	VU	0	0	0	0	0
Magnolia fansipanensis	18	CR	4	5	2	unknown	unknown
Magnolia platyphylla	18	EN	1	1	0	unknown	unknown
Magnolia quangninhensis	18	VU	0	0	0	0	0
Magnolia thailandica	18	VU	0	0	0	0	0
Magnolia albosericea	17	VU	1	1	0	unknown	unknown
Magnolia borneensis	17	NT	0	0	0	0	0
Magnolia flaviflora	17	NT	0	0	0	0	0
Magnolia nilagirica	17	VU	1	1	0	unknown	unknown
Magnolia sirindhorniae	17	EN	3	3	2	unknown	unknown
Magnolia angatensis	16	DD	0	0	0	0	0
Magnolia ashtonii	16	DD	0	0	0	0	0
Magnolia banghamii	16	DD	0	0	0	0	0
Magnolia beccarii	16	DD	0	0	0	0	0
Magnolia bintuluensis	16	DD	0	0	0	0	0
Magnolia braianensis	16	DD	0	0	0	0	0
Magnolia clemensiorum	16	DD	0	0	0	0	0
Magnolia coriacea	16	EN	5	5	4	unknown	unknown
Magnolia duperreana	16	DD	0	0	0	0	0
Magnolia griffithii	16	DD	0	0	0	0	0
Magnolia kingii	16	DD	0	0	0	0	0
Magnolia koordersiana	16	DD	0	0	0	0	0
Magnolia lanuginosoides	16	DD	0	0	0	0	0
Magnolia lasia	16	DD	0	0	0	0	0
Magnolia macklottii	16	DD	0	0	0	0	0
Magnolia mariusjacobsia	16	DD	0	0	0	0	0
Magnolia masticata	16	DD	0	0	0	0	0
Magnolia odoratissima	16	EN	7	8	0	0	0
Magnolia pahangensis	16	DD	0	0	0	0	0
Magnolia praecalva	16	DD	0	0	0	0	0
Magnolia punduana	16	DD	0	0	0	0	0
Magnolia sarawakensis	16	DD	0	0	0	0	0
Magnolia scortechinii	16	DD	0	0	0	0	0

Species name	Concern Score	IUCN Red List Category	Number of ex situ collections	Number of individuals in ex situ	Number of wild origin accessions	Percentage of Geographic range represented ex situ	Percentage of Ecological range represented ex situ
South & Southeast Asia (cont)							
Magnolia singapurensis	16	DD	0	0	0	0	0
Magnolia sumatrae	16	DD	0	0	0	0	0
Magnolia tsiampacca	16	DD	0	0	0	0	0
Magnolia villosa	16	DD	0	0	0	0	0
Magnolia xianianhei	16	DD	0	0	0	0	0
Magnolia calophylloides	15	DD	1	1	0	unknown	unknown
Magnolia carsonii	15	LC	0	0	0	0	0
Magnolia championii	15	DD	3	3	0	unknown	unknown
Magnolia duclouxii	15	DD	5	5	0	unknown	unknown
Magnolia fistulosa	15	DD	2	2	0	unknown	unknown
Magnolia gigantifolia	15	DD	1	1	0	unknown	unknown
Magnolia lamdongensis	15	DD	1	1	0	unknown	unknown
Magnolia oblonga	15	LC	0	0	0	0	0
Magnolia rabaniana	15	DD	1	1	0	unknown	unknown
Magnolia vrieseana	15	DD	1	1	0	unknown	unknown
Magnolia caveana	14	DD	2	4	1	unknown	unknown
Magnolia elegans	14	DD	3	3	1	unknown	unknown
Magnolia kisopa	14	DD	2	2	1	unknown	unknown
Magnolia persuaveolens	14	LC	1	1	0	unknown	unknown
Magnolia philippinensis	14	DD	2	5	3	unknown	unknown
Magnolia sabahensis	14	LC	1	1	0	unknown	unknown
Magnolia sumatrana	14	LC	5	5	0	unknown	unknown
Magnolia utilis	14	DD	2	2	1	unknown	unknown
Magnolia ventii	14	EN	3	17	0	0	0
Magnolia betongensis	13	LC	3	5	3	unknown	unknown
Magnolia citrata	13	LC	1	1	1	unknown	unknown
Magnolia mediocris	13	LC	3	5	3	unknown	unknown
Magnolia hongheensis	12	VU	1	15	15	unknown	unknown
Magnolia kwangsiensis	12	VU	9	12	4	unknown	unknown
Magnolia mannii	12	VU	1	15	15	unknown	unknown
Magnolia pterocarpa	12	DD	2	10	9	unknown	unknown
Magnolia fulva	11	DD	9	11	3	unknown	unknown
Magnolia henryi	11	DD	7	9	4	unknown	unknown
Magnolia hookeri	11	DD	7	10	3	unknown	unknown
Magnolia lanuginosa	11	DD	10	12	2	unknown	unknown
Magnolia montana	11	DD	2	11	10	unknown	unknown
Magnolia rufibarbata	11	EN	5	24	20	unknown	unknown
Magnolia siamensis	11	LC	2	8	7	unknown	unknown
Magnolia chevalieri	10	DD	9	14	10	unknown	unknown
Magnolia grandis	10	CR	18	20	4	unknown	unknown
Magnolia hypolampra	10	DD	5	17	1	unknown	unknown
Magnolia rostrata	10	EN	22	35	1	unknown	unknown
Magnolia balansae	9	DD	8	18	1	unknown	unknown
Magnolia cathcartii	9	LC	10	11	4	unknown	unknown
Magnolia lacei	9	EN	6	25	23	10	44

Species name	Concern Score	IUCN Red List Category	Number of ex situ collections	Number of individuals in ex situ	Number of wild origin accessions	Percentage of Geographic range represented ex situ	Percentage of Ecological range represented ex situ
South & Southeast Asia (cont)							
Magnolia nitida	9	VU	22	44	3	unknown	unknown
Magnolia aromatica	8	EN	21	24	10	9	43
Magnolia rajaniana	8	VU	6	26	20	19	53
Magnolia coco	7	DD	30	36	1	unknown	unknown
Magnolia conifera	7	LC	27	46	0	unknown	unknown
Magnolia doltsopa	7	DD	49	107	3	unknown	unknown
Magnolia garrettii	7	DD	18	19	3	unknown	unknown
Magnolia hodgsonii	7	LC	15	17	0	unknown	unknown
Magnolia lucida	7	EN	7	46	12	46	100
Magnolia odora	7	VU	22	117	43	5	36
Magnolia baillonii	6	LC	10	85	24	unknown	unknown
Magnolia chapensis	6	LC	27	41	2	unknown	unknown
Magnolia dandyi	6	LC	9	28	20	unknown	unknown
Magnolia liliifera	6	LC	16	32	2	unknown	unknown
Magnolia compressa	5	DD	45	195	134	unknown	unknown
Magnolia floribunda	5	DD	27	103	67	unknown	unknown
Magnolia macclurei	5	LC	22	65	4	unknown	unknown
Magnolia yunnanensis	5	DD	35	95	28	unknown	unknown
Magnolia campbellii	4	LC	75	495	11	unknown	unknown
Magnolia champaca	4	LC	75	340	26	unknown	unknown
Magnolia fordiana	4	LC	34	66	11	unknown	unknown
Magnolia foveolata	4	LC	39	88	22	unknown	unknown
Magnolia globosa	4	LC	38	75	14	unknown	unknown
Magnolia insignis	4	LC	76	486	370	unknown	unknown
Magnolia martinii	4	LC	21	41	21	unknown	unknown
Magnolia sapaensis	3	VU	20	39	24	93	100

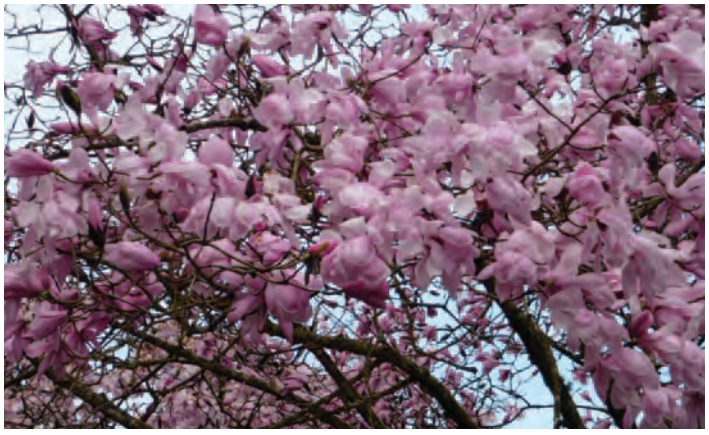
Magnolia sapaensis (Arboretum Wespelaar)

Magnolia sargentiana (Arboretum Wespelaar)

Species name	Concern Score	IUCN Red List Category	Number of ex situ collections	Number of individuals in ex situ	Number of wild origin accessions	Percentage of Geographic range represented ex situ	Percentage of Ecological range represented ex situ
South America							
Magnolia arroyoana	20	CR	0	0	0	0	0
Magnolia betuliensis	20	CR	0	0	0	0	0
Magnolia calimaensis	20	CR	0	0	0	0	0
Magnolia canandeana	20	CR	0	0	0	0	0
Magnolia cararensis	20	CR	0	0	0	0	0
Magnolia cespedesii	20	CR	0	0	0	0	0
Magnolia chiguila	20	CR	0	0	0	0	0
Magnolia chimantensis	20	CR	0	0	0	0	0
Magnolia clementinana	20	CR	0	0	0	0	0
Magnolia coronata	20	CR	0	0	0	0	0
Magnolia dixonii	20	CR	0	0	0	0	0
Magnolia manguillo	20	CR	0	0	0	0	0
Magnolia narinensis	20	CR	0	0	0	0	0
Magnolia resupinatifolia	20	CR	0	0	0	0	0
Magnolia sanchez-vegae	20	CR	0	0	0	0	0
Magnolia virolinensis	20	CR	0	0	0	0	0
Magnolia arcabucoana	19	EN	0	0	0	0	0
Magnolia argyrothricha	19	EN	0	0	0	0	0
Magnolia boliviana	19	EN	0	0	0	0	0
Magnolia brasiliensis	19	EN	0	0	0	0	0
Magnolia calophylla	19	EN	0	0	0	0	0
Magnolia chocoensis	19	EN	0	0	0	0	0
Magnolia colombiana	19	CR	1	1	0	unknown	unknown
Magnolia espinalii	19	CR	1	1	0	unknown	unknown
Magnolia gentryi	19	EN	0	0	0	0	0
Magnolia georgii	19	EN	0	0	0	0	0
Magnolia guatapensis	19	EN	0	0	0	0	0
Magnolia irwiniana	19	EN	0	0	0	0	0
Magnolia jaenensis	19	EN	0	0	0	0	0
Magnolia jardinensis	19	CR	1	1	0	unknown	unknown
Magnolia juninensis	19	EN	0	0	0	0	0
Magnolia katiorum	19	CR	1	1	0	unknown	unknown
Magnolia kichuana	19	EN	0	0	0	0	0
Magnolia llanganatensis	19	EN	0	0	0	0	0
Magnolia madidiensis	19	EN	0	0	0	0	0
Magnolia manuensis	19	EN	0	0	0	0	0
Magnolia mercedesiarum	19	EN	0	0	0	0	0
Magnolia napoensis	19	EN	0	0	0	0	0
Magnolia neillii	19	EN	0	0	0	0	0
Magnolia neomagnifolia	19	EN	0	0	0	0	0
Magnolia palandana	19	EN	0	0	0	0	0
Magnolia pastazaensis	19	EN	0	0	0	0	0
Magnolia polyhypsophylla	19	CR	1	1	0	unknown	unknown
Magnolia santanderiana	19	EN	0	0	0	0	0
Magnolia shuarorum	19	EN	0	0	0	0	0

Species name	Concern Score	IUCN Red List Category	Number of ex situ collections	Number of individuals in ex situ	Number of wild origin accessions	Percentage of Geographic range represented ex situ	Percentage of Ecological range represented ex situ
South America							
Magnolia wolfii	19	CR	1	1	0	unknown	unknown
Magnolia yantzazana	19	EN	0	0	0	0	0
Magnolia bankardiorum	18	VU	0	0	0	0	0
Magnolia caricifragrans	18	EN	1	1	0	unknown	unknown
Magnolia gilbertoi	18	EN	1	1	0	unknown	unknown
Magnolia henaoi	18	EN	1	1	0	unknown	unknown
Magnolia hernandezii	18	EN	2	2	0	unknown	unknown
Magnolia lenticellata	18	EN	1	1	0	unknown	unknown
Magnolia mahechae	18	EN	1	1	0	unknown	unknown
Magnolia mindoensis	18	VU	0	0	0	0	0
Magnolia silvioi	18	EN	2	2	0	unknown	unknown
Magnolia striatifolia	18	EN	1	1	0	unknown	unknown
Magnolia urraoensis	18	EN	1	1	0	unknown	unknown
Magnolia vargasiana	18	VU	0	0	0	0	0
Magnolia yarumalensis	18	EN	1	1	0	unknown	unknown
Magnolia azulensis	16	DD	0	0	0	0	0
Magnolia elfina	16	DD	0	0	0	0	0
Magnolia lozanoi	16	DD	0	0	0	0	0
Magnolia paranaensis	16	DD	0	0	0	0	0
Magnolia peruviana	16	DD	0	0	0	0	0
Magnolia ptaritepuiana	16	DD	0	0	0	0	0
Magnolia sambuensis	16	NT	2	2	0	unknown	unknown
Magnolia sellowiana	16	DD	0	0	0	0	0
Magnolia venezuelensis	16	DD	0	0	0	0	0
Magnolia zamorana	16	DD	0	0	0	0	0
Magnolia amazonica	15	LC	0	0	0	0	0
Magnolia equatorialis	15	LC	0	0	0	0	0
Magnolia mashpi	15	LC	0	0	0	0	0
Magnolia rimachii	15	LC	0	0	0	0	0
Magnolia ovata	14	LC	3	3	0	unknown	unknown

Magnolia aromatica (Keming Yang, South China Botanical Garden)



Magnolia dawsoniana (Arboretum Wespelaar)

Appendix H. Species Profiles

Individual profiles for species where spatial analysis could be performed are listed below.

Individual profiles for species of conservation concern can be downloaded from the GCCM website. Page numbers for the species profiles within the full-length PDF https://globalconservationconsortia.org/resources/global-conservation-gap-analysis-of-magnolia/ are given.

Species Profile	Region	Contry	Page Numbers
Magnolia amoena	East Asia	*China*	92 - 96
Magnolia aromatica	East Asia	*China (Vietnam)*	97 - 101
Magnolia cylindrica	East Asia	*China*	102 - 106
Magnolia dawsoniana	East Asia	*China*	107 - 111
Magnolia dodecapetala	Caribbean	*Caribbean*	112 - 117
Magnolia iltisiana	Mexico & Central America	*Mexico*	118 - 121
Magnolia lacei	East Asia	*China*	122 - 126
Magnolia lucida	East Asia	*China (Vietnam)*	127 - 131
Magnolia mexicana	Mexico & Central America	*Mexico*	132 - 138
Magnolia oaxacensis	Mexico & Central America	*Mexico*	139 - 142
Magnolia odora	East Asia	*China (Vietnam, Laos)*	143 -148
Magnolia ofeliae	Mexico & Central America	*Mexico*	149 - 153
Magnolia officinalis	East Asia	*China*	154 - 159
Magnolia pacifica	Mexico & Central America	*Mexico*	160 - 164
Magnolia portoricensis	Caribbean	*Caribbean*	165 - 170
Magnolia pugana	Mexico & Central America	*Mexico*	171 - 176
Magnolia rajaniana	South & Southeast Asia	*Thailand*	177 - 181
Magnolia rzedowskiana	Mexico & Central America	*Mexico*	182 - 186
Magnolia sapaensis	South & Southeast Asia	*Vietnam*	187 - 191
Magnolia sargentiana	East Asia	*China*	192 - 197
Magnolia sharpii	Mexico & Central America	*Mexico*	198 - 202
Magnolia sinica	East Asia	*China*	203 - 208
Magnolia stellata	East Asia	*Japan*	209 - 215
Magnolia tamaulipana	Mexico & Central America	*Mexico*	216 - 220
Magnolia vallartensis	Mexico & Central America	*Mexico*	221 - 226
Magnolia vovidesii	Mexico & Central America	*Mexico*	227 - 232
Magnolia yoroconte	Mexico & Central America	*Honduras*	233 - 236
Magnolia zenii	East Asia	*China*	237 - 241

Magnolia amoena W.C.Cheng

Section: *Yulania* **Synonyms:** *Yulania amoena* (W.C.Cheng) D.L.Fu **Common names:** Tianmu Mulan
IUCN Red List Category and Criteria: Vulnerable B1ab(iii,iv)

Suggested citation: Linsky, J. (2022). *Magnolia amoena* W.C.Cheng. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.


Arboretum Wespelaar


Arboretum Wespelaar

Distribution and Ecology

Magnolia amoena is a small, deciduous tree to 12 meters tall, native to parts of southeastern China where it occurs in small, scattered stands across parts of southern Anhui, southern Jiangsu, Zhejiang and Jiangxi Provinces, in mixed forest, between 700-1,000 m asl. *M. amoena* is assessed on the IUCN Red List as Vulnerable due to its fragmentation and the impact on regeneration of the collection of flower buds for medicinal purposes (China Expert Workshop 2014).

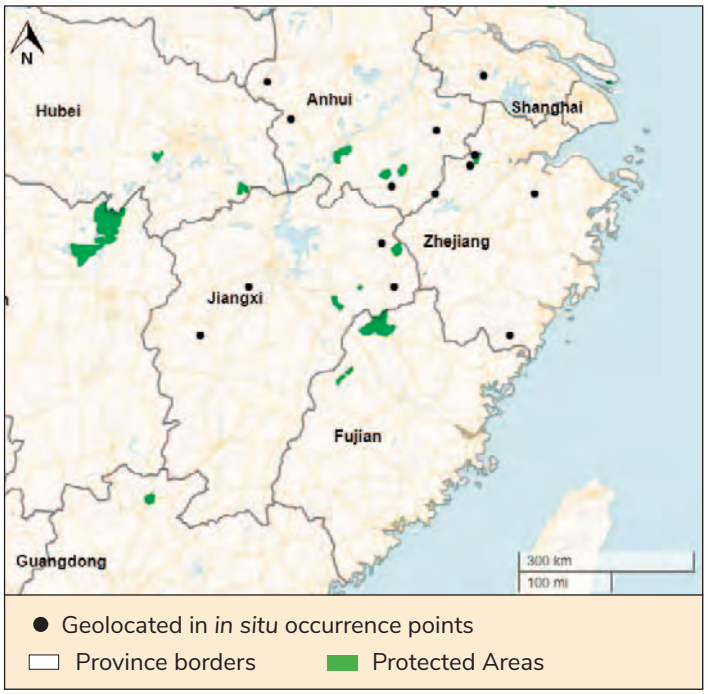


Figure 1. Geolocated *in situ* occurrence points for *Magnolia amoena* (IUCN 2014; GBIF 2021) . Protected areas are from Protected Planet (UNEP-WCMC 2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia amoena*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	5
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	40
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	20
					Average vulnerability score		22

Threats to Wild populations

The IUCN Red List assessment for *M. amoena* reports lack of reproduction due to overcollection of flowers for medicinal purposes as a major threat. Respondents to the conservation actions recognize this wild harvesting as well as possible inbreeding in fragmented populations, disturbance regime modification and agriculture, silviculture and/or ranching as the most significant threats to wild populations of this species.


Arboretum Wespelaar

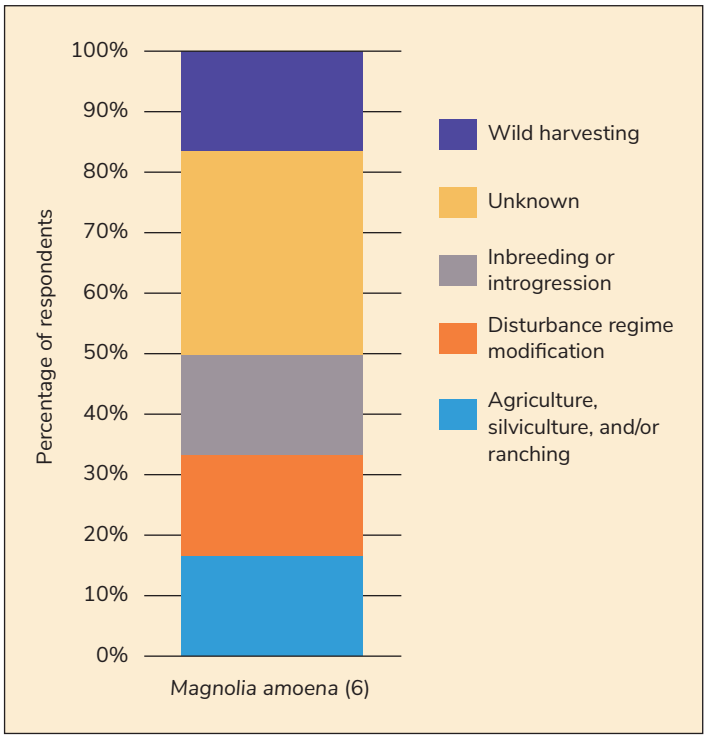


Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. amoena* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	55
Number of plants in ex *situ* collections:	85
Average number of plants per institution:	2
Percent of ex *situ* plants of wild origin:	24%
Percent of wild origin plants with known locality:	66%

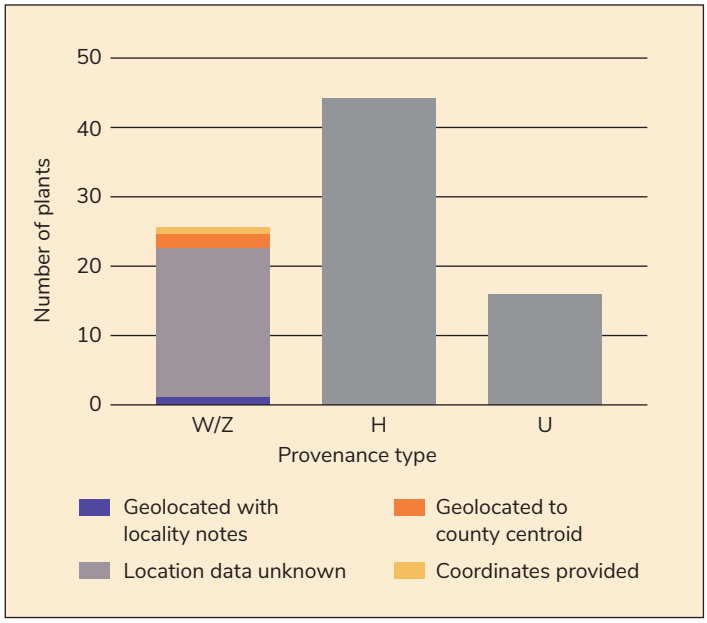


Figure 3. Number and origin of *Magnolia amoena* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

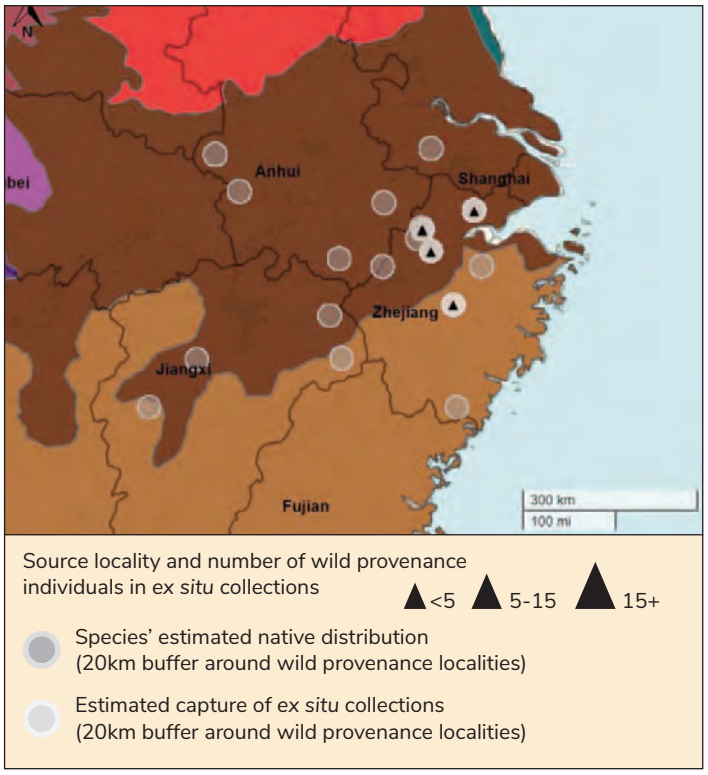


Figure 4. *Magnolia amoena in situ* occurrence points and ex *situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Changjiang Plain evergreen forests and Jian Nan subtropical evergreen forests ecoregions.

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	5,107 / 20,779 **(25%)**	26,771 / 114,718 **(23%)**	72,442 / 294,405 **(25%)**	**24%**
Ecological coverage	2 / 2 **(100%)**	2 / 2 **(100%)**	2 / 3 **(67%)**	**89%**

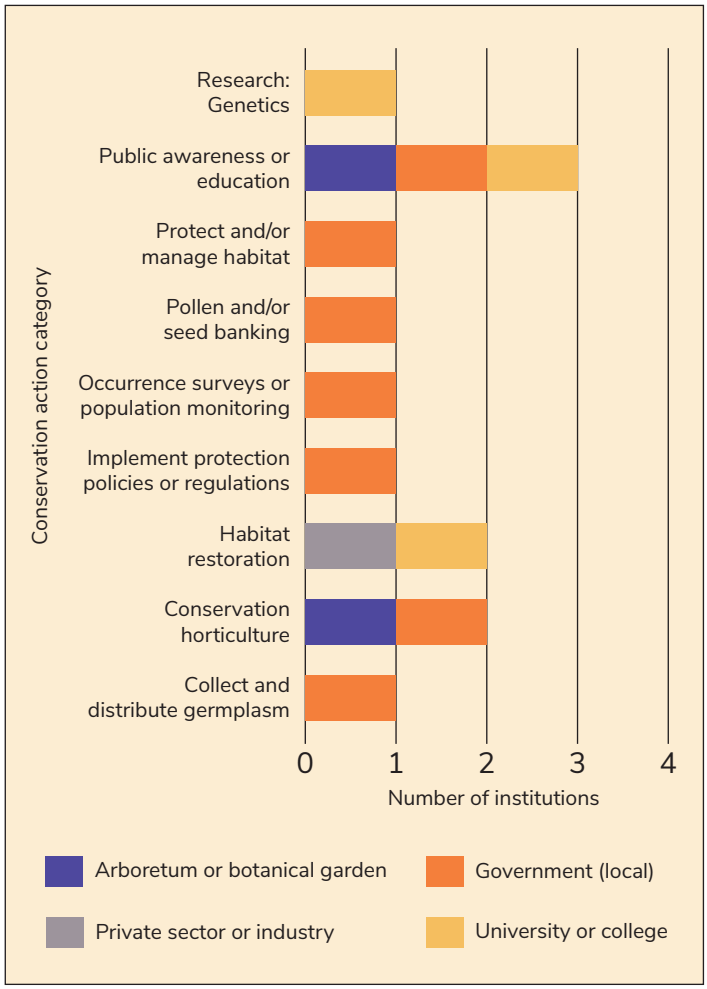


Figure 5. Number of institutions reporting conservation activities for *M. amoena* grouped by organization type. Five of 56 institutions reported activities focused on *M. amoena* (see Appendix F for a list of all responding institutions).

Research: Genetics
The Gifu Academy of Forest Science and Culture reports carrying out genetic research on *M. amoena*.

Public Awareness/Education
The Gardens of the Big Bend at University of Florida, Shenzhen Fairy Lake Botanical Garden and Zhejiang A&F University all report carrying out public awareness or education about this species.

Protect and/or manage habitat
This species is found in the following protected areas: Tianmushan, Huangshan, Mount Sanqingshan National Park and Wuyishan Biosphere Reserve. This species is listed as Vulnerable in the 2017 Threatened Species List of China's Higher Plants (Qin et *al*. 2017). Shenzhen Fairy Lake Botanical Garden reported habitat protection/management as an activity carried out for this species.

Pollen and/or seed banking
Shenzhen Fairy Lake Botanical Garden reports pollen and/or seed banking of *M. amoena*.

Population reinforcement or introduction
M. amoena has been part of reintroduction projects in China (Ren, H. 2020).

Occurrence surveys/Population monitoring
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. amoena*.

Implement protection policies or regulations
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. amoena*.

Habitat restoration
Zhejiang A&F University and one other institution report habitat restoration as an activity carried out for *M. amoena*.

Conservation horticulture
The Gardens of the Big Bend at University of Florida and Shenzhen Fairy Lake Botanical Garden report conservation horticulture activities for *M. amoena*.

Collection and distribution of germplasm
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. amoena*. *Ex situ* collections are reported from the eastern parts of the Changjiang Plain evergreen forests and Jian Nan subtropical evergreen forests ecoregions (Figure 4).


Arboretum Wespelaar

Conservation Actions Needed

Regulation of the collection of flower buds and monitoring of the populations of this species are recommended. Habitat restoration, public awareness and education, occurrence surveys/population monitoring, collection/distribution of germplasm and population reinforcement or reintroduction are all recommended for this species by questionnaire respondents.

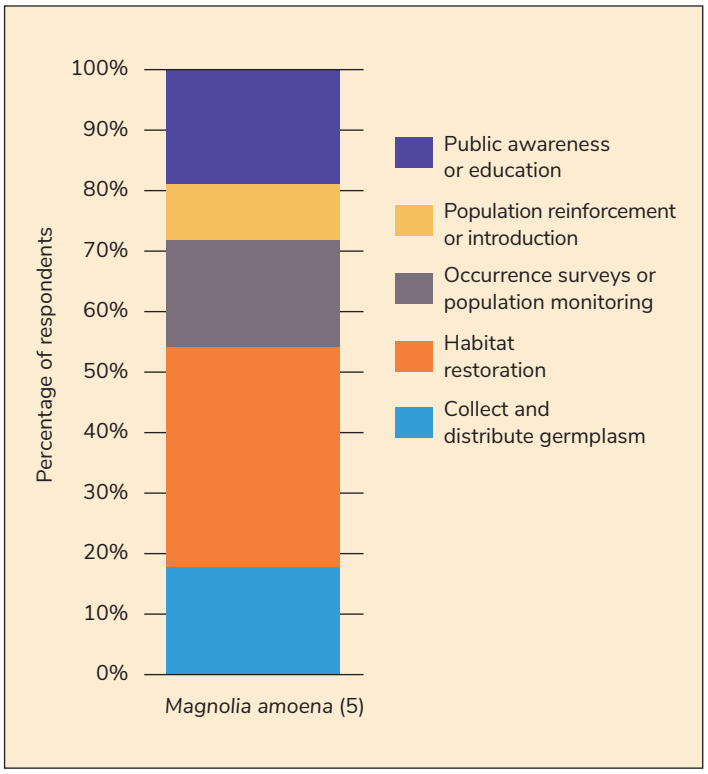


Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. amoena* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Ren, H. (Ed.) (2020). *Conservation and Reintroduction of Rare and Endangered Plants in China*. Springer Nature Singapore Pte Ltd., Singapore. https://doi.org/10.1007/978-981-15-5301-1

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Magnolia aromatica (Dandy) V.S.Kumar

Section: *Manglietia* **Synonyms:** *Manglietia aromatica* Dandy, *Paramanglietia aromatica* (Dandy) Hu & W.C.Cheng
Common names: Xiang Mulian **IUCN Red List Category and Criteria:** Endangered C2a(i)

Suggested citation: Linsky, J. (2022). Magnolia aromatica (Dandy) V.S.Kumar. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia aromatica is a large, evergreen tree up to 35 meters tall, native to parts of southern China, occurring in Yunnan, Guizhou and Guangxi Provinces. It is possible that it also occurs in parts of neighbouring north-eastern Viet Nam, though its presence here is unconfirmed. Within its known distribution, it is found in mixed forest, on limestone substrates, between 800 and 1,600 m asl. Only a few, small populations are known (Pan et *al*. 2003). Individual specimens are known to flower and fruit abundantly, though fruits generally contain only few seeds, resulting in poor regeneration in the wild (Pan et *al*. 2003).


Keming Yang, South China Botanical Garden


Keming Yang, South China Botanical Garden

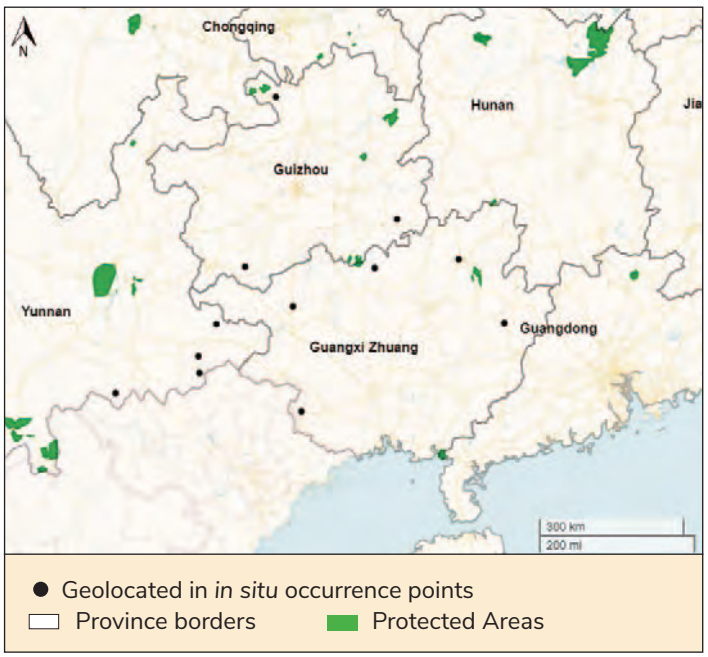

Figure 1. Documented *in situ* occurrence points for *Magnolia aromatica* (GBIF 2021; IUCN 2015). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia aromatica*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	10
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	0
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	10
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	10
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
						Average vulnerability score	8

Threats to Wild populations

Low reproductive success as well as habitat loss are threats to this species. Studies show low numbers of individuals that are fragmented which likely is leading to low gene flow and a loss of genetic diversity (Pan, 2003). Respondents of the questionnaire highlight agriculture, silviculture and/or ranching; climate change; development, mining and/or roads and in-breeding or introgression as significant threats to wild populations of this species.

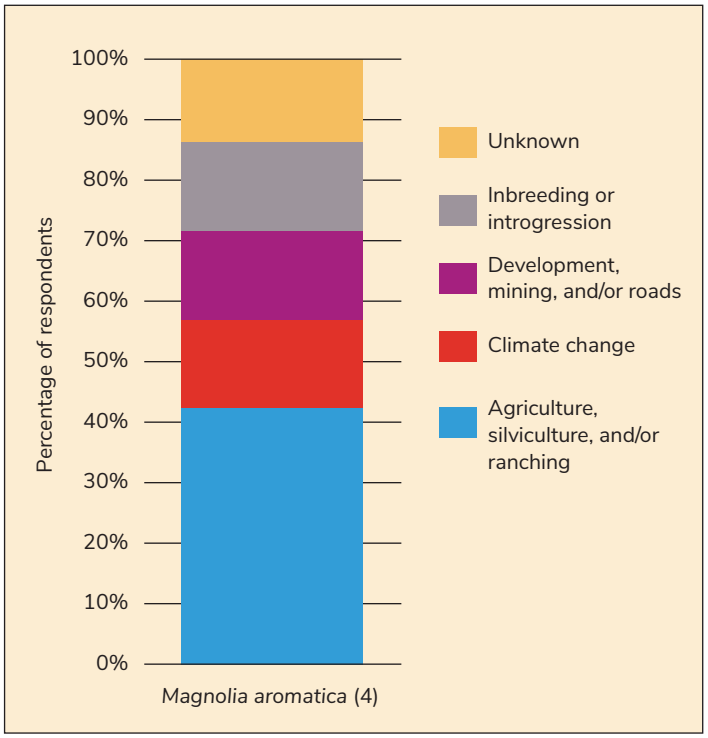

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. aromatica* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	22
Number of plants in ex *situ* collections:	24
Average number of plants per institution:	1
Percent of ex *situ* plants of wild origin:	42%
Percent of wild origin plants with known locality:	80%

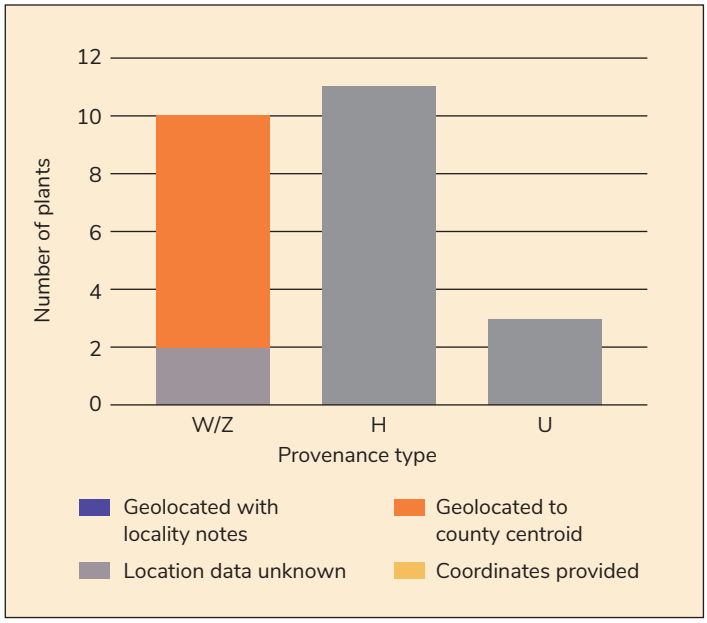

Figure 3. Number and origin of *Magnolia aromatica* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.


Keming Yang, South China Botanical Garden

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	6,526 / 19,945 **(33%)**	6,526 / 19,945 **(33%)**	93,520 / 280,900 **(33%)**	**33%**
Ecological coverage	4 / 5 **(80%)**	4 / 5 **(80%)**	5 / 6 **(83%)**	**88%**

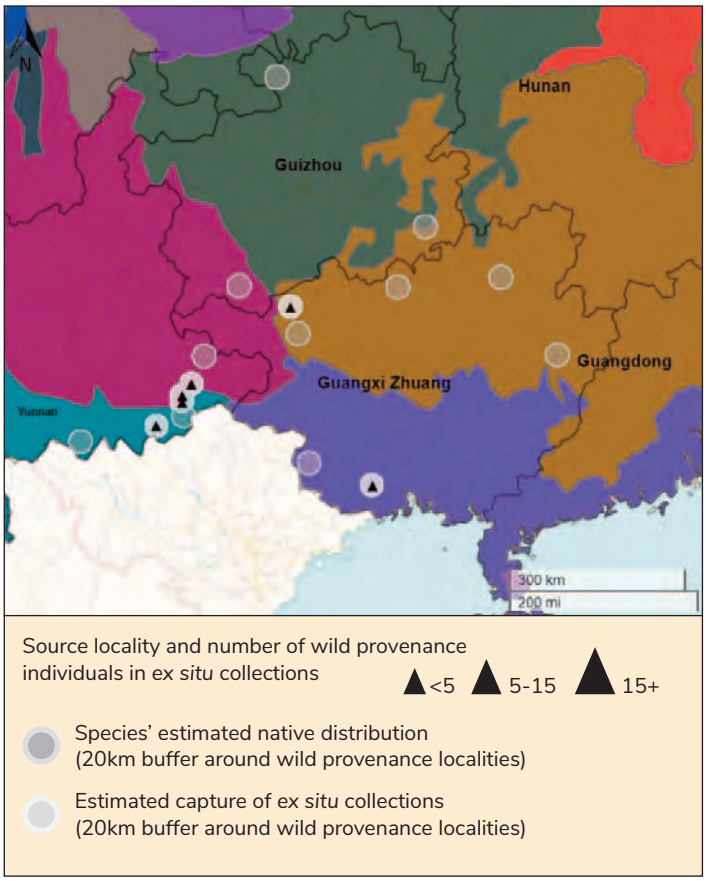

Figure 4. *Magnolia aromatica in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Guizhou Plateau broadleaf and mixed forests, Jian Nan subtropical evergreen forests, Yunnan Plateau subtropical evergreen forests, Northern Indochina subtropical forests and South China-Vietnam subtropical evergreen forests ecoregions.

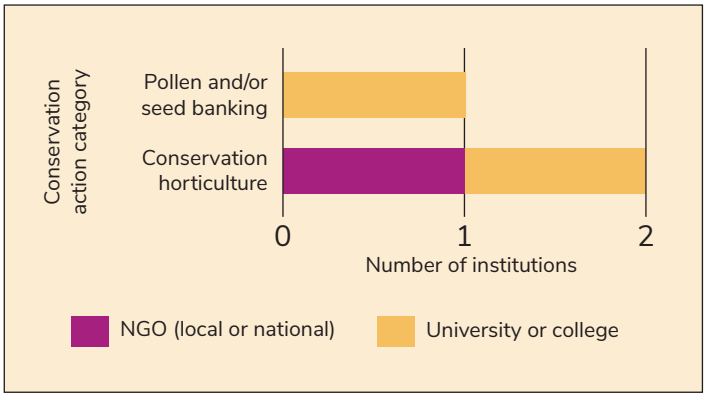

Figure 5. Number of institutions reporting conservation activities for *Magnolia aromatica* grouped by organization type. Two of 56 institutions reported activities focused on *M. aromatica* (see Appendix F for a list of all responding institutions).

Pollen and/or seed banking

The University of British Columbia Botanical Garden reports carrying out pollen and/or seed banking for *M. aromatica*.

Conservation Horticulture

The University of British Columbia Botanical Garden and one other institution report carrying out conservation horticulture for this species.

Population reinforcement or introduction

This species is on the China National Key Protected Wild Plants List and has been part of reintroduction projects (Ren, H. 2020).

Collection and distribution of germplasm

Ex situ collections are reported from the Jian Nan subtropical evergreen forests, Yunnan Plateau subtropical evergreen forests, Northern Indochina subtropical forests and South China-Vietnam subtropical evergreen forests ecoregions. No collections are reported from the Guizhou Plateau broadleaf and mixed forests ecoregion (Figure 4).


Philippe de Spoelberch

Conservation Actions Needed

Development of a propagation protocol and re-introduction populations to increase population gene flow is recommended (Pan et al. 2003). Respondents to the questionnaire recommend further conservation horticulture, collection and distribution of germplasm as well as further pollen and/or seed banking, occurrence surveys/population monitoring, implementation of protection policies/regulations, habitat restoration and cryopreservation/micropropagation.

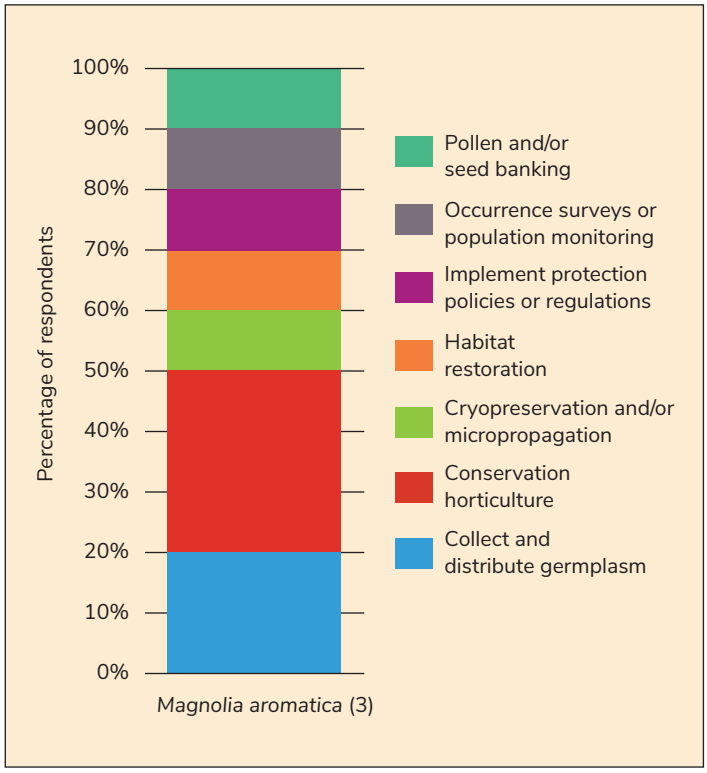

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. aromatica* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia cylindrica E.H.Wilson

Section: *Yulania* **Synonyms:** *Yulania cylindrica* (E.H.Wilson) D.L.Fu
Common names: Huangshan Mulan **IUCN Red List Category and Criteria:** Vulnerable B2ab(iii)

Suggested citation: Linsky, J. (2022). *Magnolia cylindrica* E.H.Wilson. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia cylindrica is endemic to China and occurs in the Anhui, Fujian, Jiangxi and Zhejiang Provinces. It is assessed as Vulnerable due to its fragmentation and the continuing decline of the area, extent and quality of its habitat.

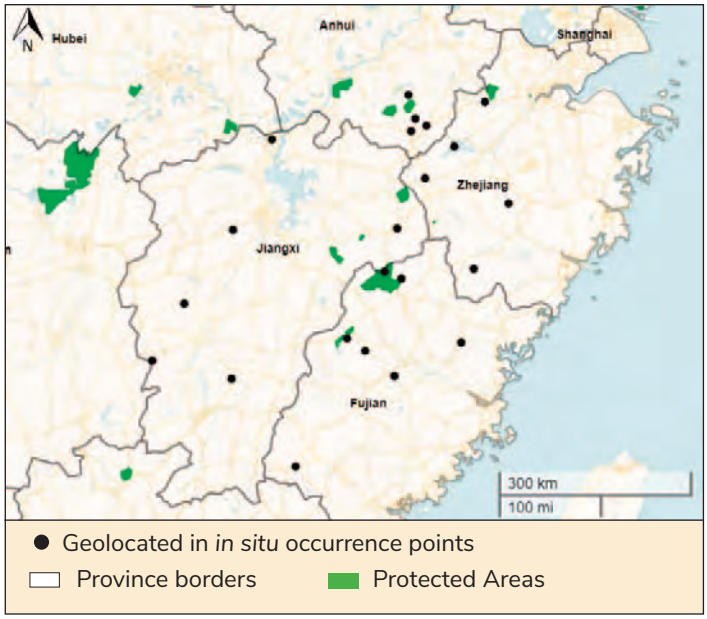

Figure 1. Geolocated *in situ* occurrence points for *Magnolia cylindrica* (IUCN 2014; GBIF 2021) . Protected areas are from Protected Planet (UNEP-WCMC 2021).


Philippe de Spoelberch

Threats to Wild populations

Agriculture, silviculture, and/or ranching are most reported to be the significant threat to *M. cylindrica*. Wild harvesting, climate change, inbreeding/introgression, disturbance regime modification and development, mining and/or roads are also reported as significant threats to this species.

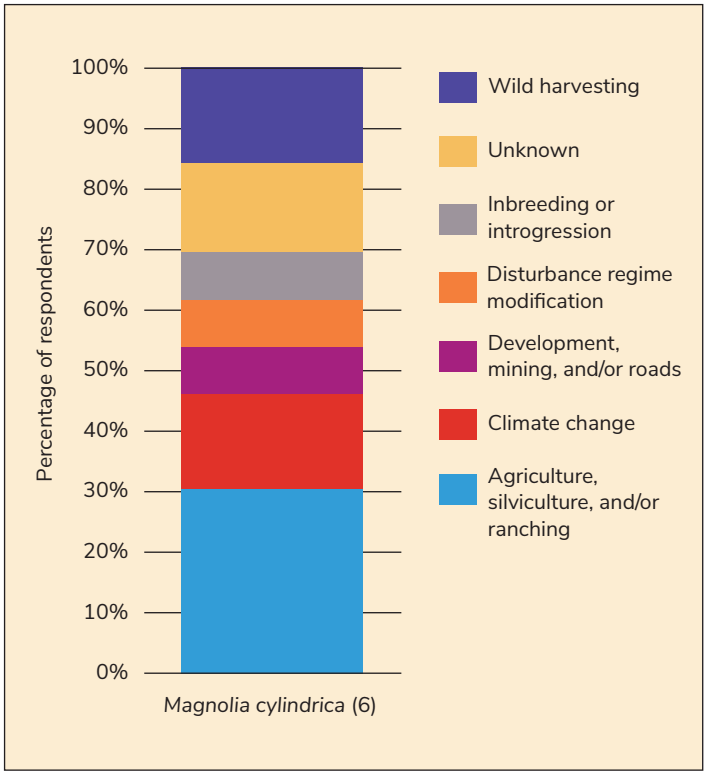

Figure 2. . Responses from the *Magnolia* conservation action questionnaire for *M. cylindrica* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia cylindrica*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	5
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	40
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
					Average vulnerability score		23

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of *ex situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of *ex situ* survey

Number of *ex situ* collections reporting this species:	110
Number of plants in *ex situ* collections:	207
Average number of plants per institution:	2
Percent of *ex situ* plants of wild origin:	17%
Percent of wild origin plants with known locality:	44%

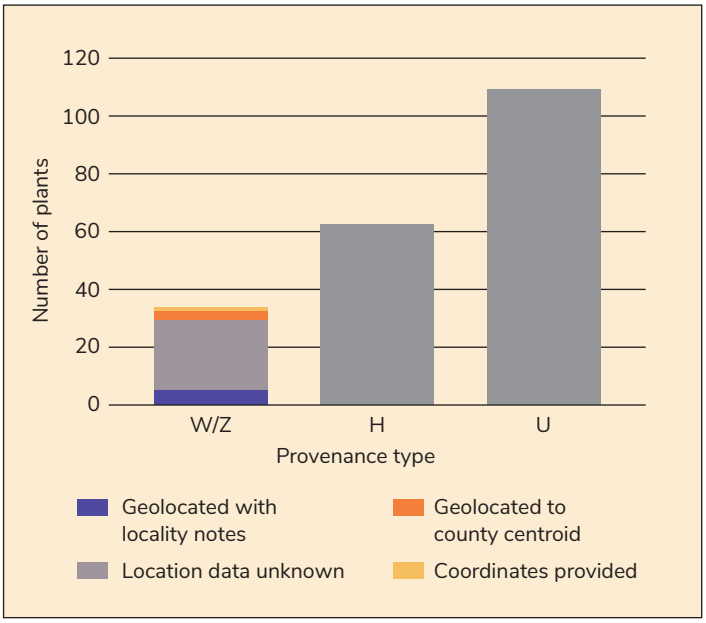

Figure 3. Number and origin of *Magnolia cylindrica* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

Arboretum Wespelaar

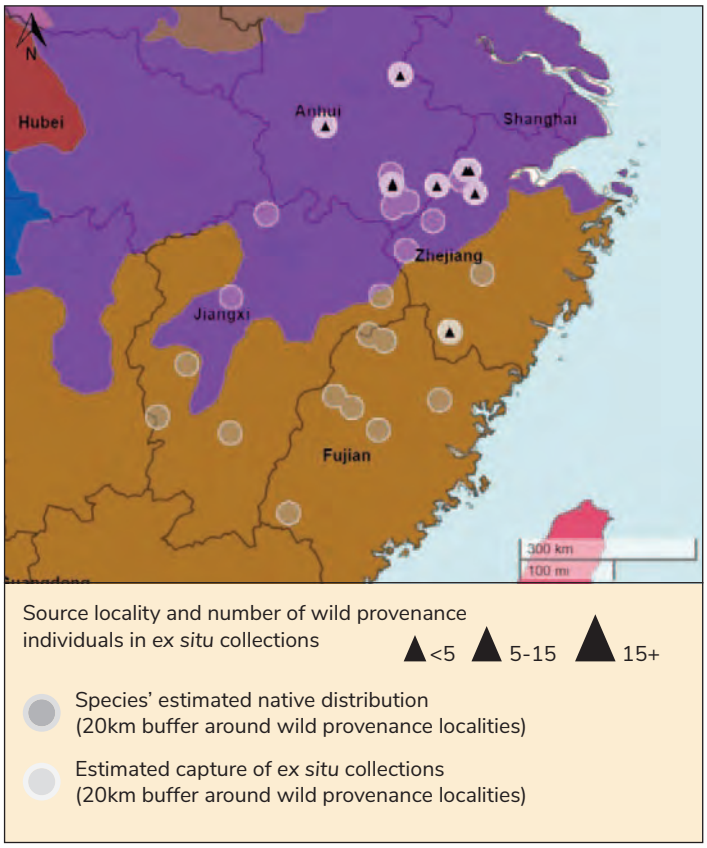

Figure 4. *Magnolia cylindrica in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Changjiang Plain evergreen forests and Jian Nan subtropical evergreen forests ecoregions.

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in *ex situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The *ex situ* buffer area represents the native range "captured" in *ex situ* collections, or "combined area *ex situ*" (CAE20, CAE50, CAE100). Geographic coverage of *ex situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

Philippe de Spoelberch

Estimated *ex situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	9,210 / 32,341 **(28%)**	46,882 / 158,703 **(30%)**	145,427 / 420,430 **(35%)**	**31%**
Ecological coverage	2 / 2 **(100%)**	2 / 2 **(100%)**	2 / 2 **(100%)**	**100%**

Research: climate change
One institution reports climate change research on *M. cylindrica*.

Public awareness/education
Shenzhen Fairy Lake Botanical Garden and one other institution report this activity for *M. cylindrica*.

Protect and/or manage habitat
This species is found in the following protected areas: Wuyishan, China Danxia, Tianmushan, Huangshan and Sanqingshan. Shenzhen Fairy Lake Botanical Garden reports carrying out this activity for *M. cylindrica*.

Population reinforcement or introduction
Study on ecological interactions and arbuscular mycorrhizal (AM) fungi showed that *M. cylindrica* forms a strong symbiosis with AM fungi. The relationship between the AM fungi and *M. cylindrica* and other species is a strong driver of community structure and provides information on habitat structure for potential reintroduction and needs for successful propagation (Yang et *al*. 2011). This species has been part of reintroduction projects in China (Ren, H. 2020). Zhejiang A&F University and one other institution report population reinforcement/introduction as an activity carried out for *M. cylindrica*.

Pollen and/or seed banking
Shenzhen Fairy Lake Botanical Garden and University of British Columbia Botanical Garden report pollen and/or seed banking of *M. cylindrica*.

Occurrence surveys/population monitoring
Shenzhen Fairy Lake Botanical Garden reports carrying out this activity for *M. cylindrica*.

Implement protection policies or regulations
Shenzhen Fairy Lake Botanical Garden reports carrying out this activity for *M. cylindrica*.

Habitat restoration
Zhejiang A&F University reports habitat restoration for *M. cylindrica*.

Cryopreservation or micropropagation
The Huntington reports cryopreservation of *M. cylindrica*.

Conservation horticulture
The Filoli Center, Shenzhen Fairy Lake Botanical Garden, University of British Columbia Botanical Garden, Zhejiang A&F University and one other institution report carrying conservation horticulture for *M. cylindrica*.

Collect and distribute germplasm
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. cylindrica*. *Ex situ* collections are mainly reported from the Changjiang Plain evergreen forests ecoregion with fewer from the Jian Nan subtropical evergreen forests ecoregion (Figure 4).

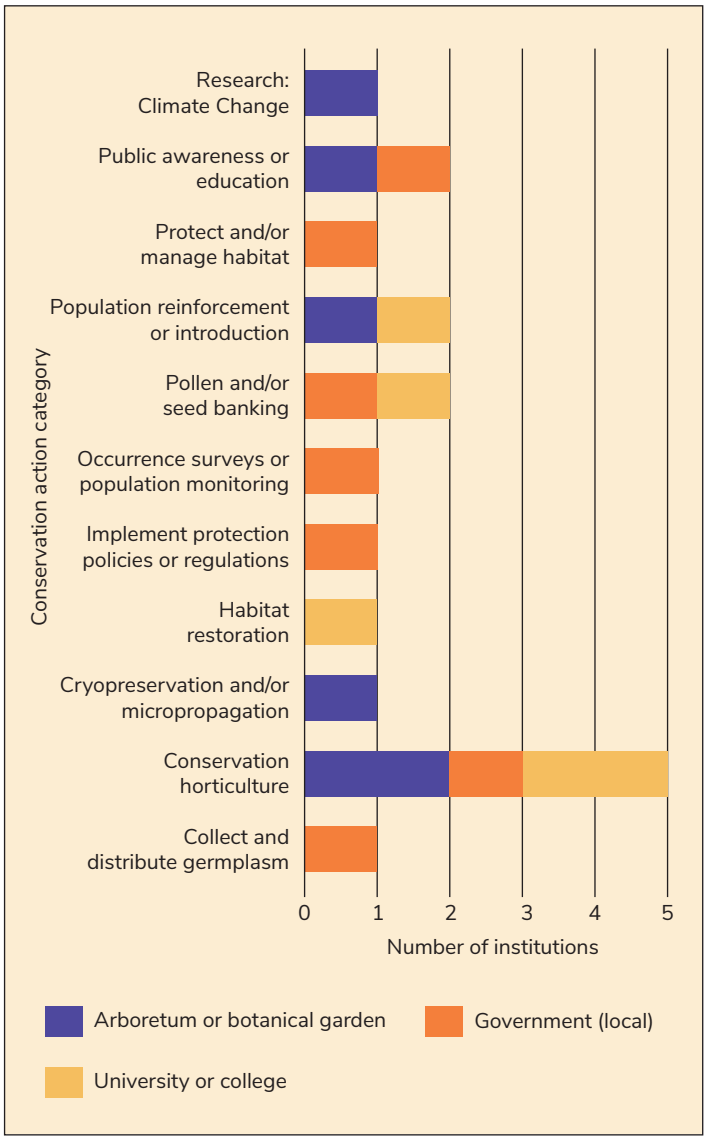

Figure 5. Number of institutions reporting conservation activities for *Magnolia cylindrica* grouped by organization type. Seven of 56 institutions reported activities focused on *M. cylindrica* (see Appendix F for a list of all responding institutions).

Conservation Actions Needed

Further conservation horticulture as well as collection and distribution of germplasm, cryopreservation/micro-propagation and habitat restoration are recommended for *M. cylindrica*. Research on genetics and pests/pathogens, public awareness, population reinforcement or introduction, pollen and/or seed banking, occurrence surveys or population monitoring and implementation of protection policies or regulations are all recommended.

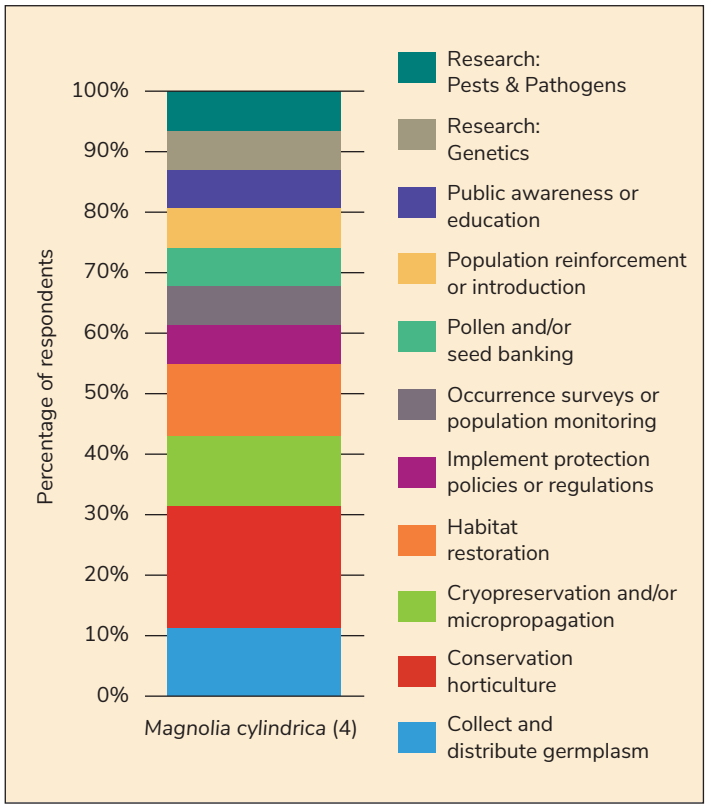

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. cylindrica* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia dawsoniana Rehder & E.H.Wilson

Section: *Yulania* **Synonyms:** *Yulania dawsoniana* (Rehder & E.H.Wilson) D.L.Fu
Common names: None **IUCN Red List Category and Criteria:** Endangered B2ab(iii)

Suggested citation: Linsky, J. (2022). *Magnolia dawsoniana* Rehder & E.H.Wilson. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia dawsoniana is endemic to China where it occurs in Sichuan and Hunan. This species is assessed as Endangered due to its fragmentation in small subpopulations across at least two provinces in China.

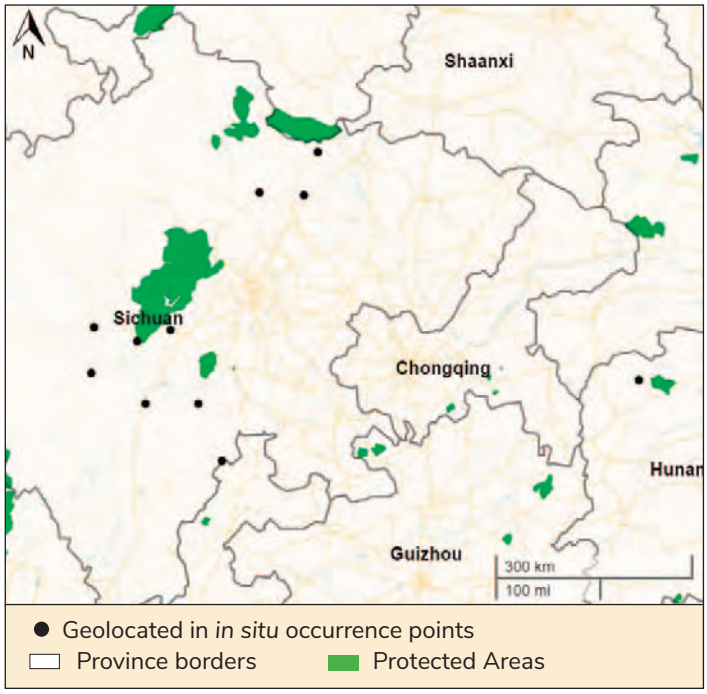

Figure 1. Georeferenced *in situ* occurrence points for *Magnolia dawsoniana* (GBIF 2021; IUCN 2015). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Threats to Wild populations

Intensive logging, illegal logging in protected areas and potential fires are reported as threats to this species. Respondents to the conservation action questionnaire report agriculture, silviculture, and/or ranching; climate change, disturbance regime modification and inbreeding as significant threats.

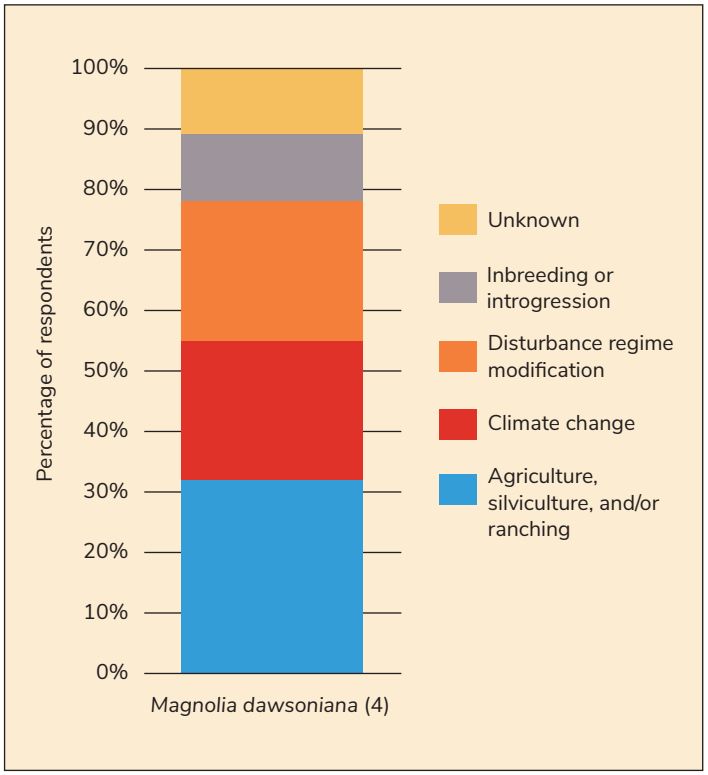

Figure 2. . Responses from the *Magnolia* conservation action questionnaire for *M. dawsoniana* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia dawsoniana*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	40
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
					Average vulnerability score		25

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of *ex situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of *ex situ* survey

Number of *ex situ* collections reporting this species:	51
Number of plants in *ex situ* collections:	117
Average number of plants per institution:	2
Percent of *ex situ* plants of wild origin:	2%
Percent of wild origin plants with known locality:	50%

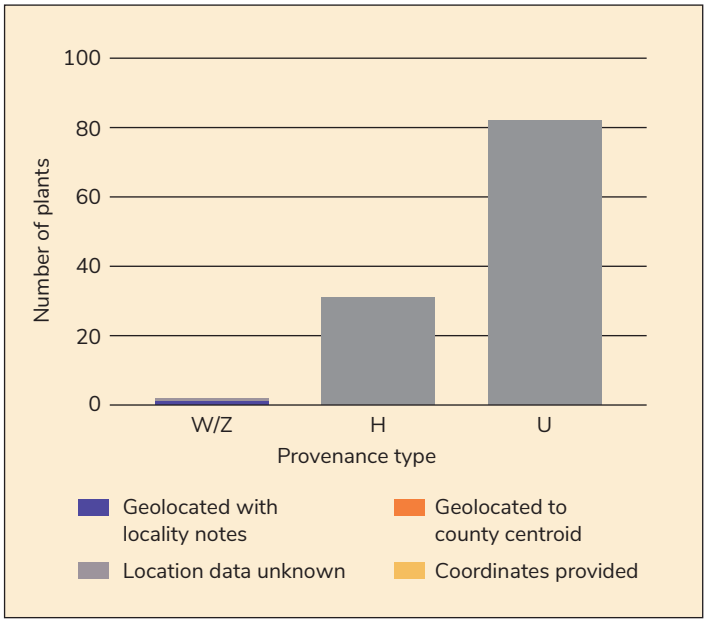

Figure 3. Number and origin of *Magnolia dawsoniana* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

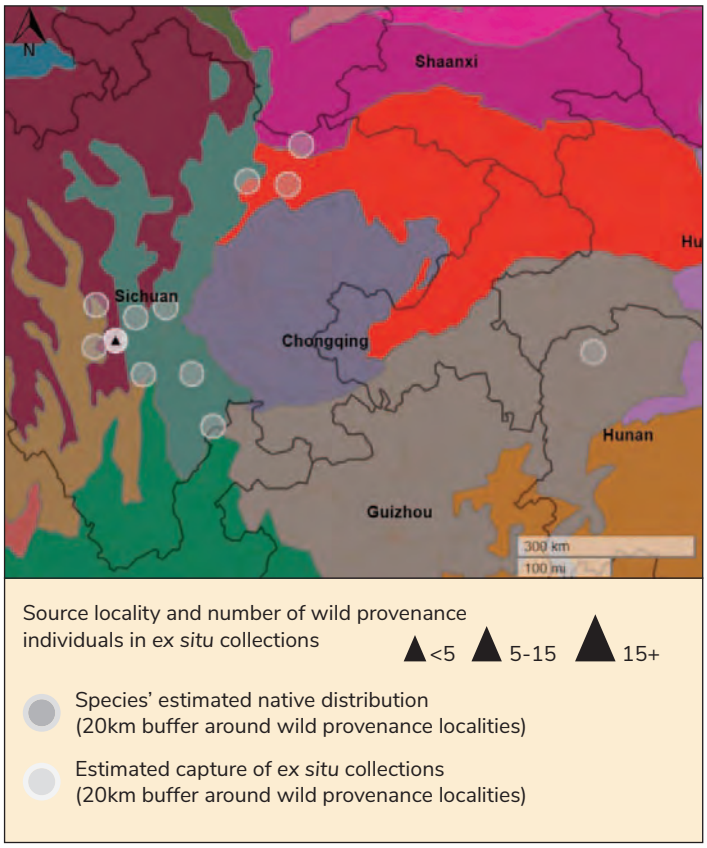

Figure 4. *Magnolia dawsoniana in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Qin Ling Mountains deciduous forests, Daba Mountains evergreen forests, Qionglai-Minshan conifer forests, Southeast Tibet shrublands and meadows, Hengduan Mountains subalpine conifer forests, Guizhou Plateau broadleaf and mixed forests ecoregions.

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in *ex situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The *ex situ* buffer area represents the native range "captured" in *ex situ* collections, or "combined area *ex situ*" (CAE20, CAE50, CAE100). Geographic coverage of *ex situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

Estimated *ex situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	1,257 / 15,038 **(8%)**	7,854 / 75,604 **(10%)**	31,414 / 197,245 **(16%)**	**12%**
Ecological coverage	2 / 7 **(29%)**	3 / 8 **(38%)**	4 / 8 **(50%)**	**39%**

Research: climate change
One institution reports research on climate change for *M. dawsoniana*.

Public awareness/education
Shenzhen Fairy Lake Botanical Garden and one other institution report this activity for *M. dawsoniana*.

Protect and/or manage habitat
This species is found in the following protected areas: Meigu – Dafengding National Nature Reserve , Wolong, Mt. Siguniang and Jiajin Mountains. Shenzhen Fairy Lake Botanical Garden reports this activity for *M. dawsoniana*.

Population reinforcement/introduction
One institution reports this activity for *M. dawsoniana*.

Pollen and/or seed banking
Shenzhen Fairy Lake Botanical Garden and University of British Columbia Botanical Garden report pollen and/or seed banking of *M. dawsoniana*.

Occurrence surveys/population monitoring
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. dawsoniana*.

Implement protection policies or regulations
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. dawsoniana*.

Habitat restoration
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. dawsoniana*.

Cryopreservation/micropropagation
The Huntington reports cryopreservation of *M. dawsoniana*.

Conservation horticulture
The Filoli Center, Shenzhen Fairy Lake Botanical Garden, The Huntington and University of British Columbia Botanical Garden report conservation horticulture activities for *M. dawsoniana*.

Collect and distribute germplasm
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. dawsoniana*. *Ex situ* collections are reported from the Southeast Tibet shrublands and meadows ecoregion (Figure 4).

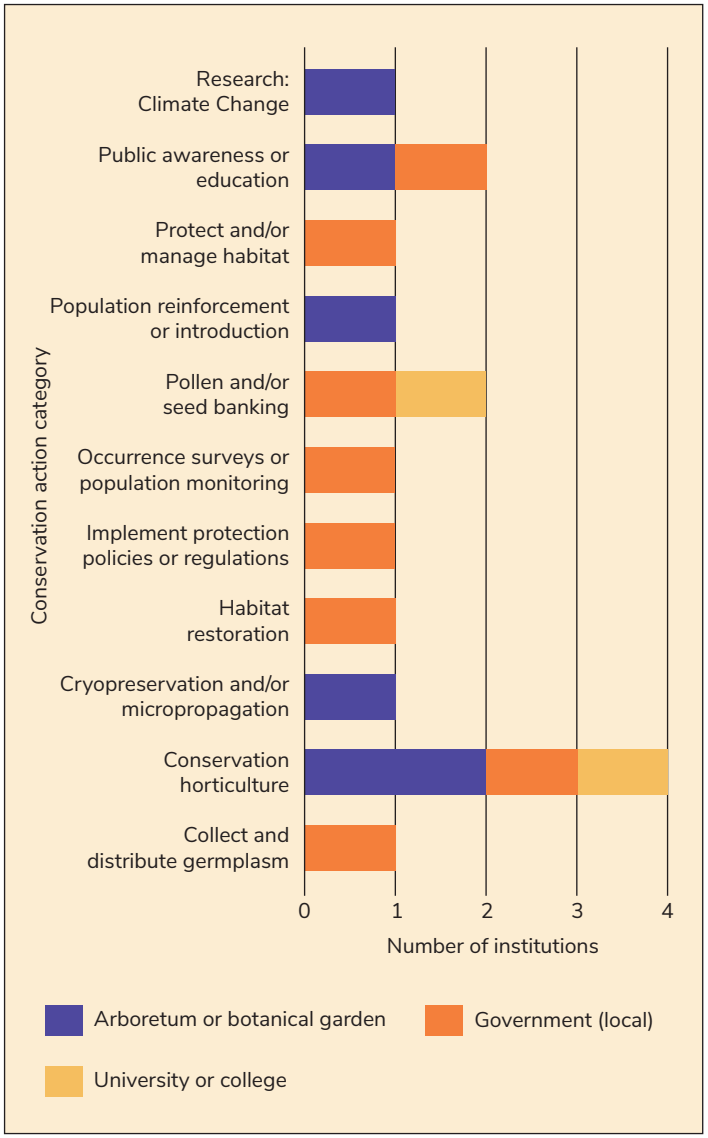

Figure 5. Number of institutions reporting conservation activities for *Magnolia dawsoniana* grouped by organization type. Five of 56 institutions reported activities focused on *M. dawsoniana* (see Appendix F for a list of all responding institutions).


Philippe de Spoelberch

Conservation Actions Needed

Collection and distribution of germplasm, conservation horticulture and cryopreservation and/or micropropagation are suggested most for this species. Additional recommendations include research (on pests and pathogens and genetics), public awareness or education, pollen and/or seed banking, occurrence surveys or population monitoring, implementation of protection policies or regulations and habitat restoration are also recommended.

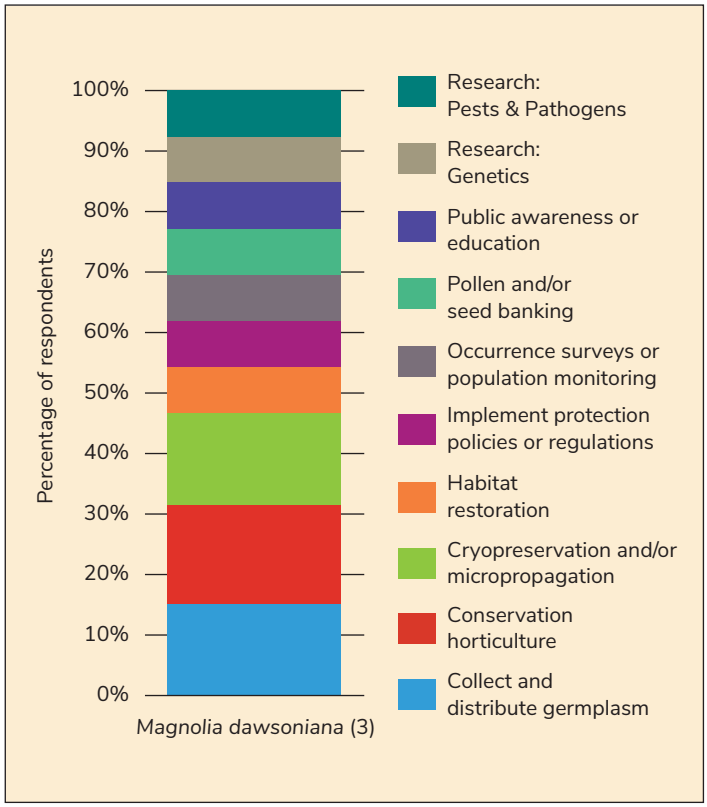

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. dawsoniana* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Arboretum Wespelaar

Magnolia dodecapetala (Lam.) Govaerts

Section: Talauma **Synonyms:** *Annona dodecapetala* Lam., *Magnolia fatiscens* Rich. ex DC., *Magnolia plumieri* Sw., *Magnolia linguifolia* L. ex Descourt., *Talauma caerulea* J.St.-Hil., *Talauma dodecapetala* (Lam.) Urb., *Talauma plumieri* (Sw.) DC., *Talauma plumieri* (Sw.) DC. var. *longifolia* DC. **Common names:** Still in use in 2016 (pers. comm. Emily Veltjen): Wild almond (Saint Vincent), Bwapen mawon (Saint Lucia). Reported in Stehlé & Marie (1947): pin, bois pin, pomme pin, and specifically in Guadeloupe and Martinique: cachiman montagne and bois cachiman. **IUCN Red List Category and Criteria:** Vulnerable B1ab(iii)

Co-authors: Emily Veltjen, Ghent University Botanical Garden; Marie-Stéphanie Samain, Instituto de Ecología, A.C.

Suggested citation: Linsky, J., Veltjen E. & Samain, M.S. (2022). *Magnolia dodecapetala* (Lam.) Govaerts. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia dodecapetala is endemic to the Lesser Antilles, where it occurs on the islands St. Vincent, St. Lucia, Martinique, Dominica and the Basse-Terre part of Guadeloupe. Previous reports of its presence in Trinidad and Tobago were based on two herbarium specimens with the locality "Trinidad": F.W. Sieber 293 (MO) and Parmentier s.n. (P), yet, the presence of *M. dodecapetala* on the island Trinidad has not been confirmed by other sources and is currently considered erroneous (Veltjen 2020). *M. dodecapetala* trees are found in dense, hygrophytic forests (Stehlé & Marie, 1947). A 2016 expedition of 21 field days reported 251 individuals on the five islands between 100-1000 m asl (Veltjen 2020). Its dense and opulent dark green foliage classifies it as a shade tolerant tree (Stehlé & Marie 1947). Its seedlings are very delicate, a fact which explains why this species is rarely found in pure stands or in communities (Stehlé & Marie, 1947). Flowering and seed production is apparent throughout the year, but the most active months in Guadeloupe, Dominica, and Martinique are April-May, and July-August for flowering, June to September for fruiting, and May-June and September-October for seeds (Stehlé & Marie 1947). In all five islands recent recruitment appears ongoing as there were individuals found with a diameter at breast height (dbh) between 0-4.9 cm in the 2016 expedition, however, on all islands but Saint Vincent, the majority of the found trees had a dbh of more than 30 cm (Veltjen 2020).

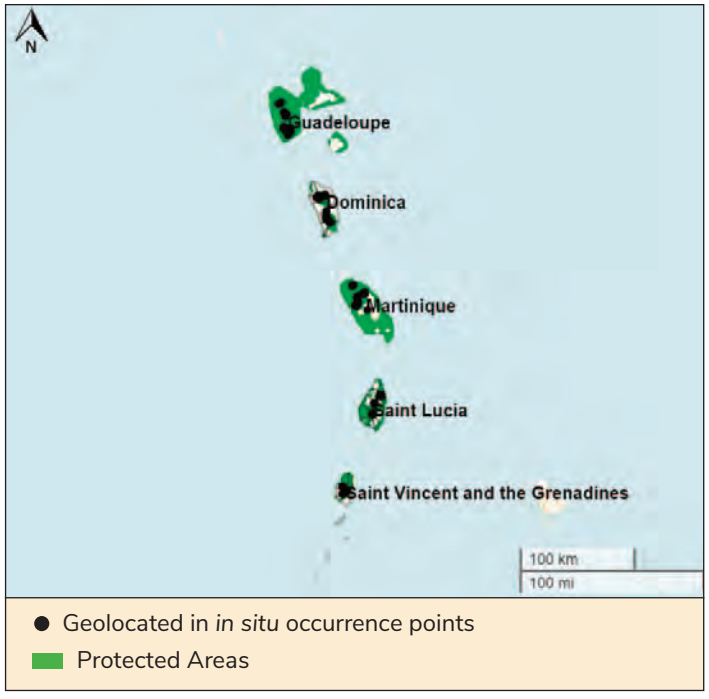

Figure 1. Documented *in situ* occurrence points for *Magnolia dodecapetala* (GBIF 2021; IUCN 2014; E. Veltjen obs.). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia dodecapetala*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	10
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation		Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	20
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	20
					Average vulnerability score		15

Threats to Wild populations

Deforestation for agriculture is on-going in St. Vincent. Urban, commercial and industrial development, and tourism are generally impacting forests in the region. Increasing frequency and severity of hurricanes and other tropical storms also threaten the forests on these islands. A genetic study showed that four out of the five islands had genetic signatures of inbreeding, yet, the genetic diversity could be labeled as moderately genetically diverse (Veltjen, 2020; Veltjen *et al.* submitted). In two out of five islands (i.e. Saint Vincent and Dominica) genetic substructure was detected. The inbreeding and detected substructure is most likely to be attributed to forest fragmentation and general finite size of the islands and forests within. A respondent to the questionnaire highlighted tourism or recreation, development, climate change and agriculture, silviculture and/or ranching as threats to this species. Stehlé and Marie (1947) report that the wood of *M. dodecapetala* was cherished and available only to the more wealthy people and that it could be used for musket butts, furniture, floors, boats and hulls of fishing canoes.

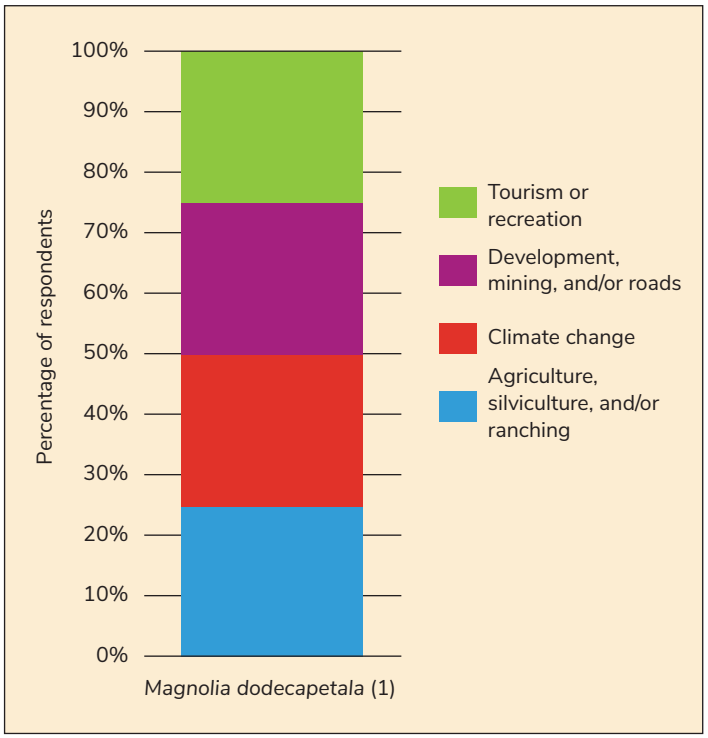

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. dodecapetala* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	1
Number of plants in ex *situ* collections:	3
Average number of plants per institution:	3
Percent of ex *situ* plants of wild origin:	100%
Percent of wild origin plants with known locality:	100%

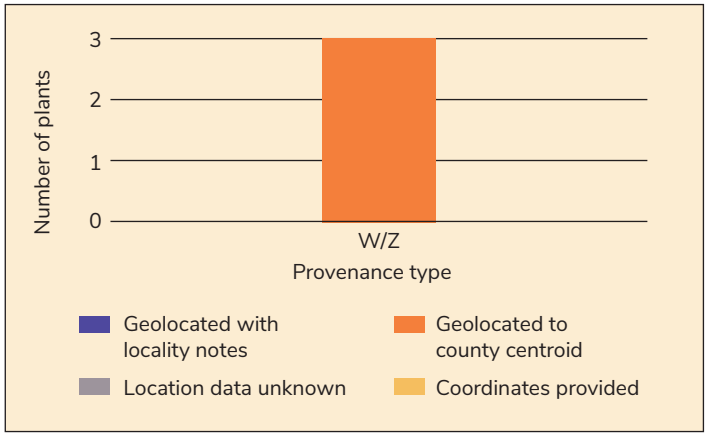

Figure 3. Number and origin of *Magnolia dodecapetala* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections.

Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

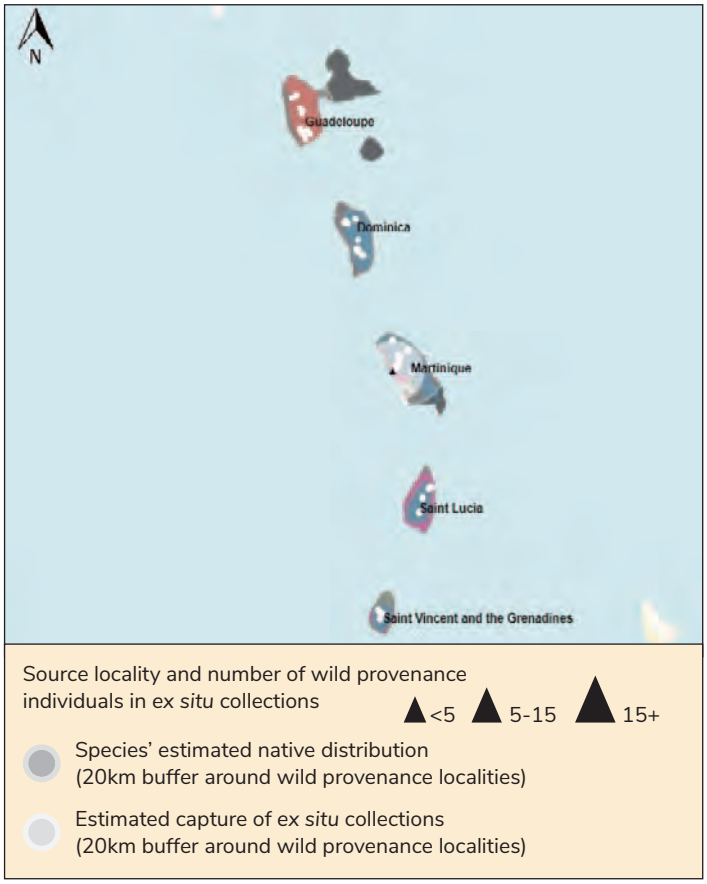

Figure 4. *Magnolia dodecapetala in situ* occurrence points and ex *situ* collection source localities. Terrestrial Ecoregions of the World (Olson 2001) are coloured; the recorded distribution is included in the Leeward Islands moist forests, Windward Islands moist forests, Lesser Antillean dry forests ecoregions.

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	681 / 3,637 **(19%)**	1,148 / 4,547 **(25%)**	1,828 / 4,547 **(40%)**	**28%**
Ecological coverage	4 / 5 **(80%)**	4 / 5 **(80%)**	4 / 5 **(80%)**	**80%**

Research: Genetics & Taxonomy

A phylogenetic study (Veltjen *et al*., 2022) found that the genetic differences between the populations of Martinique and Guadeloupe in all six Sanger sequencing alignments show a similar extent as differences between within-island sister species pairs of Caribbean magnolias. In a follow-up study, including Sanger sequencing data of all five islands (Veltjen 2020; Veltjen et al. submitted) the result was further confirmed and the authors called for a re-evaluation of the species' taxonomy, given the distinct genetic differences found between the different island populations. The Instituto de Ecología, A.C. is currently carrying out further research on taxonomy and genetic relationships of this species, using one representative of each island in a phylogenomic analysis (Veltjen *et al*. 2018). The potential splitting of the species' is also confirmed by preliminary morphological data whereby a very large variation in fruit morphology was recorded; the fruit length and hence the number of carpels significantly differed between the individuals of the different islands: magnolias from St. Vincent and Guadeloupe had the smallest fruits, Saint Lucia had intermediate sized fruits and Martinique and Dominica had the largest fruits (Veltjen 2020).

(Saint Vincent) *Emily Veltjen*

(Saint Lucia) *Emily Veltjen*

A conservation genetic study using microsatellite markers, focussed on magnolias in the Caribbean (Veltjen *et al*. 2019), included populations of *M. dodecapetala* in Martinique and Guadeloupe, each represented by 20 individuals. The *M. dodecapetala* populations were flagged for potential inbreeding or undetected substructure and a follow-up study was urgently required. This follow-up conservation genetic study, focussed solely on *M. dodecapetala* in its full range whereby 195 individuals were genotyped (Veltjen 2020; Veltjen *et al*. submitted), continued to find genetic signs of inbreeding in four out of five islands (i.e. St. Vincent, Martinique, Dominica and Guadeloupe). Although inbreeding was significant, compared with other studied Caribbean magnolias, the *M. dodecapetala* populations scored moderate in their overall allelic diversity (Veltjen 2020). Altogether, the researchers advised that all five populations need conservation monitoring and management, especially given the potential taxonomical splitting ahead, whereby the populations of St. Vincent and Dominica have the highest priority. The population in St. Vincent showed the least amount of individuals, (the) low(est) genetic diversity that was substructered over the different sampling sites, and hence, is in need of immediate action. Veltjen (2020) advises to promote connectivity between forest patches through reinforcement planting. Further explorations and conservation genetic research of the population on Dominica is recommended (Veltjen 2020) as the data showed strong genetic substructure and inbreeding within the island.

M. dodecapetala was found to be diploid based on chromosome counts in root tips (Veltjen 2020).

Conservation horticulture

As with *M. portoricensis*, informal germination experiments have been conducted at Ghent University Botanical Garden with good germination rates. The general workflow of these germination experiments was inspired by Mejía, M. (1990) and "the guide for *Magnolia cubensis* identification and management in the wild" a product of the MAGNOLIA project of Planta!, which both reported high germination rates for Caribbean magnolias. Fruits were collected in the range of all carpels fully opened with seeds exposed hanging from their funiculi to at least one opening carpel, as this was used as an indication that the seeds were mature. If the carpels of the fruits were open at the time of collection, the seeds were removed and cleaned thoroughly by soaking them in water and manually removing all fleshy sarcotesta on the same day of collection. Fruits that had carpels which were not completely opened when collected, were dried using a fan (indoors) and seeds were collected once the fruits opened (e.g. one or two days later). The seeds collected after drying the fruits were cleaned in the same manner. For storage between washing and planting, the seeds were kept in a resealable bag which was kept humid on the inside using a small wet piece of paper towel, placed in the same bag, yet not touching the seeds. The seeds were monitored regularly during transit for humidity (some drops of water were added now and then) and checked for fungi (if caught early: the seeds were washed again and if recurrent, the moldy seeds were isolated from the others) and were stored this way for 1-3 weeks. The seeds were germinated on standard soil to which some perlite was added in a greenhouse at Ghent University Botanical Garden and watered daily. Germination rates were good and the seedlings continued to be watered daily. The seedlings grew to have 4-6 leaves, however mortality was high at this stage and the growth was not good compared to that reported in the *M. cubensis* guide. The reasons for this are still unclear, however, this may be due to too little water, soil, incorrectly sized containers or sun compared to the natural conditions or a lack of associated mycorrhizae within the *ex situ* conditions.

Collection and distribution of germplasm

Ex situ collections are reported from the Windward Islands moist forests/Lesser Antillean dry forests ecoregions (Olson 2001, Figure 4). The only *ex situ* collection reported is from Martinique.

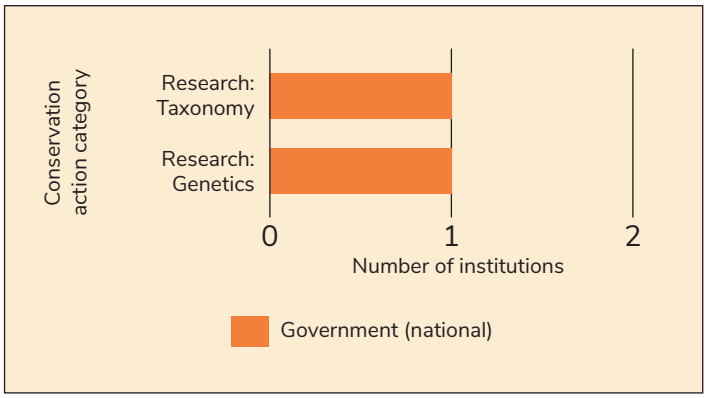

Figure 5. Number of institutions reporting conservation activities for *M. dodecapetala* grouped by organization type. One of 56 institutions reported activities focused on *Magnolia dodecapetala* (see Appendix F for a list of all responding institutions).

Conservation Actions Needed

Monitoring of the population across its range is recommended, to understand trends and reproductive capacity as well as to monitor impacts of inbreeding. No additional information was provided via the questionnaire.


(Saint Lucia) Emily Veltjen

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(Saint Vincent) Emily Veltjen

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Magnolia iltisiana Vazquez

Section: *Magnolia* **Synonyms:** none **Common names:** Ahuatoso, Yoloxochitl
IUCN Red List Category and Criteria: Vulnerable B1ab(iii,v)

Suggested citation: Linsky, J. (2022). *Magnolia iltisiana* Vazquez. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia iltisiana is known from a few localities, mostly from the Sierra de Manantlan, in the state of Jalisco and near Morelia in Michoacán. The populations within the Sierra de Manantlan are relatively well connected, however the populations in Michoacán are quite fragmented (Vazquez-Garcia et *al.* 2021). It is a tree of 20 to 40 m in height. It is found in ravines of sub-deciduous mesophilic forests (Muñiz-Castro et *al.* 2019). A disjunct subpopulation in Guerrero has been reported, and recent collections include specimens from Oaxaca, however these are now thought to be distinct from *M. iltisiana* based on morphology and climatic differences of the habitat. This species is assessed as Vulnerable due to its restricted range and the threat of deforestation and logging.

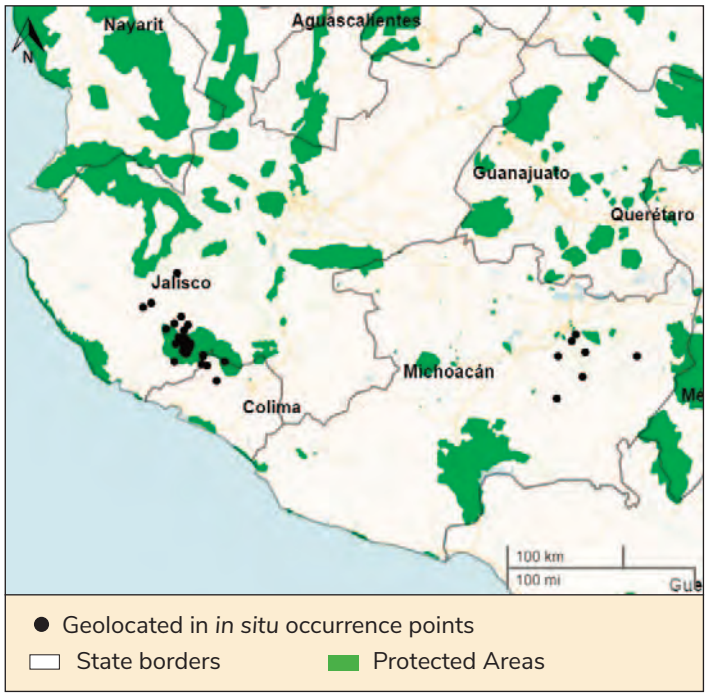

Figure 1. Documented *in situ* occurrence points for *Magnolia iltisiana* (GBIF 2021; Lisa Wheeler 2014). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Threats to Wild populations

Four biological factors (in addition to the anthropogenic ones) seem to limit the populations of this species in its expansion towards equivalent habitats: the excessive predation of seeds by squirrels, the rapid degradation of indehiscent fruits while they ripen on the ground, its apparent intolerance to shade during early phases of development, and the low efficiency in the dispersion of its relatively large seeds. Populations in Michoacan are fragmented, whereas those in the Sierra de Manantlan Biosphere Reserve are not fragmented. Deforestation from logging and livestock threaten the species, including incursions into its protected area habitat.

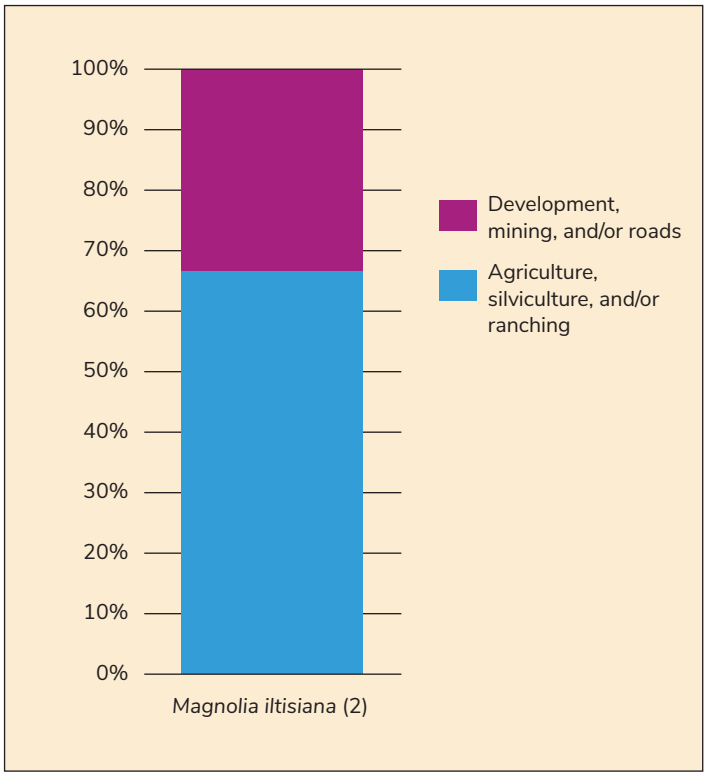

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. iltisiana* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia iltisiana*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	5
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	5
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	10
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
					Average vulnerability score		7

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	2
Number of plants in ex *situ* collections:	3
Average number of plants per institution:	2
Percent of ex *situ* plants of wild origin:	67%
Percent of wild origin plants with known locality:	100%

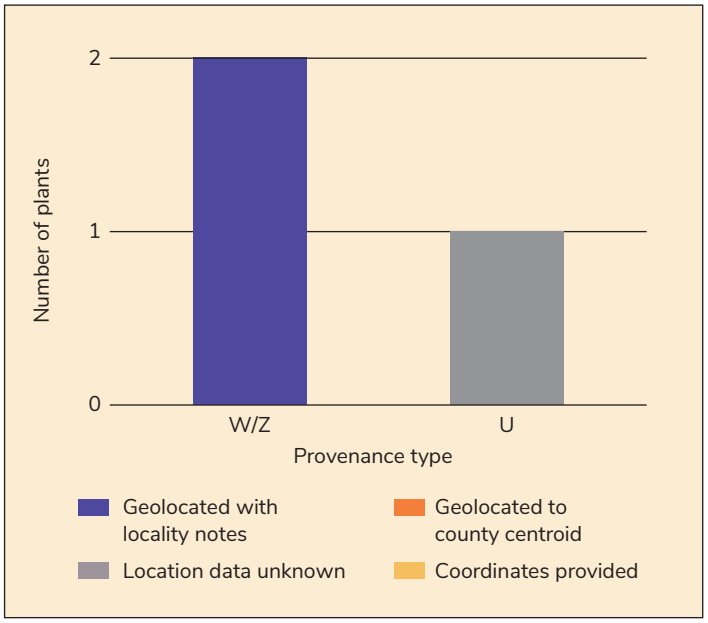

Figure 3. Number and origin of *Magnolia iltisiana* plants in ex situ collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in *ex situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The *ex situ* buffer area represents the native range "captured" in *ex situ* collections, or "combined area *ex situ*" (CAE20, CAE50, CAE100). Geographic coverage of *ex situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

Research: taxonomy
Universidad de Guadalajara reports carrying out research on the taxonomy of *M. iltisiana*.

Research: genetics
Universidad de Guadalajara reports carrying out research on the genetics of *M. iltisiana*.

Protect and/or manage habitat
M. iltisiana is found in the Official Mexican Norm NOM-059 on Environmental Protection for native species of flora and fauna. *M. iltisiana* is located within the Sierra de Manantlán Biosphere Reserve, a federally protected area. Universidad de Guadalajara reports protection and/or management of *M. iltisana*.

Occurrence surveys/population monitoring
Universidad de Guadalajara reports carrying out this activity for *M. iltisiana*.

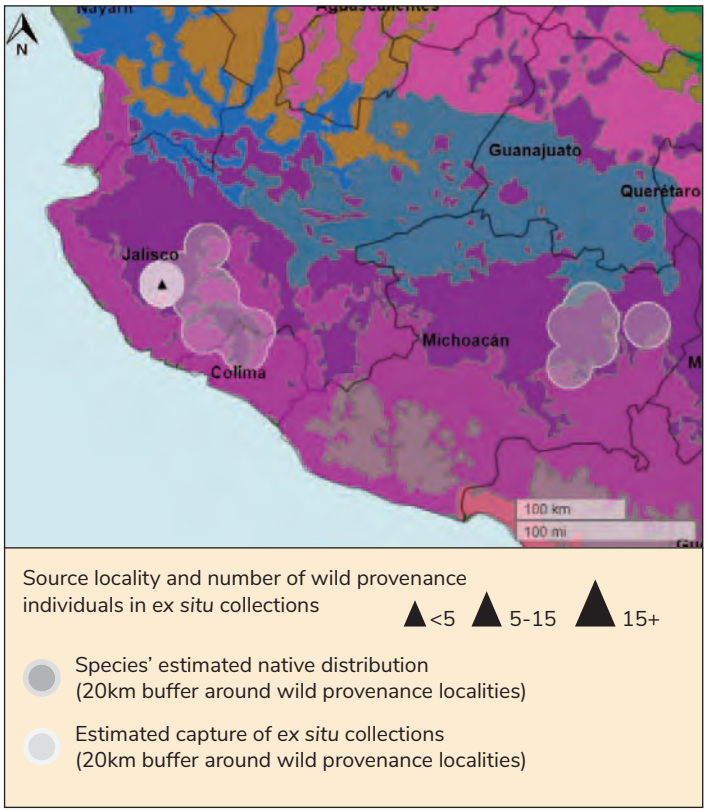

Figure 4. *Magnolia iltisiana in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Trans-Mexican Volcanic Belt pine-oak forests and Jalisco dry forests ecoregions.

Conservation horticulture
In a study by Saldaña-Acosta *et al.* (2001), manual scarification treatment and manual removal of the aril was used to break physical dormancy for successful seed germination. However, further study on seed physiology is required to more clearly understand barriers to germination and successful propagation strategies.

Collection and distribution of germplasm
Ex situ collections are reported from the boundary between the Trans-Mexican Volcanic Belt pine-oak forests and Jalisco dry forests ecoregions (Figure 4).

Estimated *ex situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	1,257 / 9,136 **(14%)**	7,854 / 34,353 **(23%)**	24,740 / 88,711 **(28%)**	**22%**
Ecological coverage	2 / 4 **(50%)**	2 / 4 **(50%)**	5 / 8 **(62%)**	**54%**

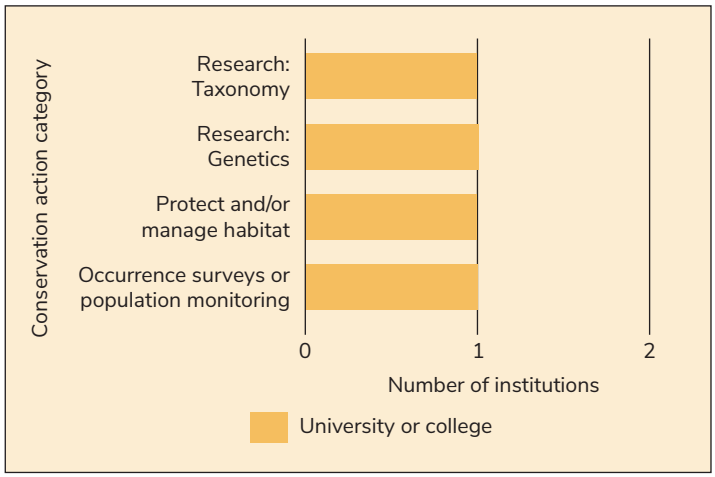

Figure 5. Number of institutions reporting conservation activities for *Magnolia iltisiana* grouped by organization type. One of 56 institutions reported activities focused on *M. iltisiana* (see Appendix F for a list of all responding institutions).

Conservation Actions Needed

Further study of genetics, collection and distribution of germplasm, conservation horticulture, habitat restoration and population reinforcement or introduction are recommended for this species.

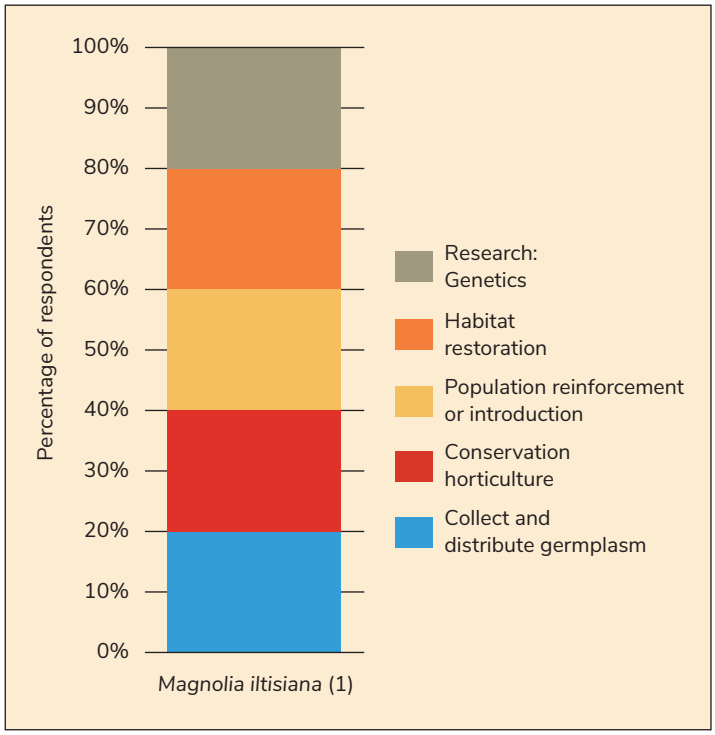

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. iltisiana* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia lacei (W.W.Sm.) Figlar

Section: Michelia **Synonyms:** *Michelia pachycarpa* Y.W.Law & R.Z.Zhou, *Michelia lacei* W.W.Sm., *Michelia magnifica* Hu, *Michelia* tignifera Dandy, *Michelia uniflora* Dandy **Common names:** none
IUCN Red List Category and Criteria: Endangered D

Co-author: Weibang Sun, Kunming Botanical Garden, CAS

Suggested citation: Linsky, J., & Sun, W.B. (2022). *Magnolia amoena* W.C.Cheng. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia lacei is found in southern China in southeast Yunnan and recently in northern Viet Nam. The last field studies in China by the Kunming Botanical Garden's Plant Species with Extremely Small Populations (PSESP) conservation group found that a total of 45 individuals (38 individuals are mature trees) in 10 localities have been recorded in southeast Yunnan's Maguan County (29 mature individuals and 5 young trees), Malipo County (3 mature individuals), Jinping County (3 mature individuals and 2 young trees), Hekou County (2 mature individuals) and Yuanyang County (1 mature individual) (pers. comm. Weibang Sun 2021). The species may be present in Myanmar and Laos and further surveys are needed to determine its full range. The sparse population in Viet Nam also requires further research. The species is assessed as Endangered based on the small population size however more information is needed on the population trends and threats to this species.


Dr. Lei Cai

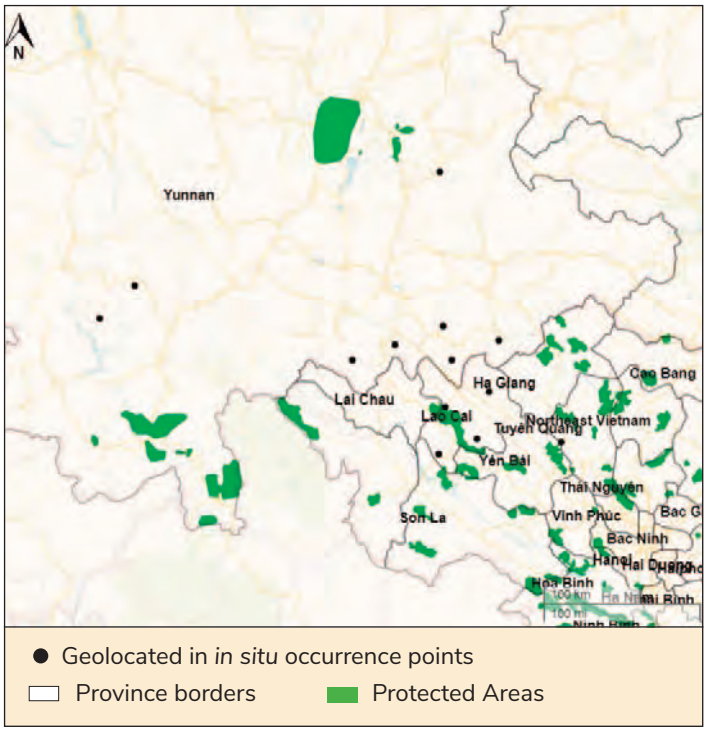

Figure 1. Documented *in situ* range for *Magnolia lacei*. Most distribution points were geolocated based on a range and do not represent exact locations (GBIF 2021, IUCN 2015). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia lacei*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	20
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	-
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	-
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
						Average vulnerability score	20

Threats to Wild populations

Among 10 localities of the species geographical distribution in China, only one locality with two individuals is within a nature reserve. All of the other nine localities with 43 individuals outside the nature reserves are facing threats from the plantation of banana (*Musa nana*), *Amomum tsaoko* and other economic plants, and also the illegal collection of fruits and seeds sometimes occurs. There are no *in situ* conservation plots or sites established to protect the individuals and the habitats of the species currently.

Tourism or recreation as well as agriculture, silviculture and/or ranching are reported to threaten this species.

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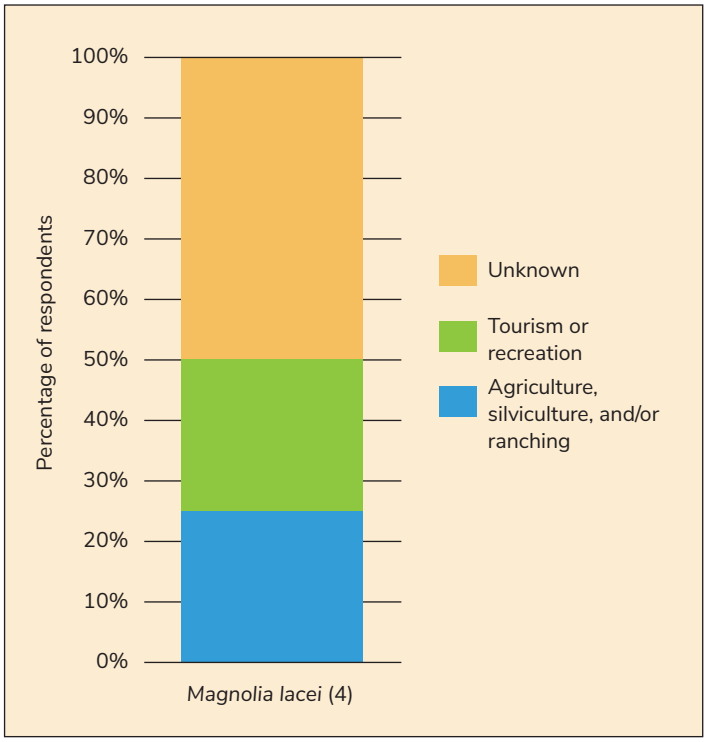

Figure 2. . Responses from the *Magnolia* conservation action questionnaire for *M. lacei* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	6
Number of plants in ex *situ* collections:	25
Average number of plants per institution:	4
Percent of ex *situ* plants of wild origin:	92%
Percent of wild origin plants with known locality:	100%

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

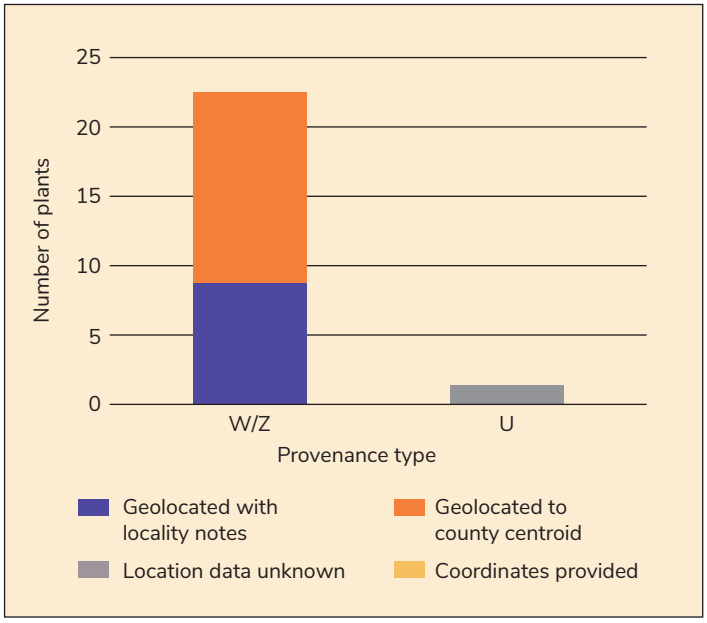

Figure 3. Number and origin of *Magnolia lacei* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	6,283 / 21,119 **(30%)**	35,222 / 83,470 **(42%)**	107,340 / 197,412 **(54%)**	**42%**
Ecological coverage	2 / 3 **(67%)**	2 / 4 **(50%)**	3 / 4 **(75%)**	**64%**

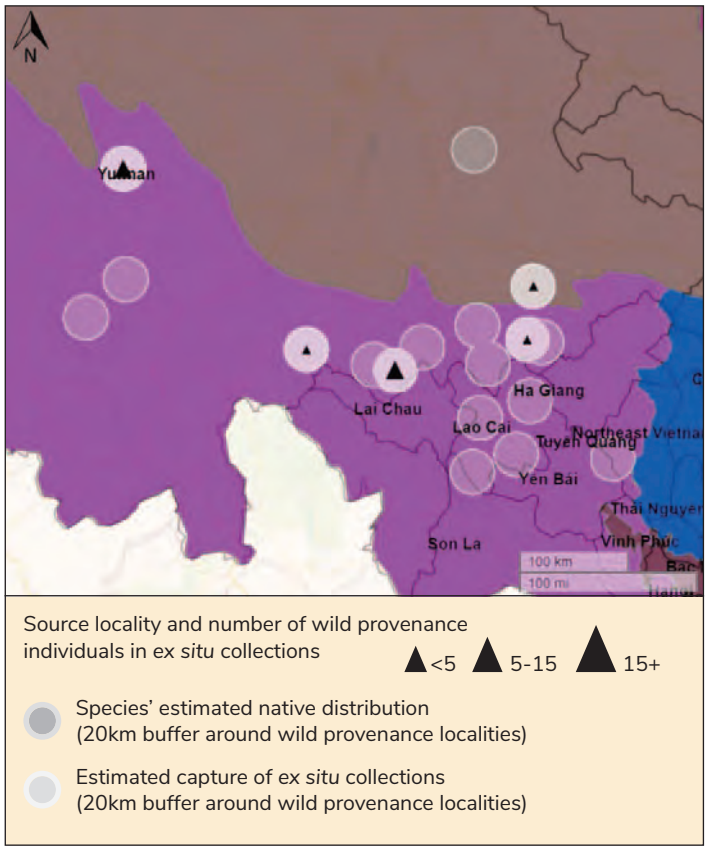

Figure 4. *Magnolia lacei in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Yunnan Plateau subtropical evergreen forests and Northern Indochina subtropical forests ecoregions.

Pollen and/or seed banking

The Vietnam National University of Forestry reports pollen and/or seed banking of *M. lacei*.

Occurrence surveys/population monitoring

The Vietnam National University of Forestry reports this activity for *M. lacei*.

Implement protection policies or regulations

M. lacei is listed as a PSESP (Plant species with extremely small populations) by the Yunnan Government as requiring urgent conservation. In the updated Yunnan List of PSESP conservation (2021 version will be released by the government authority soon at time of writing), *M. lacei* is one of the 101 PSESP species for conservation priority during the next 5 years.

Conservation horticulture

One institution reports carrying out conservation horticulture activities for *M. lacei*.

Collect and distribute germplasm

Kunming Botanical Garden, South China Botanical Garden, Wuhan Botanic Garden, Guilin Botanical Garden and Fairy Lake Botanical Garden (Xian Hu) are the 5 main institutions for *M. lacei ex situ* conservation in China (Sun WB et *al*., 2019; Cai et *al*. 2017). Kunming Botanical Garden collected seeds from the Jingping County population in southeast Yunnan in 1987, and 11 seedlings were propagated and the saplings were cultivated in two sites of the garden. Twenty years after planting, in 2017, 2 of the 11 trees started to flower and produce fruits. Currently, seedlings propagated from seeds of KBG's *M. lacei* trees have been well cultivated in the nursery (pers. comm. Weibang Sun, 2021). Most *ex situ* collections are reported from the Northern Indochina subtropical forests ecoregion (Figure 4).

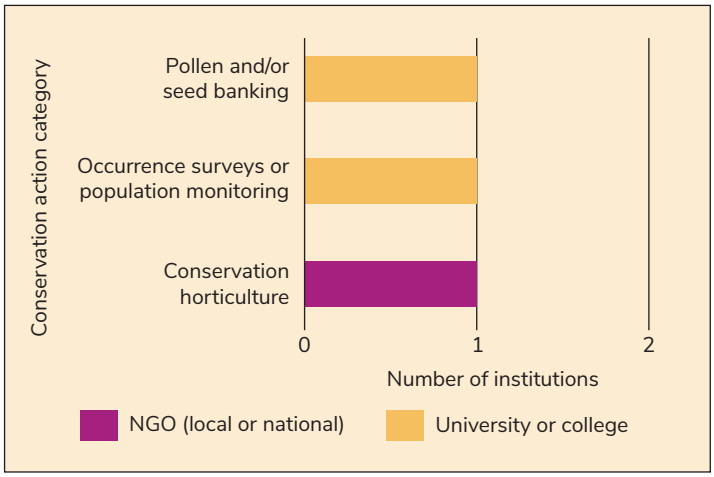

Figure 5. Number of institutions reporting conservation activities for *Magnolia lacei* grouped by organization type. Two of 56 institutions reported activities focused on *M. lacei* (see Appendix F for a list of all responding institutions).

Conservation Actions Needed

Further surveys are required in southwestern China, Myanmar and northern Viet Nam, and also in other areas of its potential range, such as Laos to clarify the species status (Cai et *al*. 2017). Respondents to the questionnaire also recommend collection and distribution of germplasm as well as conservation horticulture for this species.

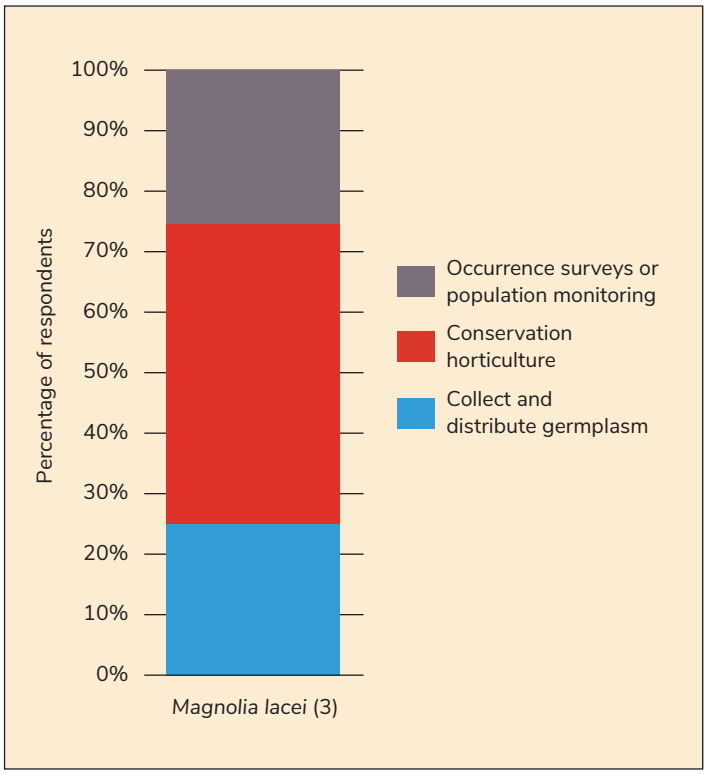

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. lacei* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia lucida (B.L.Chen & S.C.Yang) V.S.Kumar

Section: *Manglietia* **Synonyms:** *Manglietia lucida* B.L.Chen & S.C.Yang **Common names:** None
IUCN Red List Category and Criteria: Endangered B1ab(iii)

Suggested citation: Linsky, J. (2022). *Magnolia lucida* (B.L.Chen & S.C.Yang) V.S.Kumar. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia lucida is found in Yunnan Province in China. This species is recorded from Viet Nam, occurring in a secondary forest in the Hoang Lien National Park, Sapa, Lao Cai Province (Xia & Vu 2010). It has high ornamental value with large green leaves and showy elegant flowers. This species is currently assessed as Endangered due to its restricted distribution, however more information is needed on the population size, trends and threats to this species.

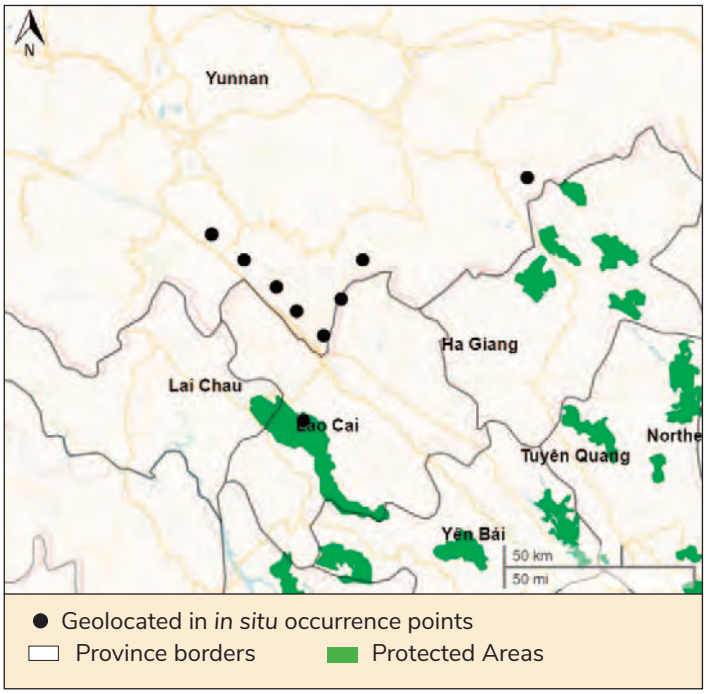

Figure 1. Documented *in situ* occurrence points for *Magnolia lucida* (Wheeler et al. 2014). Protected areas are from Protected Planet (UNEP-WCMC 2021).

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Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia lucida*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	20
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	-
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low		Medium	High	Very high	Unknown	-
						Average vulnerability score	20

Threats to Wild populations

Agriculture, silviculture and/or ranching, climate change and development, mining and/or roads are all reported as significant threats to *M. lucida*.

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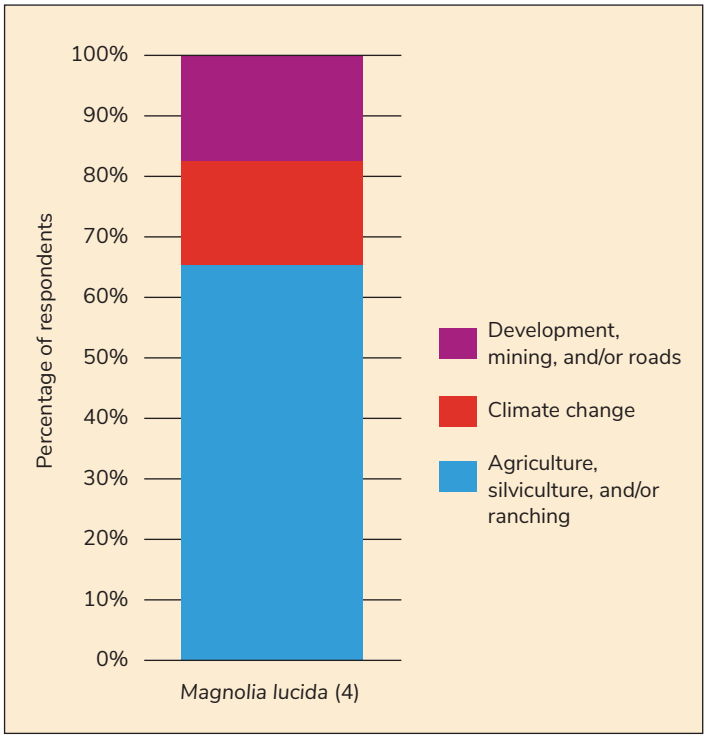

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. lucida* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	7
Number of plants in ex *situ* collections:	46
Average number of plants per institution:	7
Percent of ex *situ* plants of wild origin:	26%
Percent of wild origin plants with known locality:	100%

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

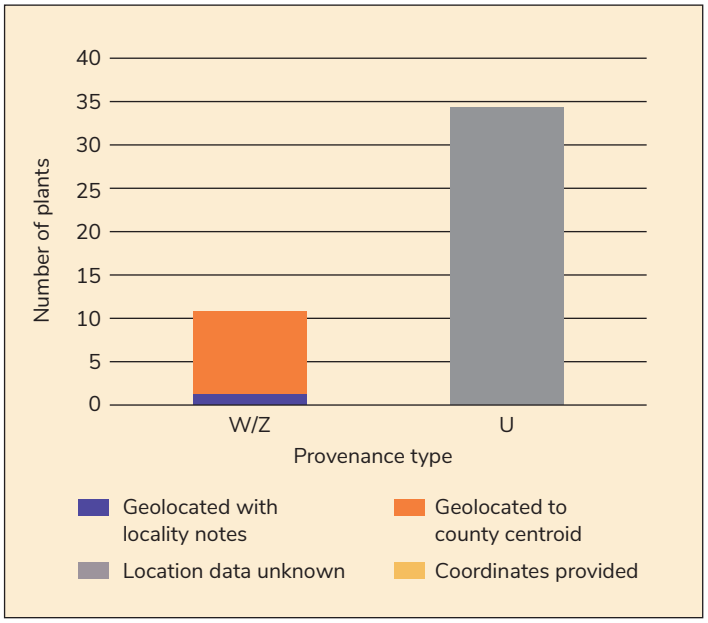

Figure 3. . Number and origin of *Magnolia lucida* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.


Keming Yang, South China Botanical Garden

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	3,770 / 9,383 **(40%)**	21,233 / 35,639 **(60%)**	74,428 / 97,590 **(76%)**	**59%**
Ecological coverage	2 / 2 **(100%)**	2 / 2 **(100%)**	3 / 3 **(100%)**	**100%**

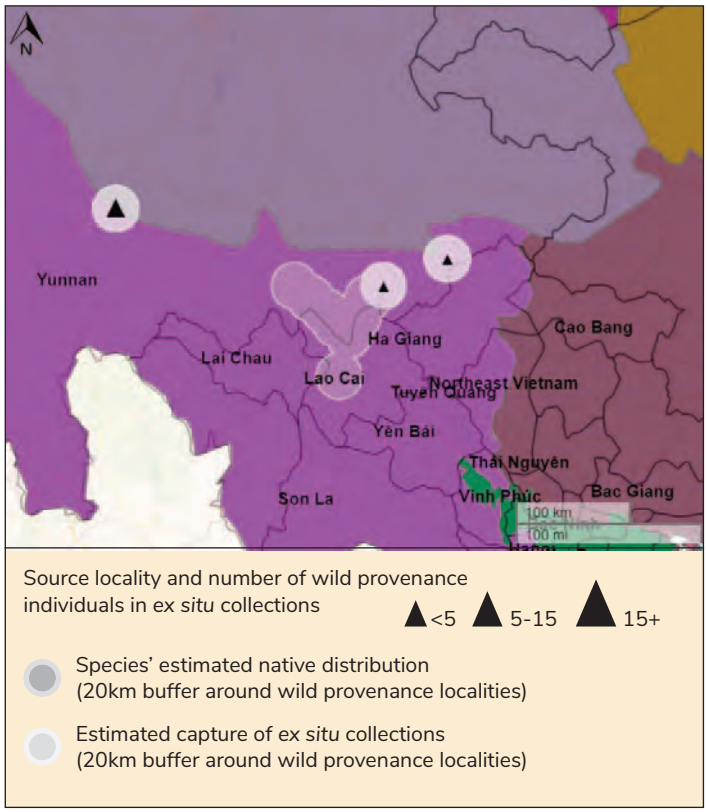

Figure 4. *Magnolia lucida in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Northern Indochina subtropical forests ecoregion and possibly in the Yunnan Plateau subtropical evergreen forests ecoregion.

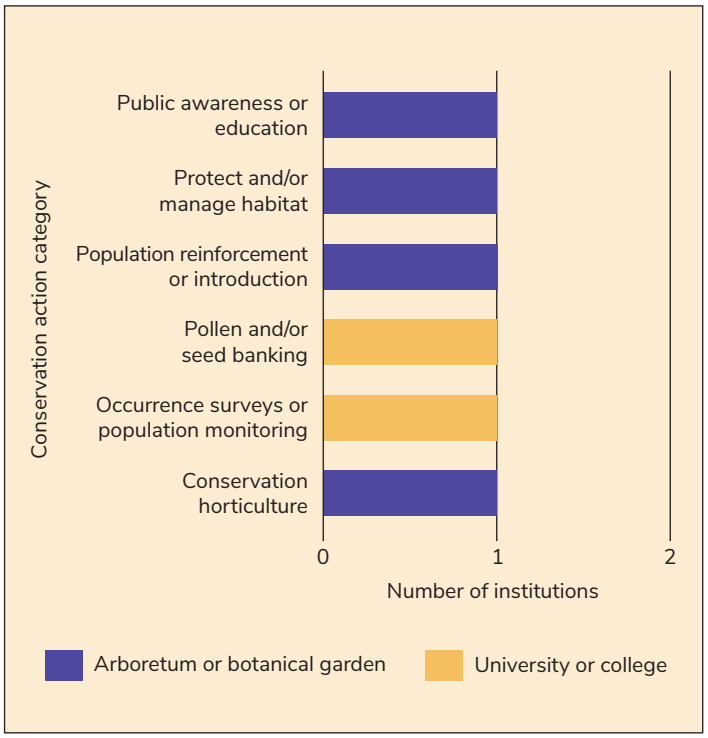

Figure 5. Number of institutions reporting conservation activities for *Magnolia lucida* grouped by organization type. Two of 56 institutions reported activities focused on *M. lucida* (see Appendix F for a list of all responding institutions).

Public awareness/education
Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences reports public awareness/education activities for *M. lucida*.

Protect and/or manage habitat
The species is known from Hoang Lien National Park in Viet Nam so may be afforded some protection there (Xia and Vu, 2010). Xishuangbanna Tropical Botanical Garden, CAS also reports protection and/or management of the habitat of *M. lucida* in China.

Population reinforcement or introduction
M. lucida has been studied for its use as a landscape plant. (Chen et *al*. 2010). Xishuangbanna Tropical Botanical Garden, CAS reports population reinforcement or introduction activities for this species.

Pollen and/or seed banking
Vietnam National University of Forestry reports carrying out pollen and/or seed banking of *M. lucida*.

Occurrence surveys/population monitoring
Xishuangbanna Tropical Botanical Garden, CAS reports occurrence surveys or population monitoring of *M. lucida*.

Cryopreservation and/or micropropagation
A micropropagation protocol has been developed using tissue culture (Kang et *al*. 2020).

Conservation horticulture
Xishuangbanna Tropical Botanical Garden, CAS reports conservation horticulture for *M. lucida*.

Collection and distribution of germplasm
Ex situ collections are reported from the Northern Indochina subtropical forests ecoregion (Figure 4).

Conservation Actions Needed

The accession level data provided for this study is geolocated to county and locality level only. Further study of georeferenced collections within the range in China and Viet Nam will contribute to the conservation of this species. Further exploration of the habitat in both countries will also provide information on the population size, extent and threats. Respondents to the questionnaire recommend further pollen and/or seed banking, cryopreservation/micropropagation, conservation horticulture and collection and distribution of germplasm.

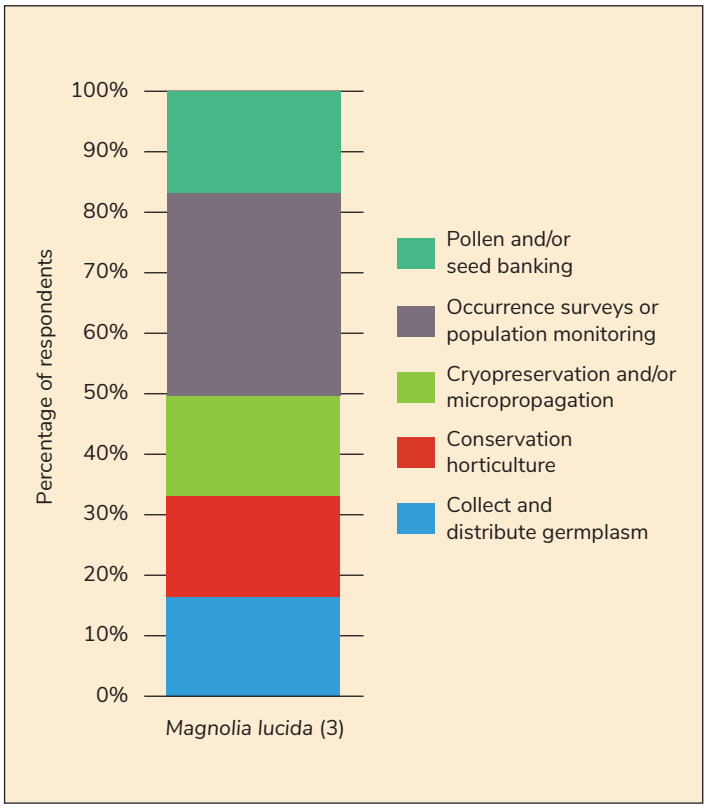

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. lucida* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Keming Yang, South China Botanical Garden

Magnolia mexicana DC.

Section: *Talauma* **Synonyms:** *Talauma mexicana* (DC.) G.Don **Common names:** aguacote, flor de atole, flor de corazón, flor del corazón, kuwixánat, hualhua, laurel tulipán, magnolia, palo de flor, súchil, yolosúchil, yolosóchitl, yoloxóchitl. **IUCN Red List Category and Criteria:** Vulnerable B1ab(iii,v)

Co-authors: Marisol Gutiérrez-Lozano & Arturo Sánchez-González, Universidad Autónoma del Estado de Hidalgo, Fabián Augusto Aldaba Núñez, Instituto de Ecología, A.C.

Suggested citation: Linsky, J., Gutiérrez-Lozano, M., Sánchez-González, A., & Aldaba Núñez, F.A. (2022). *Magnolia mexicana* DC. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Before the year 2000, *Magnolia mexicana* was considered the only species of the genus *Talauma* in northern Mesoamerica: Mexico, Guatemala and Honduras (Don 1831, Standley 1920, Standley & Steyermark 1946; Lozano-Contreras 1994; Vázquez-García 1994), but in later studies (Vázquez-García et al. 2012a, 2012b, 2013a, 2013b; Domínguez-Yescas and Vázquez-García 2019), 16 allopatric species were segregated from the *M. mexicana* complex, 12 that are distributed in Mexico and four in Central America, which are part of the genus *Magnolia*, section *Talauma* (Wang et *al*. 2020). However, complementary studies are still required at the molecular level to confirm the taxonomic identity of the segregated species of the *M. mexicana* complex (Arteaga and Ríos, 2020; Chávez-Cortázar et *al*. 2021). Based on the above information, it is probable that many of the distribution records based on herbarium specimens in different regions of Mexico refer to different species of the *M. mexicana* complex. The studies by Vázquez-García et *al*. (2012a, 2012b, 2013a, 2013b) and Domínguez-Yescas and Vázquez-García (2019), suggest that the distribution area of *M. mexicana* is narrower than previously believed and that it is probably restricted to eastern Mexico, in the states of Puebla and Veracruz.

According to previous information, the populations of *M. mexicana* are distributed in the transition between the cloud forest and the evergreen tropical forest (Palacios 2006), in a warm and sub-warm humid climate, in an altitudinal interval between 450 and 1,500 m (Sánchez-Cuahua et *al*. 2016). However, in a recent study, Gutiérrez Lozano et *al*. (2021), mention that some relict populations of this species, from the municipalities of Xicotepec de Juárez, Tuzamapan de Galena, Hueytamalco, Quimixtlán (in Puebla), Cosautlán de Carvajal and Zongolica (in Veracruz), grow as shade trees in coffee plantations and maize crops near houses, in sites that border with patches of secondary vegetation of highly fragmented tropical forest. The altitudinal range in which they are distributed, considering only the populations of the six aforementioned municipalities, is 614 - 1236 m asl. From this study, the population density is low, the number of adult trees in the largest populations is less than 40. It is important to mention that the populations of *M. mexicana* in the six municipalities of the states of Puebla and Veracruz are isolated from each other by distance and, considering the small number of individuals, it is unlikely that there is gene flow between them, and regeneration is scarce, considering that the trees develop in the middle of fields of cultivation and coffee plantations, where cleaning of the land is constantly carried out. Studies by Aldaba Núñez et *al*. (2021) suggest a wider altitudinal distribution of 320-1575 m asl and populations have been found with around 250 adult trees.

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The flowering period is between March and June, but occasionally flowers can be found months later in some isolated individuals; the fruiting phase begins in the months of July-November and the largest number of fruits appear in September-November, culminating in March or April of the following year.

The flowers and bark are used to treat heart conditions (Waizel-Bucay, 2002; Sánchez-Cuahua et *al*. 2016), the infusion prepared with the bark is used against arterial hypertension; the flowers are used to flavor chocolate and to prepare atole, a traditional hot drink. It is also used as an ornamental tree in backyards, parks and gardens, such as in the municipalities of Magdalena and Xalapa, Veracruz, where there are trees in some squares and public parks. In the town of Zapotla (Zongolica, Veracruz), the ripe fruits are sold at very low prices in neighboring towns, the seeds are used to treat partial paralysis.

Threats to Wild populations

Agriculture, silviculture and/or ranching; climate change; disturbance regime modification, inbreeding, pests/pathogens and wild harvesting are all reported as significant threats to *M. mexicana*.

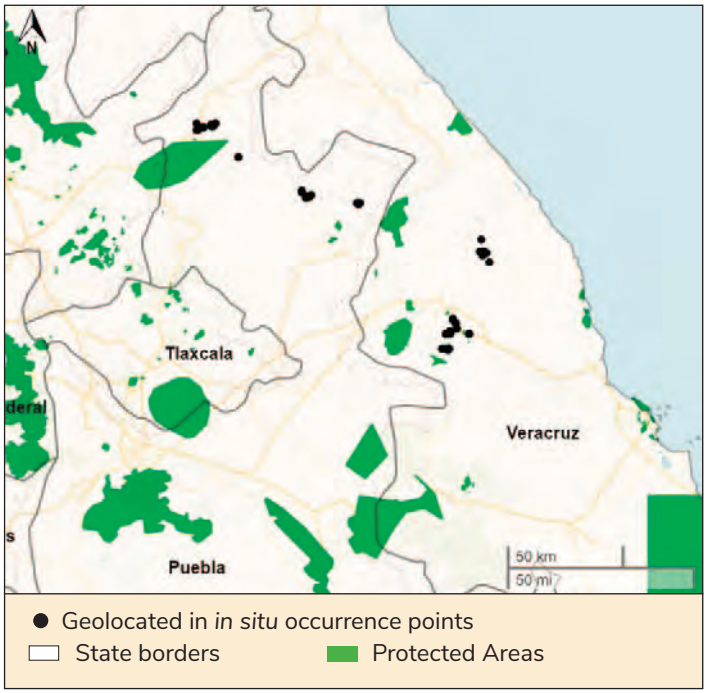

Figure 1. Documented *in situ* occurrence points for *Magnolia mexicana* (pers. comm. Aldaba Núñez 2022). Protected areas are from Protected Planet (UNEP-WCMC 2021).

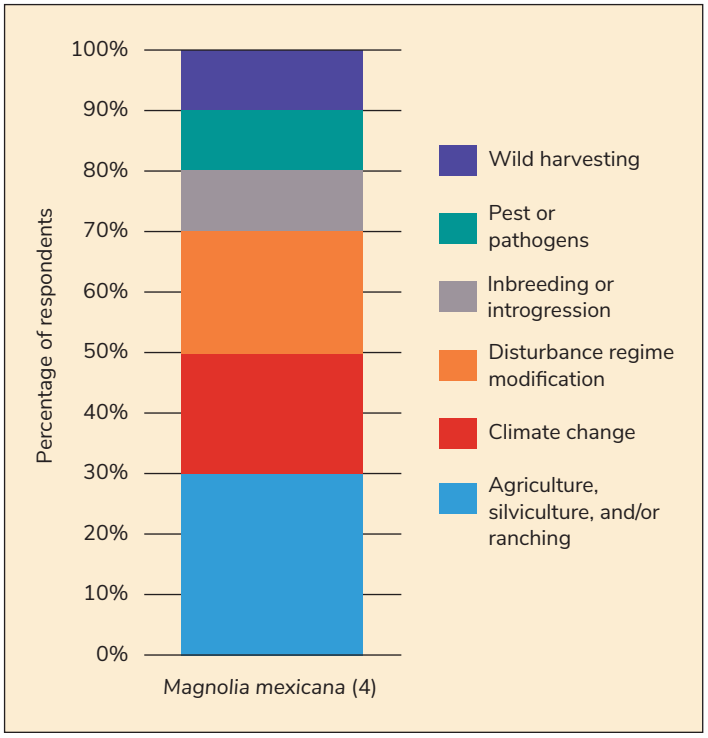

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. mexicana* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia mexicana*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	5
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	10
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	20
					Average vulnerability score		12

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	3
Number of plants in ex *situ* collections:	3
Average number of plants per institution:	1
Percent of ex *situ* plants of wild origin:	67%
Percent of wild origin plants with known locality:	100%

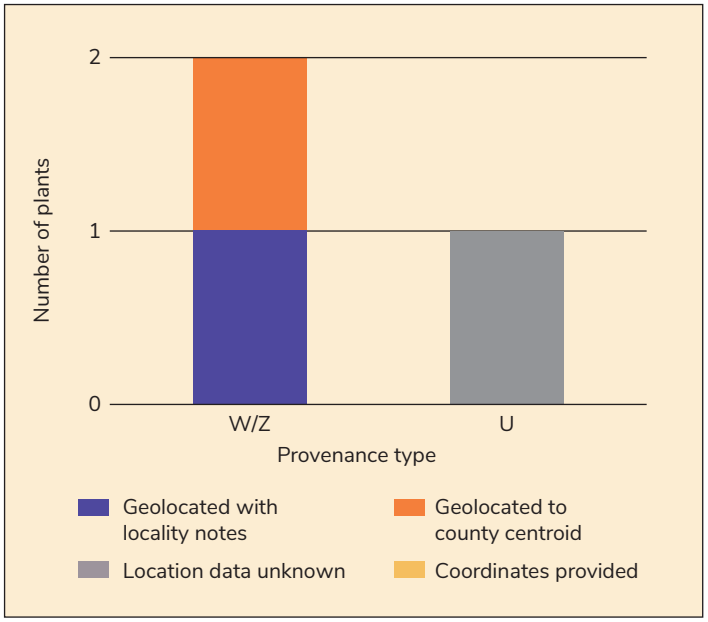

Figure 3. Number and origin of *Magnolia mexicana* plants reported in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in *ex situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The *ex situ* buffer area represents the native range "captured" in *ex situ* collections, or "combined area *ex situ*" (CAE20, CAE50, CAE100). Geographic coverage of *ex situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

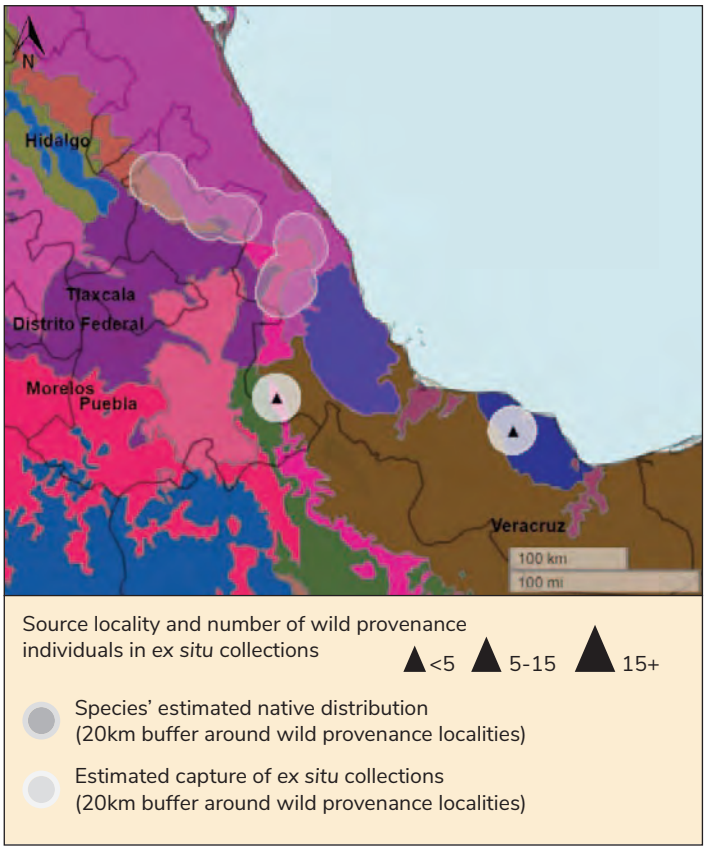

Figure 4. *Magnolia mexicana in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the World (Olson 2001) are coloured; the recorded distribution is included in the Veracruz moist forests, Veracruz montane forests, Sierra Madre Oriental pine-oak forests.

Estimated *ex situ* representation

Verification of the identification of the reported *ex situ* collections is required to confirm geographic and ecological coverage of the collections.

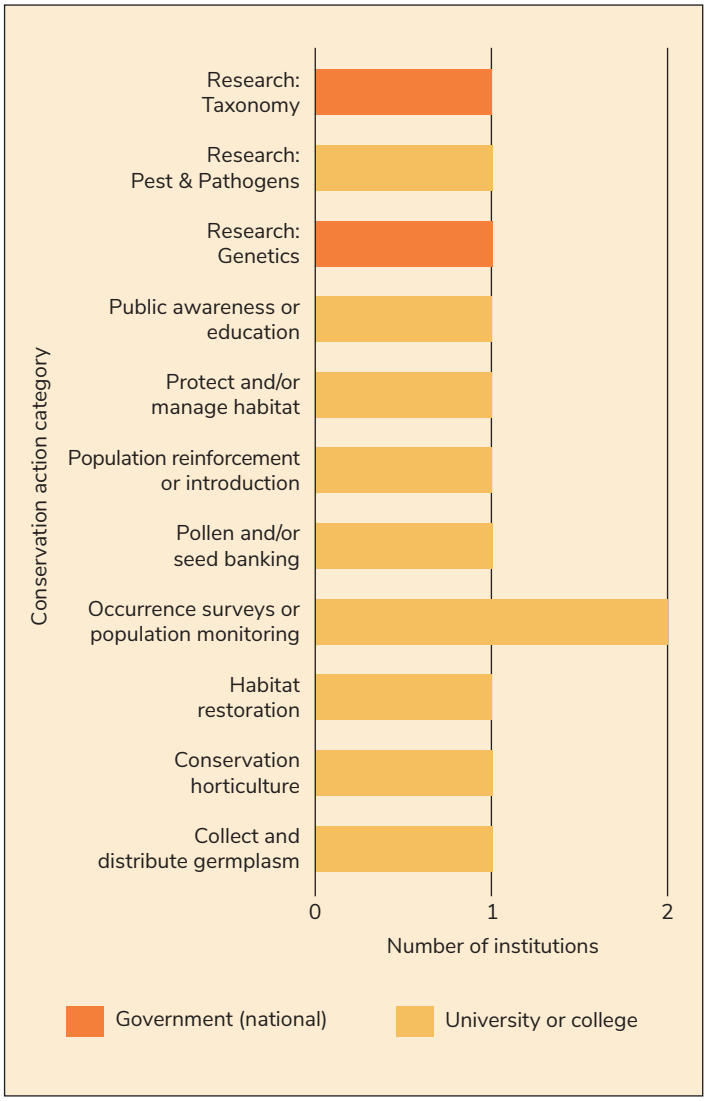

Figure 5. Number of institutions reporting conservation activities for *Magnolia mexicana* grouped by organization type. Three of 56 institutions reported activities focused on *M. mexicana* (see Appendix F for a list of all responding institutions).


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Research
Instituto de Ecología, A.C. reports research on conservation, population genetics and taxonomy and another institution reports research on pests and pathogens. Studies show low genetic diversity for cultivated populations and inbreeding was identified in some wild localities (Aldaba Núñez et *al*. 2021). Taking into account a wider distribution, the Instituto Tecnológico Superior de Zongolica (ITSZ) in Veracruz provides valuable information about seed dispersers, traditional knowledge and populations dynamics of the populations from the Sierra de Zongolica, but these could correspond to another species: *M. decastroi*.

Public awareness/education
One institution reports this activity for *M. mexicana*.

Protect and/or manage habitat
One institution reports this activity for *M. mexicana*.

Population reinforcement or introduction
One institution reports this activity for *M. mexicana*. Francisco Javier Clavijero Botanic Garden has been propagating M. mexicana for reintroduction. (Díaz-Toribio et *al*. 2021)

Pollen and/or seed banking
One institution reports this activity for *M. mexicana*.

Occurrence surveys or population monitoring
Two institutions report this activity for *M. mexicana*.

Implement protection policies or regulations
This species is found in the Official Mexican Norm NOM-059 on Environmental Protection for native species of flora and fauna (NOM-059-SEMAR- NAT-2010).

Habitat restoration
One institution reports this activity for *M. mexicana*.

Conservation horticulture
One institution reports this activity for *M. mexicana*. The species is under conservation by the Francisco Javier Clavijero Botanic Garden. The garden has been developing a propagation protocol for this species (Díaz-Toribio et *al*. 2021).

Collect and distribute germplasm
One institution reports this activity for *M. mexicana*. *Ex situ* collections are reported from the Sierra Madre Oriental (Xalapa, Veracruz) ecoregion. This species is also found in Jardín Botánico Xoxoctic in Cuetzalan, Puebla and the Parque ANP Francisco Javier Clavijero.

Conservation Action Needed

Repondents recommend habitat restoration, public awareness or education and pollen and/or seed banking for this species. Additional activities recommended include research on pests & pathogens, protection and/or management of habitat, population reinforcement/introduction, occurrence surveys/population monitoring, implementation of protection policies/regulations, conservation horticulture and collection and distribution of germplasm, as well as to redirect the collection of fruits and flowers in some areas where they are heavily collected to be sold in urban areas. The ex situ collections that have been sampled show lower genetic diversity than the wild populations and a wider sampling of trees to increase the genetic diversity within ex *situ* collections is recommended (Aldaba Núñez et *al*. 2021). The verification of currently reported *ex situ* collections in light of the taxonomic identifications within the *M. mexicana* complex are needed. Development of a protected area containing wild populations is needed, especially in the Sierra Madre Oriental, as well as more individuals in well documented *ex situ* collections (Aldaba Núñez 2020).

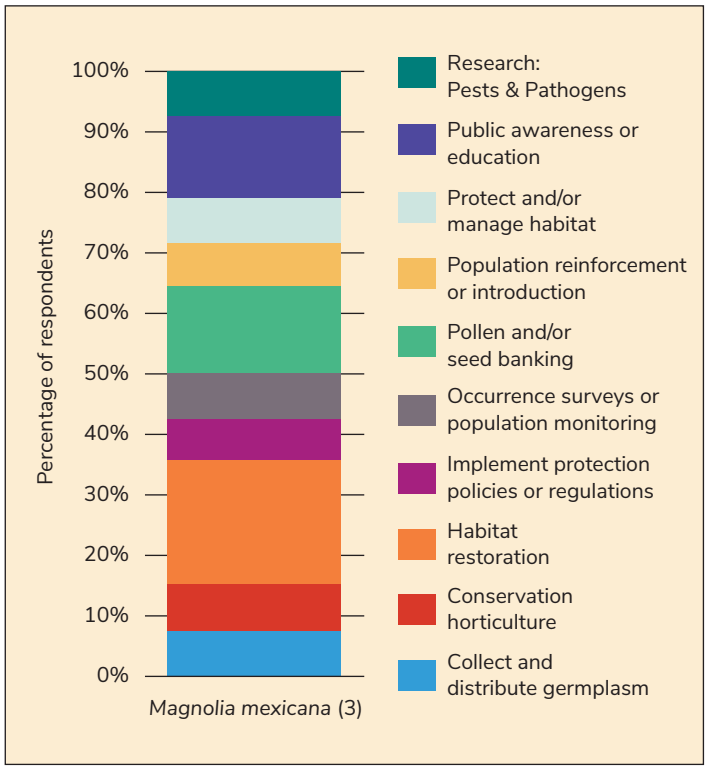

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. mexicana* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia oaxacensis A.Vázquez

Section: Magnolia **Synonyms:** None **Common names:** None **IUCN Red List Category and Criteria:** Endangered B1ab(v)

Suggested citation: Linsky, J. (2022). *Magnolia oaxacensis* A.Vázquez. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

This species is only known from the Sierra Mazateca, Oaxaca, Mexico. It grows in cloud forest, occasionally found on swampy pond margins (Rivers et *al*. 2016).

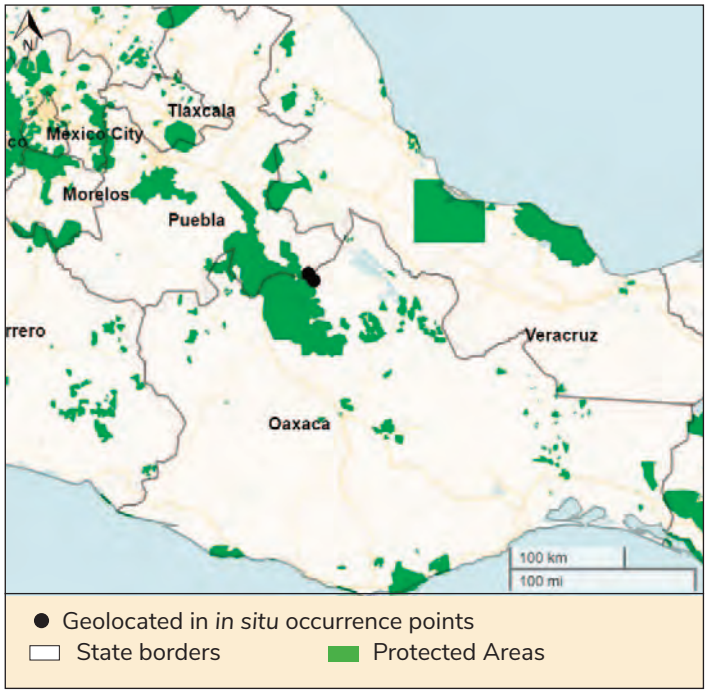

Figure 1. Documented geographic distribution of *Magnolia oaxacensis* (Vázquez-García 2010). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Threats to Wild populations

Magnolia oaxacensis is threatened by agriculture, silviculture and/or ranching, climate change and development, mining and/or roads.

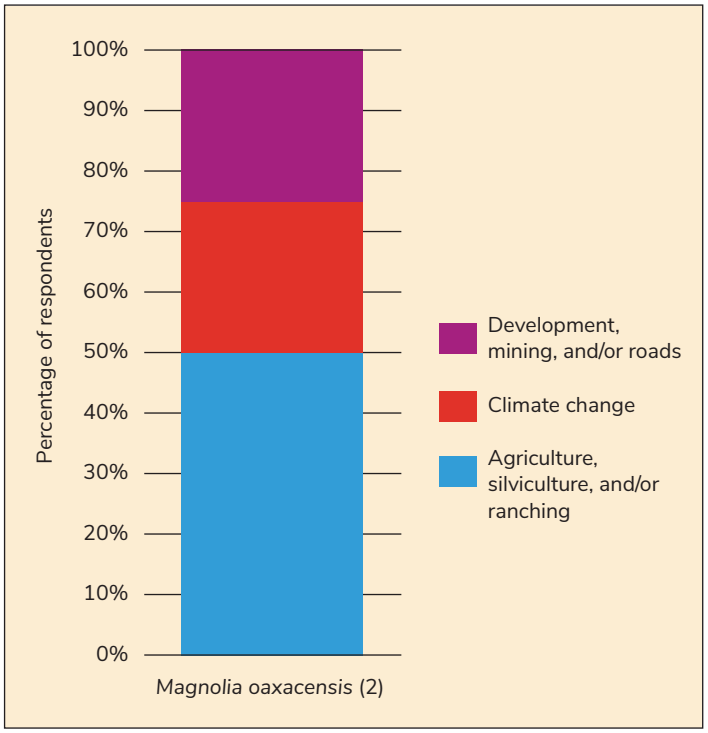

Figure 2. . Responses from the *Magnolia* conservation action questionnaire for *M. oaxacensis* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia oaxacensis*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	-
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	10
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
						Average vulnerability score	10

Miguel Angel Muñiz Castro

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of *ex situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of *ex situ* survey

Number of *ex situ* collections reporting this species:	1
Number of plants in *ex situ* collections:	1
Average number of plants per institution:	1
Percent of *ex situ* plants of wild origin:	100%
Percent of wild origin plants with known locality:	100%

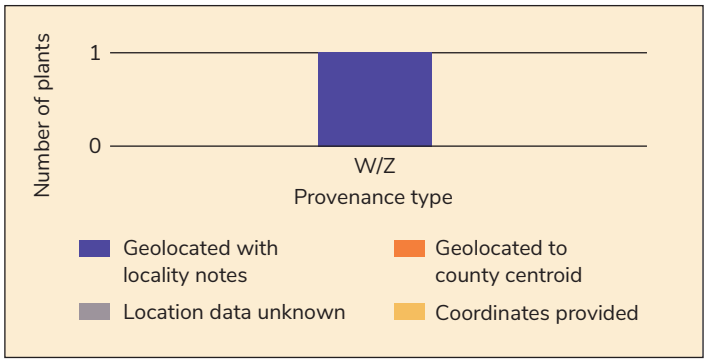

Figure 3. .Number and origin of *Magnolia oaxacensis* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in *ex situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The *ex situ* buffer area represents the native range "captured" in *ex situ* collections, or "combined area *ex situ*" (CAE20, CAE50, CAE100). Geographic coverage of *ex situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

Research

Researchers at Instituto de Ecología, A.C. report carrying out research on taxonomy and genetics of *M. oaxacensis*.

Collect and distribute germplasm

M. oaxacensis is conserved *ex situ* at Vallarta Botanical Gardens (Vázquez-García et *al*. 2021). *Ex situ* collections are reported from the Oaxacan montane forests ecoregion (Figure 4).

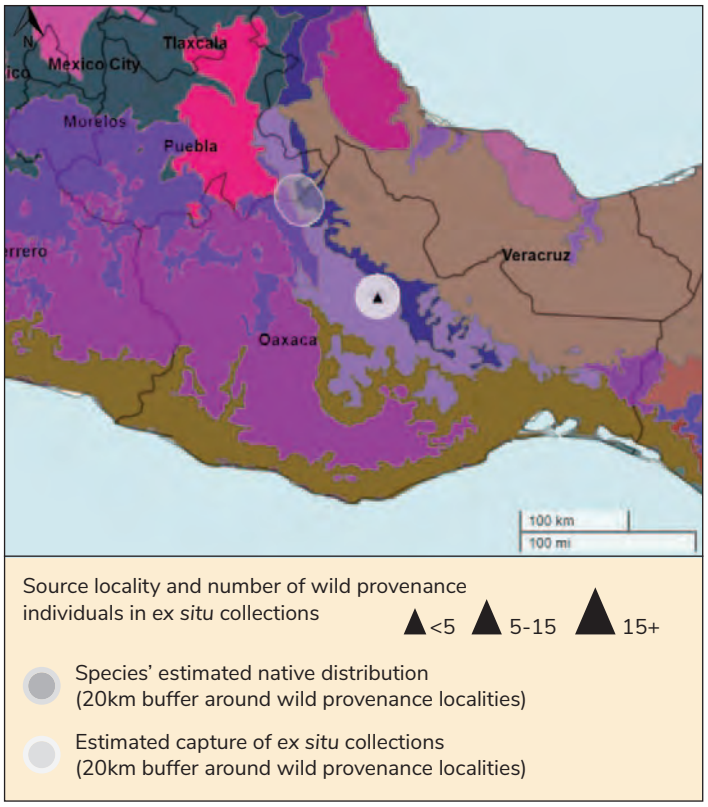

Figure 4. *Magnolia oaxacensis* native distribution and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Oaxacan montane forests and Sierra Madre de Oaxaca ecoregions.

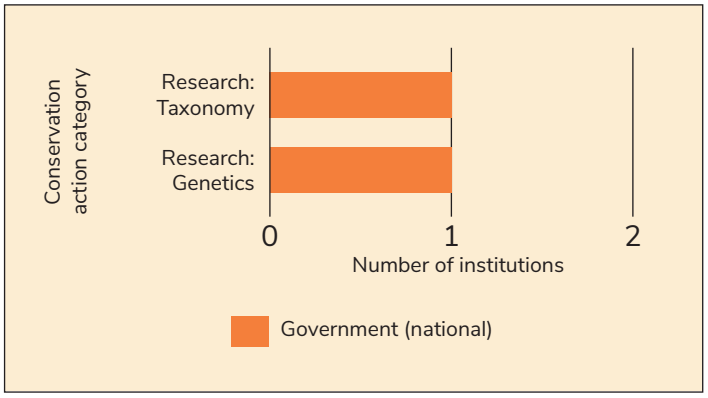

Figure 5. Number of institutions reporting conservation activities for *Magnolia oaxacensis* grouped by organization type. One of 56 institutions reported activities focused on *M. oaxacensis* (see Appendix F for a list of all responding institutions).

Estimated *ex situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	1,257 / 2,831 **(44%)**	7,854 / 16,506 **(48%)**	31,414 / 54,229 **(58%)**	**50%**
Ecological coverage	2 / 5 **(40%)**	5 / 7 **(71%)**	6 / 10 **(60%)**	**57%**

Conservation Actions Needed

Propagation of this species is highly recommended as fruits rarely produce seeds. (Vazquez-Garcia et al. 2010). Verification of the identity of existing ex situ collections and expansion of well documented ex situ collections is recommended. Respondents to the questionnaire recommend major in situ conservation via habitat restoration, implementation of protection policies or regulations, occurrence surveys/ population monitoring, protection and/or management of habitat and public awareness or education.

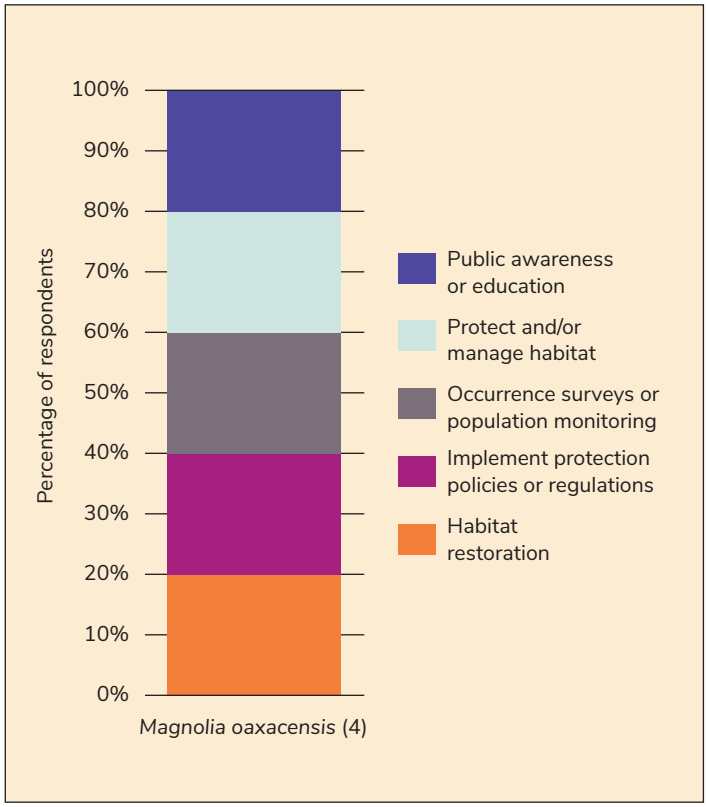

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. oaxacensis* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia odora (Chun) Figlar & Noot.

Section: *Michelia* **Synonyms:** *Michelia odora* (Chun) Noot. & B.L.Chen, *Tsoongiodendron odorum* Chun
Common names: Tsong's Tree, Guanguangmu **IUCN Red List Category and Criteria:** Vulnerable C1

Suggested citation: Linsky, J. (2022). *Magnolia odora* (Chun) Figlar & Noot. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia* . Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia odora is native to Lao PDR, Viet Nam and China (Guangdong, Guangxi, Fujian, Hainan, Yunnan, Jiangzi, Guizhou and Hunan Provinces) at elevations up to 1,000 m asl. It is found in lowland moist forest as well as mountain evergreen broadleaved forests and villages (Guo et *al*. 2005).

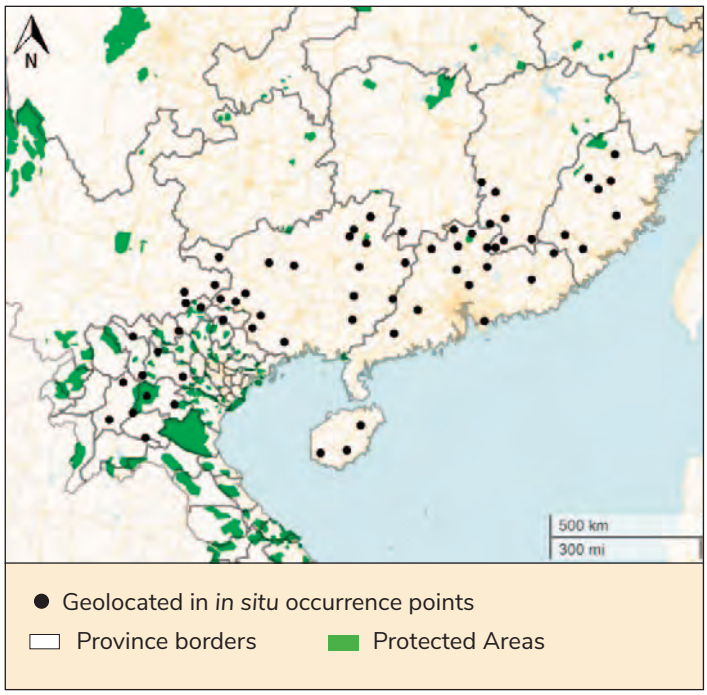


Figure 1. Geolocated *in situ* occurrence points for *Magnolia odora* (GBIF 2021; IUCN 2015). Protected areas are from Protected Planet (UNEP-WCMC 2021).


Keming Yang, South China Botanical Garden


Philippe de Spoelberch

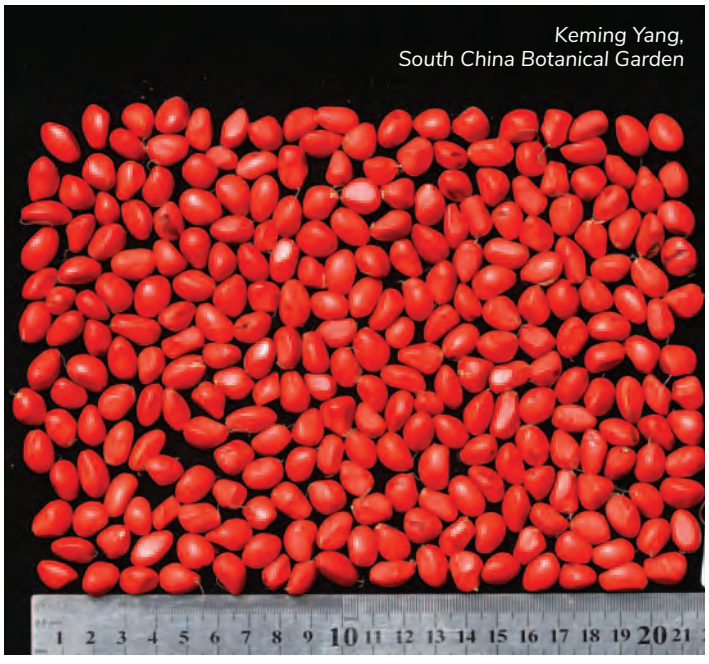
Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia odora*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	5
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	0
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	5
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	-
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	10
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	10
						Average vulnerability score	6

Threats to Wild populations

Extensive logging and habitat loss by land clearance for urban development are major threats to this species (Rivers & Wheeler 2015). Agriculture, silviculture and/or ranching and climate change are also reported as significant threats to *M. odora* from the questionnaire.



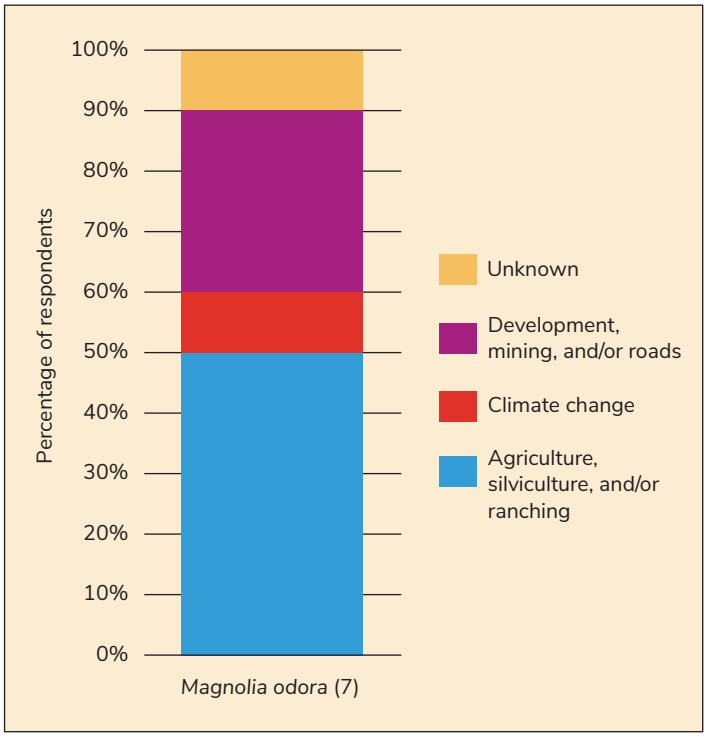


Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. odora* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	22
Number of plants in ex *situ* collections:	117
Average number of plants per institution:	5
Percent of ex *situ* plants of wild origin:	36%
Percent of wild origin plants with known locality:	84%

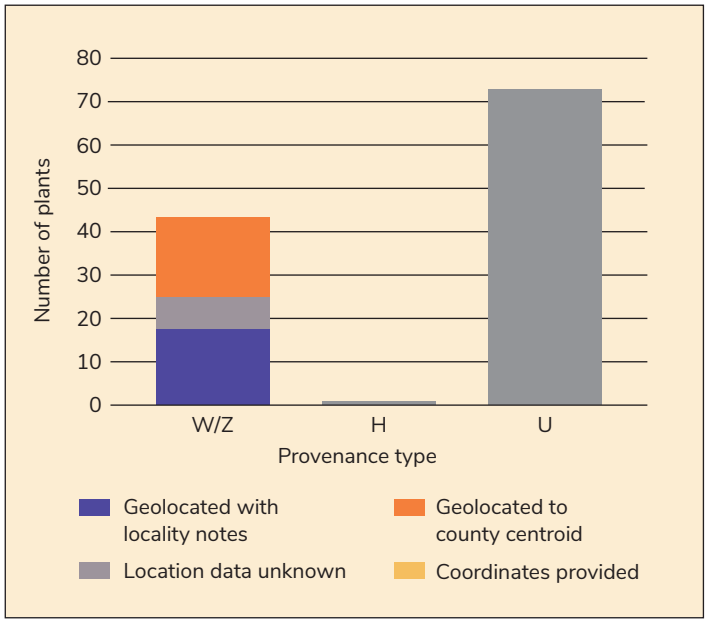


Figure 3. Number and origin of *Magnolia odora* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.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Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	10,053 / 87,514 **(11%)**	62,165 / 440,878 **(14%)**	218,236 / 865,675 **(25%)**	**17%**
Ecological coverage	6 / 8 **(75%)**	6 / 10 **(60%)**	6 / 13 **(46%)**	**60%**

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South China Botanical Garden

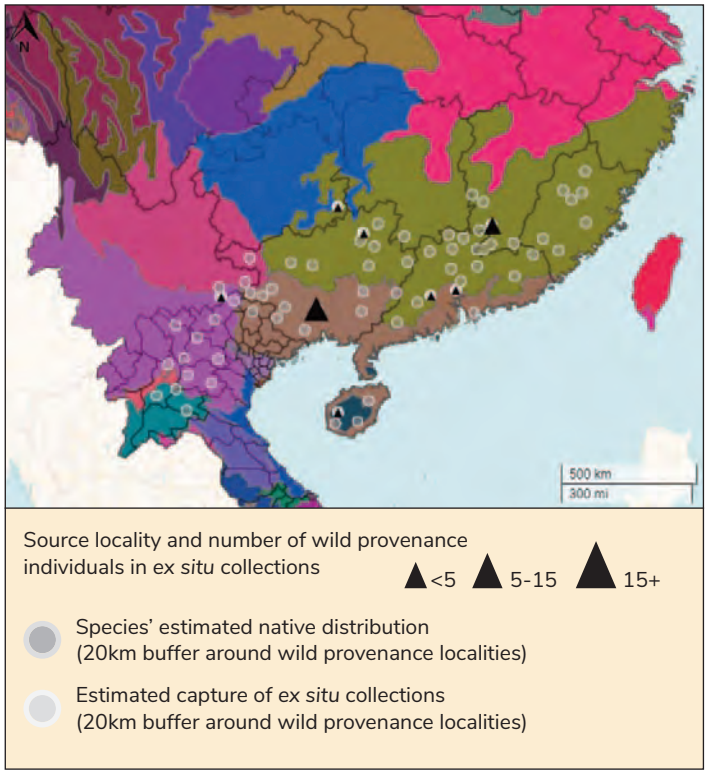

Figure 4. . *Magnolia odora in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Jian Nan subtropical evergreen forests, South China-Vietnam subtropical evergreen forests, Yunnan Plateau subtropical evergreen forests, Northern Indochina subtropical forests, Hainan Island monsoon rain forests, and Luang Prabang montane rain forests ecoregions.

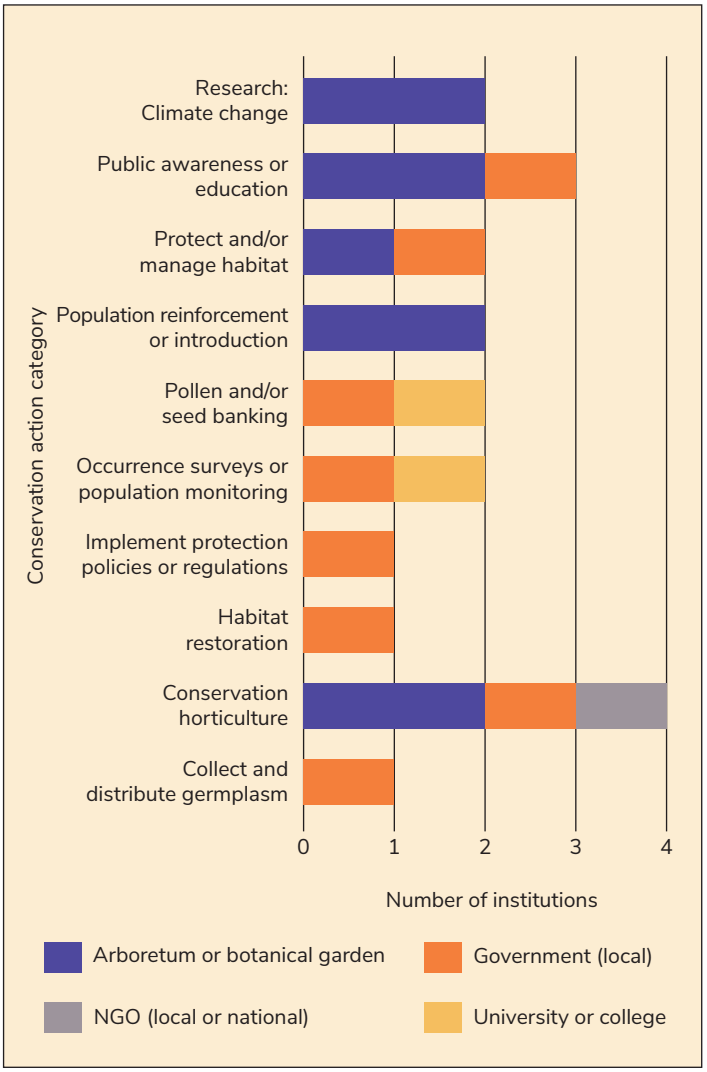

Figure 5. Number of institutions reporting conservation activities for *Magnolia odora* grouped by organization type. Six of 56 institutions reported activities focused on *M. odora* (see Appendix F for a list of all responding institutions).

Research: Climate Change
Research on habitat suitability and climate change shows that potential future warming may negatively impact the range of the species. Populations in Guangdong and Guangxi are recommended as priority conservation areas based on species distribution modeling (Hu et *al*. 2020). Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences and one other institution report this activity for *M. odora*.

Research: Genetics
Population genetics studies of a population in Nankunshan in China revealed moderate levels of genetic diversity (Wang et *al*. 2012).

Public awareness/education
Shenzhen Fairy Lake Botanical Garden, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences and one other institution report carrying public awareness or education about *M. odora*.

Protect and/or manage habitat
Shenzhen Fairy Lake Botanical Garden and Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences report this activity for *M. odora*.

Population reinforcement or introduction
This species has been part of reintroduction projects in China (Ren, H. 2020). Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences and one other institution report this activity for *M. odora*.

Pollen and/or seed banking
Shenzhen Fairy Lake Botanical Garden and Vietnam National University of Forestry report carrying out pollen and/or seed banking of *M. odora*.

Occurrence surveys or population monitoring
Shenzhen Fairy Lake Botanical Garden and Vietnam National University of Forestry report this activity for *M. odora*.

Implement protection policies or regulations
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. odora*.

Habitat restoration
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. odora*.

Conservation horticulture
Propagation guidance from seed as well as via grafting has been studied and published in 2005 by Nanyue Arboretum (Guo et *al*. 2005). Research on the botanic and ecological characteristics, distribution, causes of threat and the development of techniques for propagation and cultivation through seeds and cuttings of this species have been carried out by the arboretum. Shenzhen Fairy Lake Botanical Garden, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences and two other institutions report conservation horticulture activities for *M. odora*.

Collect and distribute germplasm
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. odora*. *Ex situ* collections are reported from the Jian Nan subtropical evergreen forests, South China-Vietnam subtropical evergreen forests, Northern Indochina subtropical forests and Hainan Island monsoon rain forests ecoregions (Figure 4).


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Conservation Actions Needed

Main conservation activities recommended for *M. odora* are collection and distribution of germplasm, conservation horticulture and public awareness or education. Other recommendations include research (on pests & pathogens), pollen and/or seed banking, occurrence surveys/ population monitoring and cryo-preservation/micropropagation.

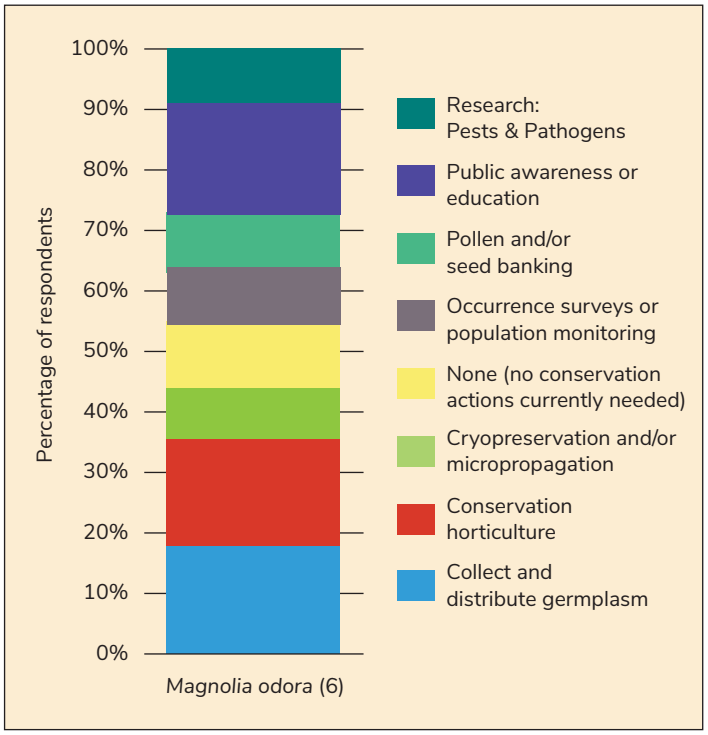

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. odora* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia ofeliae A.Vázquez & Cuevas

Section: Talauma **Synonyms:** None **Common names:** Magnolia
IUCN Red List Category and Criteria: Critically Endangered B1ab(iii)

Coauthor: J. Antonio Vázquez-García, Universidad de Guadalajara

Suggested citation: Linsky, J. & Vázquez-García, J.A. (2022). *Magnolia ofeliae* A.Vázquez & Cuevas. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

This species is known from only three locations from western Mexico. The type locality is Tajahualpa, in the municipality of Talpa de Allende in Jalisco, Mexico. A second population is found in Palo Alto and a third one in Santa Gertrudis, both also in Talpa de Allende (Muñiz-Castro *et al*. 2019, Yeo et al. 2020, Vázquez-García *et al*. 2021). It is a tree of 25-35 m in height. It is assessed as Critically Endangered due to its restricted range and the reduction in habitat caused by agricultural expansion.

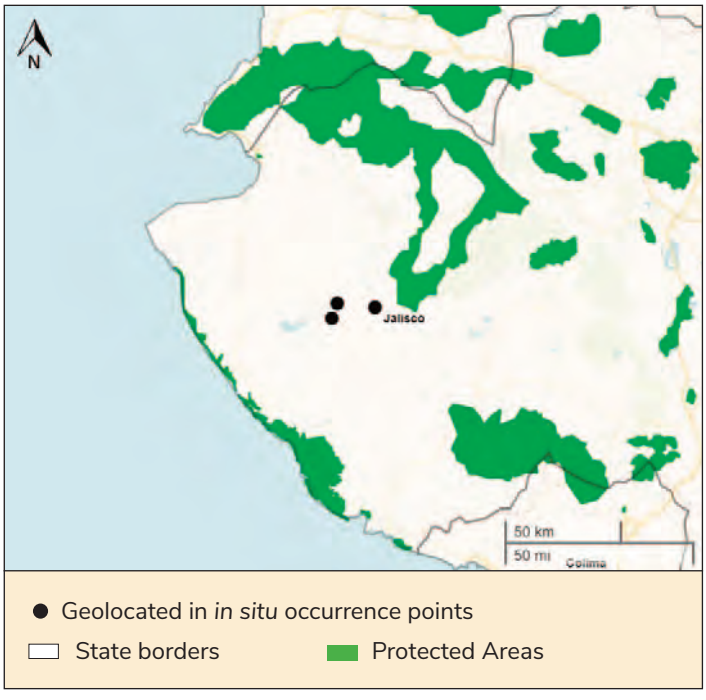

Figure 1. Documented *in situ* occurrence points for *Magnolia ofeliae* (Muñiz-Castro 2019). Protected areas are from Protected Planet (UNEP-WCMC 2021).


Antonio Vazquez Garcia

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia ofeliae*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	20
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	-
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
						Average vulnerability score	20

Threats to Wild populations

Threats from reduction of habitat and advancement of agricultural land conversion. It is hypothesized that a lack of pollinators may be impacting the reproduction of this species. Possible inbreeding or introgression is reported as a threat to this species.

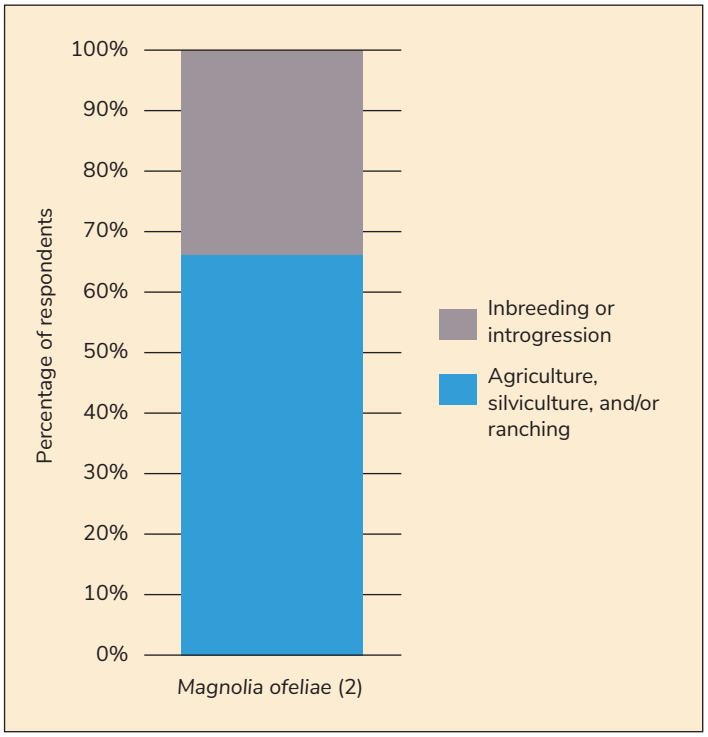

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. ofeliae* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	2
Number of plants in ex *situ* collections:	6
Average number of plants per institution:	3
Percent of ex *situ* plants of wild origin:	100%
Percent of wild origin plants with known locality:	66%

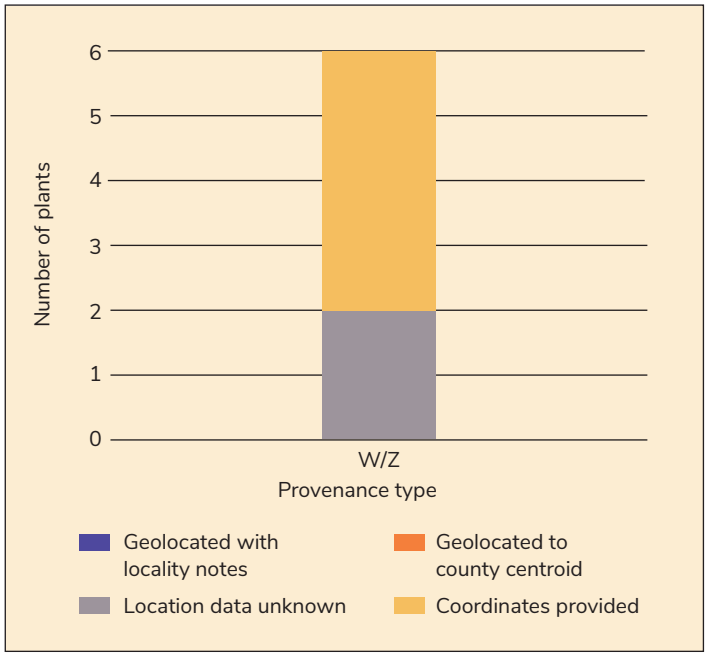

Figure 3. Number and origin of *Magnolia ofeliae* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

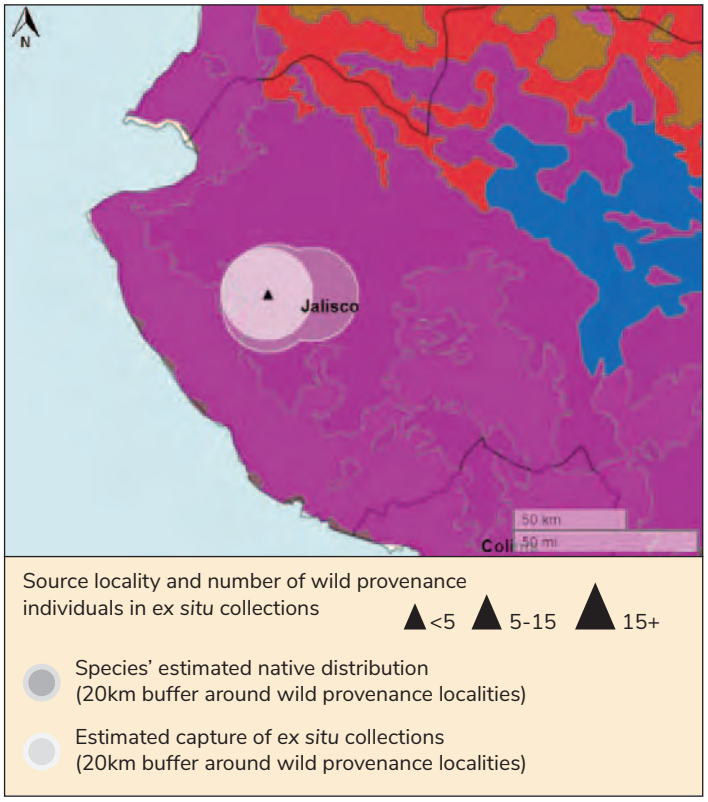

Figure 4. *Magnolia ofeliae in situ* occurrence points and ex *situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured the recorded distribution is included in the Trans-Mexican Volcanic Belt pine-oak forests ecoregion.

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	1,257 / 2,126 **(59%)**	7,854 / 9,958 **(79%)**	23,335 / 26,942 **(87%)**	**75%**
Ecological coverage	2 / 2 **(100%)**	3 / 3 **(100%)**	5 / 5 **(100%)**	**100%**

Research: Taxonomy
Universidad de Guadalajara reports carrying out research on the taxonomy of *M. ofeliae*.

Collect and distribute germplasm/Occurrence surveys or population monitoring / Conservation horticulture
This species has been part of a Global Trees Campaign project led by Centro Universitario de Ciencias Biológicas y Agropecuarias (CUCBA), Guadalajara since 2019. This project aims to survey populations, study reproductive biology, develop propagation protocols and establish ex *situ* collections while initiating in situ conservation of this species with local community participation. As part of this work Universidad de Guadalajara is collecting and distributing germplasm of this species. *Ex situ* collections are reported from the western part of its range in the Trans-Mexican Volcanic Belt pine-oak forests ecoregion (Figure 4).

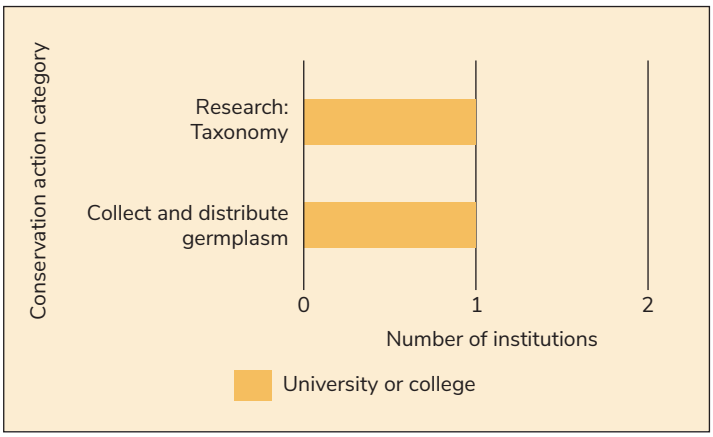

Figure 5. Number of institutions reporting conservation activities for *Magnolia ofeliae* grouped by organization type. One of 56 institutions reported activities focused on M. ofeliae (see Appendix F for a list of all responding institutions).

Conservation Actions Needed

It is proposed that a natural protected area be created in the habitat of this species to ensure protection, particularly near Santa Gertrudis, Talpa de Allende, the largest and less disturbed population. Studies on germination show no physical dormancy, but provided limited results after different germination treatments. (Ortega-Pena et *al*. 2020). Further studies on germination are suggested. A course-workshop for dissemination and training to further propagate the species is urgently needed. As well as reintroduction of ca. 130 i ndividuals reproduced by the University of Guadalajara Team. Responses from the questionnaire also highlight research on the genetics of this species, habitat restoration and further collection and distribution of germplasm as key conservation actions required for this species. More field work is necessary in order to find more wild populations; public awareness and education is highly recommended for this species.

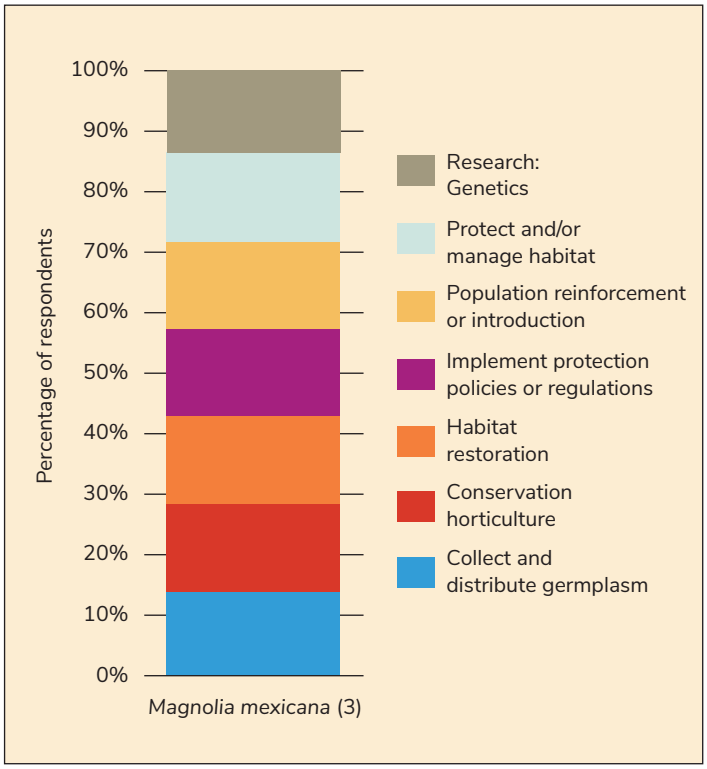

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. ofeliae* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Miguel Angel Muniz Castro

Magnolia officinalis Rehder & E.H.Wilson

Section: *Rhytidospermum* **Synonyms:** *Houpoea officinalis* (Rehder & E.H. Wilson) N.H. Xia & C.Y. Wu
Common names: Houpo **IUCN Red List Category and Criteria:** Endangered A2bd

Suggested citation: Linsky, J. (2022). *Magnolia officinalis* Rehder & E.H.Wilson. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia officinalis is widespread in China where it occurs in Anhui, Chongqing, Fujian, Guangxi, Guizhou, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, and Zhejiang (Yu et *al*. 2011) however the wild population of the species is thought to be restricted to China's nature reserves (Rivers 2015). The Red List assessment for this species states that records in the Flora of China (2007) stating that this species also occurs in Gansu and Guangdong may be cultivated occurrences (Rivers 2015). It is found at elevations up to 2,000 m asl. The bark of this species is used for medicinal purposes and the tree is cultivated for this purpose in many regions where it originally occurred. This species is assessed as Endangered due to the previous extreme decline in the species population size. This decline was due to decline in native forest habitat and bark stripping for medicinal purposes.

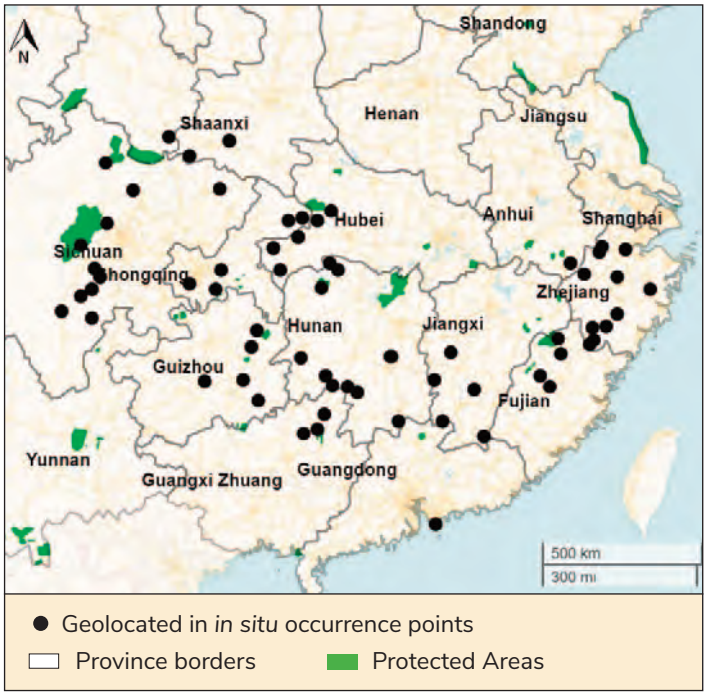

Figure 1. Documented *in situ* occurrence points for *Magnolia officinalis* (GBIF 2021). Protected areas are from Protected Planet (UNEP-WCMC 2021).


Philippe de Spoelberch


Philippe de Spoelberch

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia officinalis*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	0
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	10
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	10
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	10
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	5
						Average vulnerability score	7

Threats to Wild populations

Threats to M. officinalis include development, mining, and/or roads, agriculture, silviculture and/or ranching as well as wild harvesting, disturbance regime modification and climate change. Historical bark-stripping from M. officinalis led to the decline in wild individuals (Rivers 2015).


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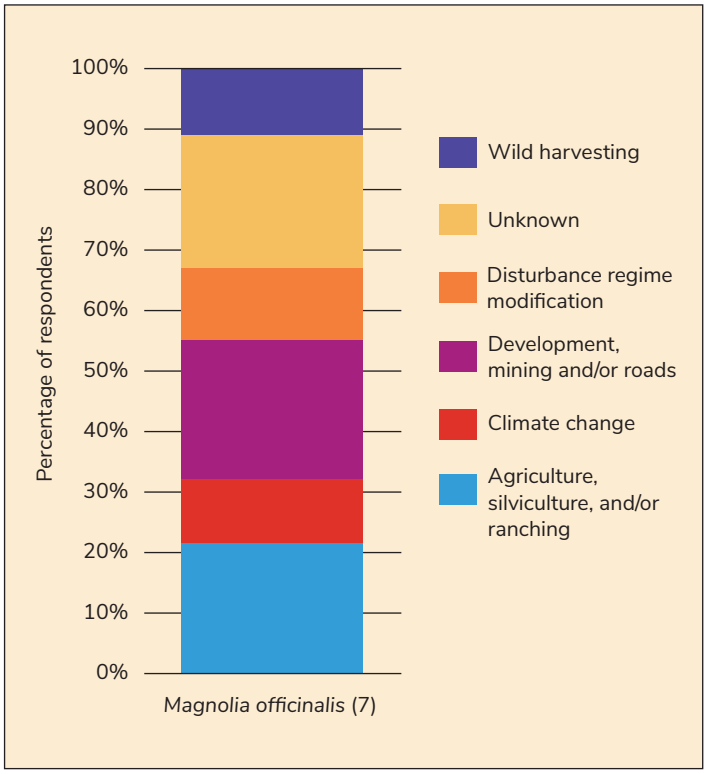

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. officinalis* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	141
Number of plants in ex *situ* collections:	337
Average number of plants per institution:	2
Percent of ex *situ* plants of wild origin:	22%
Percent of wild origin plants with known locality:	49%

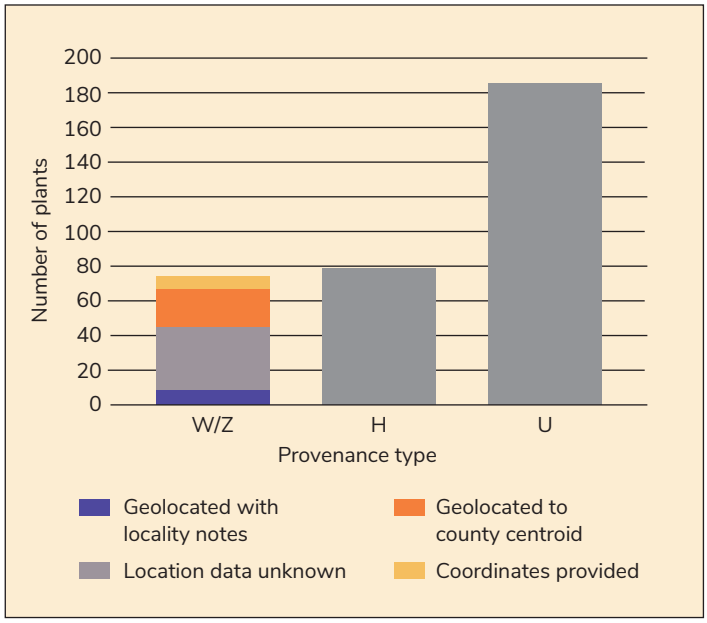

Figure 3. Number and origin of *Magnolia officinalis* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.


Matt Iobdell

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	20,345 / 95,110 **(21%)**	103,876 / 445,064 **(23%)**	344,441 / 1,097,475 **(31%)**	**25%**
Ecological coverage	9 / 11 **(82%)**	10 / 11 **(91%)**	10 / 12 **(83%)**	**85%**

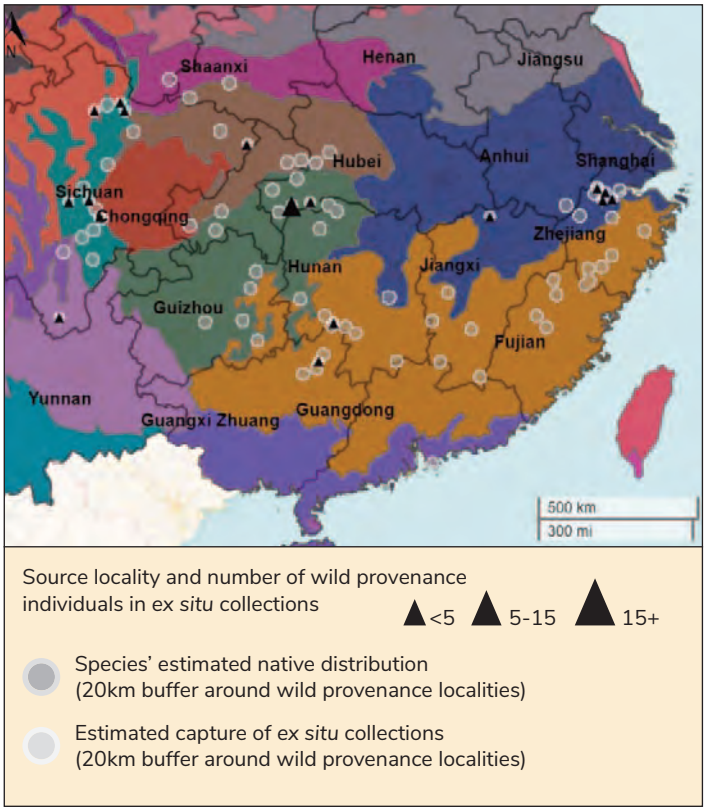

Figure 4. *Magnolia officinalis in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured, the recorded distribution is included in the Qin Ling Mountains deciduous forests, Qionglai-Minshan conifer forests, Daba Mountains evergreen forests, Guizhou Plateau broadleaf and mixed forests, Yunnan Plateau subtropical evergreen forests, Jian Nan subtropical evergreen forests and Changjiang Plain evergreen forests ecoregions.

Research: climate change
One institution reports carrying out research on climate change for *M. officinalis*.

Research: Genetics
Genetic studies of populations in Anhui and Henan suggest that their small population size and low genetic diversity lead them to be of high concern for protection. Increased gene flow within regions of the range of this species is recommended, while avoiding potential outbreeding depression (Yang et *al*. 2018). Studies suggest low genetic diversity at the population level but relatively high genetic diversity at species level (Yu et *al*. 2011).

Public awareness/education
Gardens of the Big Bend at University of Florida, Shenzhen Fairy Lake Botanical Garden, South China Botanical Garden, Chinese Academy of Sciences and one other institution report this activity for *M. officinalis*.

Protect and/or manage habitat
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. officinalis*.

Population reinforcement or introduction
This species has been part of reintroduction work in China (Ren H. 2020). South China Botanical Garden, Chinese Academy of Sciences and one other institution report this activity for *M. officinalis*.

Pollen and/or seed banking
Shenzhen Fairy Lake Botanical Garden reports pollen and/or seed banking of *M. officinalis*.

Occurrence surveys or population monitoring
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. officinalis*.

Implement protection policies or regulations
This species is on the China National Key Protected Wild Plants List (Ren H. 2020). Shenzhen Fairy Lake Botanical Garden reports this activity for *M. officinalis*. Commercial production through cultivation occurs in Zhejian, Fujian, Hunan and Guangxi Provinces (He et *al*. 2019).

Cryopreservation/micropropagation
The Huntington reports cryopreservation of *M. officinalis*.

Conservation horticulture
Gardens of the Big Bend at University of Florida, The Huntington and one other institution report conservation horticulture activities for *M. officinalis*.

Collect and distribute germplasm
Atlanta Botanical Garden and Shenzhen Fairy Lake Botanical Garden report this activity for *M. officinalis*. *Ex situ* collections are reported from the Qionglai-Minshan conifer forests, Guizhou Plateau broadleaf and mixed forests, Yunnan Plateau subtropical evergreen forests, Jian Nan subtropical evergreen forests and Changjiang Plain evergreen forests ecoregions (Figure 4).

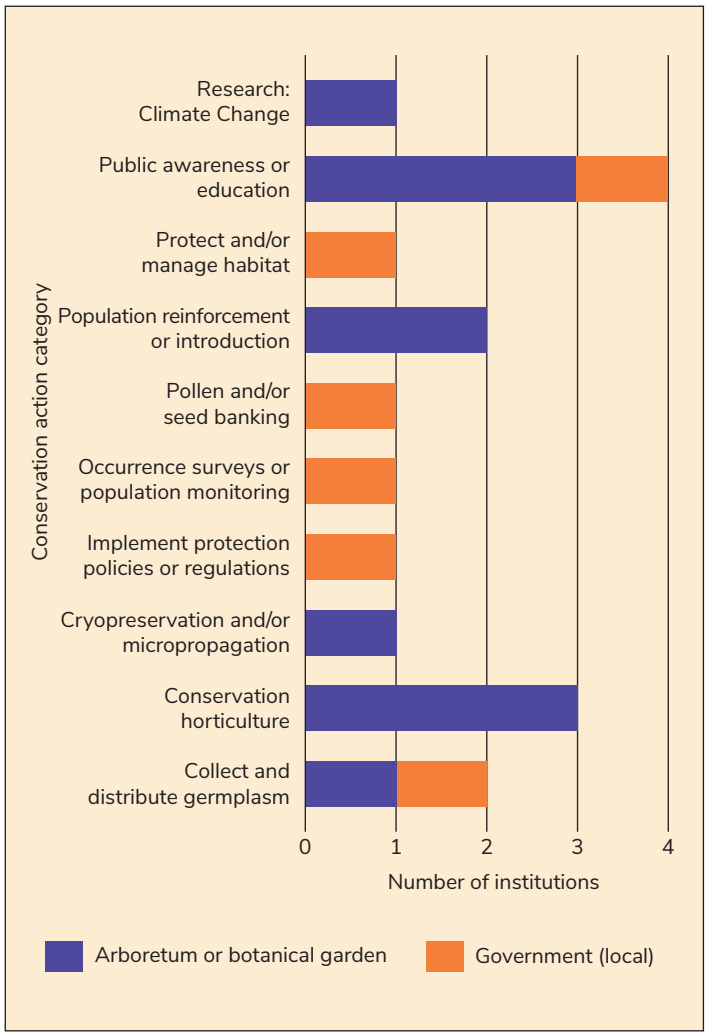

Figure 5. Number of institutions reporting conservation activities for *Magnolia officinalis* grouped by organization type. Seven of 56 institutions reported activities focused on *M. officinalis* (see Appendix F for a list of all responding institutions.)

Conservation Actions Needed

Public awareness/education was most suggested for M. officinalis. Other activities suggested are protection and/or management of habitat, conservation horticulture, research (on pests & pathogens and genetics), population reinforcement/introduction, habitat restoration, cryopreservation/micropropagation and the collection and distribution of germplasm.

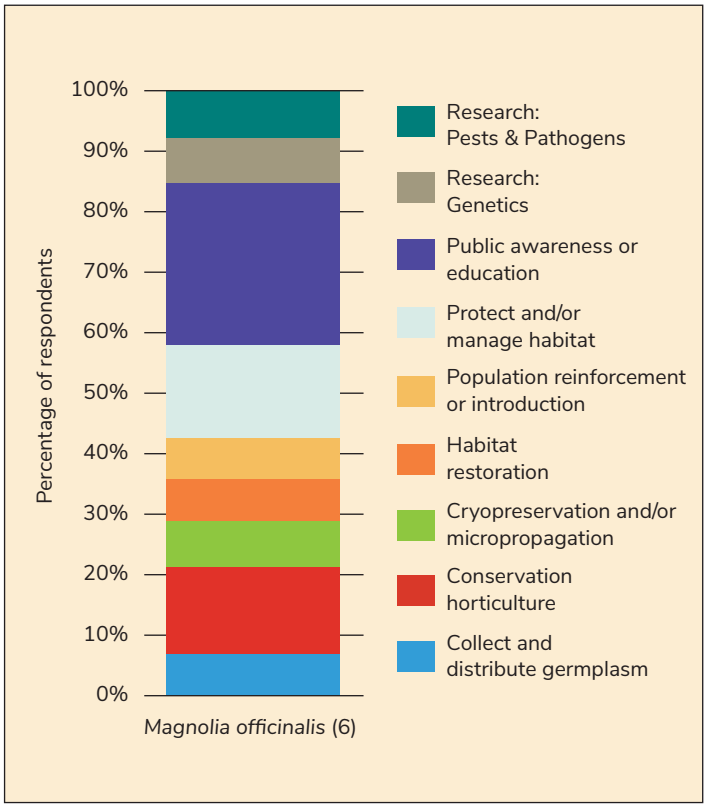

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. officinalis* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Philippe de Spoelberch

Philippe de Spoelberch

Magnolia pacifica A.Vázquez

Section: *Magnolia* **Synonyms:** *Magnolia pacifica* A.Vázquez subsp. *pacifica*
Common names: Corpus, Magnolia **IUCN Red List Category and Criteria:** Endangered B1ab(iii)

Co-author: Miguel Ángel Muñiz Castro, Universidad de Guadalajara

Suggested citation: Linsky, J., & Muñiz Castro, M.A. (2022). *Magnolia pacifica* A.Vázquez. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia pacifica is endemic to western Mexico. It is known from a few localities from southern Nayarit (Sierra de San Juan) to western Jalisco (the San Sebastián-Talpa de Allende-Cuale range) at elevations between 790 to 2,250 m asl. The species is found in riparian forests and tropical montane cloud forests, mainly in ravines with a moist warm temperate climate or microclimate. The main species with which *M. pacifica* coexists are *Quercus nixoniana*, *Q. acutifolia*, *Zinowewia concinna*, *Carpinus caroliniana*, *Ostrya virginiana*, *Persea hintoni*, *Abies jaliscana*, *Acer binzayedii*, *Juglans major*, *Matudaea trinervia*, *Ardisia revoluta*, *Saurauia serrata*, *Clethra hartwegii*, *Pinus douglasiana*, *Cyathea costaricensis*, *Podocarpus matudae*. The cloud forest ravines where *Magnolia pacifica* lives are surrounded by a matrix of more exposed pine-oak forests, which are characterized by a seasonally drier temperate climate, so *M. pacifica* populations are "archipelagos of fragmented islands", isolated in a "sea" of drier habitats, where forest fires, logging, deforestation, land use conversion to agriculture and cattle raising are very common and widespread.

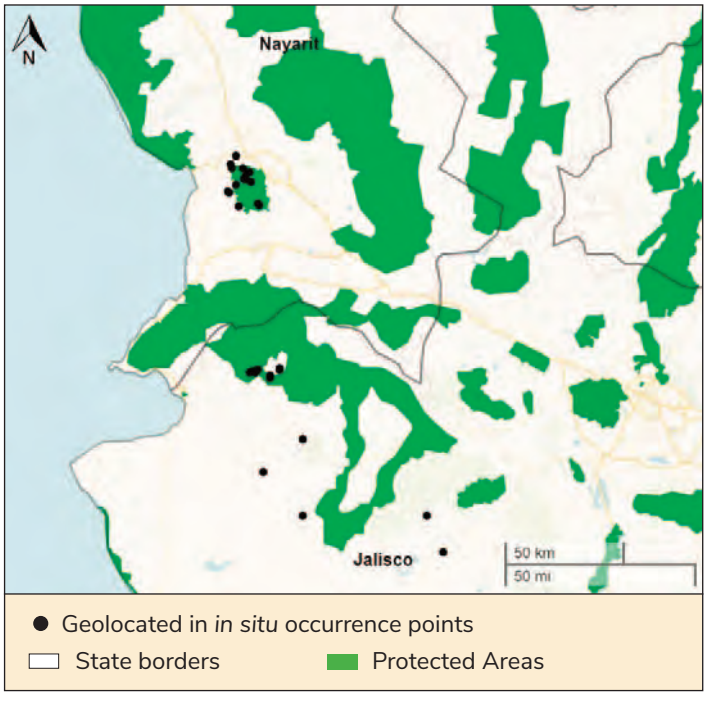

Figure 1. Documented *in situ* occurrence points for *Magnolia pacifica* (GBIF 2021). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia pacifica*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	20
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	40
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	20
					Average vulnerability score		23

Threats to Wild populations

Threatened by livestock, logging and forest fires. Natural regeneration is not observed in most of the wild populations as El Saucito, San Sebastián del Oeste y Sierra San Juan. In a few populations as that of Talpa de Allende (Bosque de Arce), there is a very scarce regeneration, but the few seedlings and saplings encountered are under a great competition for light with many other associated tree species. Despite the fact that some populations of *M. pacifica* are within protected natural areas, the low density of individuals and its low intra-population genetic diversity place this species in a vulnerable state (Muñiz-Castro et *al*. 2020). In testing the viability of the seeds was found to be 53%; there has been only one germination experiment with two treatments, and the the results have been poor, only 13% of seeds germinated with the manual removal of the sarcotesta and only 21% with cold stratification at 5 °C (Ortega-Peña et *al*. 2020). Further threats from tourism or recreation, and development, mining and/or roads as well as agriculture, silviculture and/or ranching were indicated through the questionnaire.

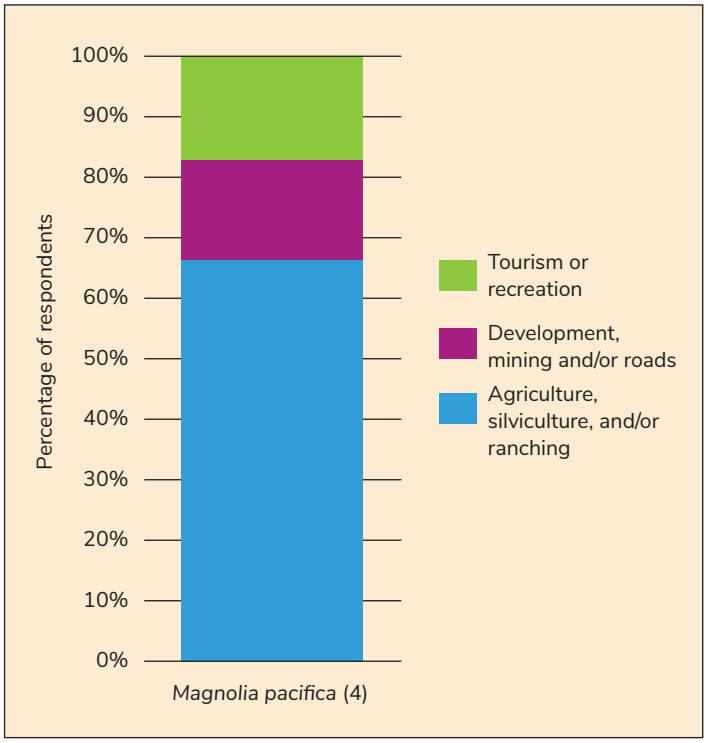

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. pacifica* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex situ collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of *ex situ* survey

Number of *ex situ* collections reporting this species:	7
Number of plants in *ex situ* collections:	73
Average number of plants per institution:	9
Percent of *ex situ* plants of wild origin:	68%
Percent of wild origin plants with known locality:	94%

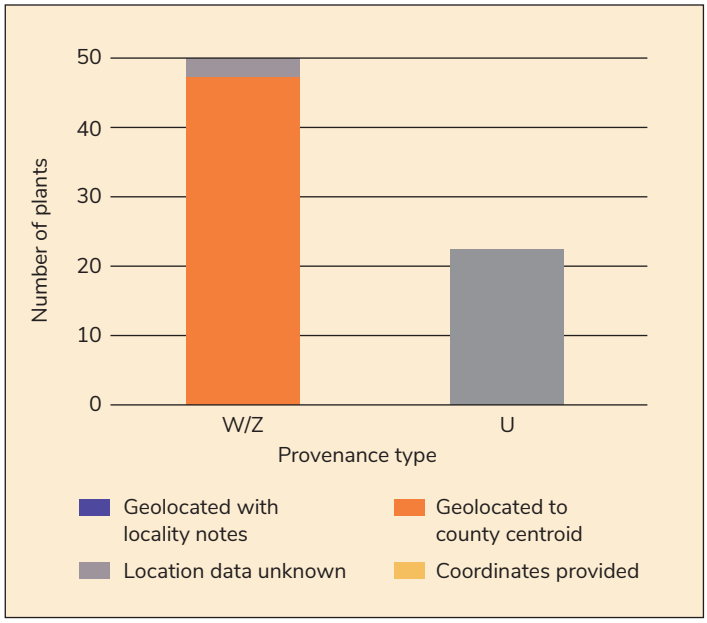

Figure 3. Number and origin of *Magnolia pacifica* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in *ex situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The *ex situ* buffer area represents the native range "captured" in *ex situ* collections, or "combined area *ex situ*" (CAE20, CAE50, CAE100). Geographic coverage of *ex situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.


Miguel Á. Muñiz Castro

Estimated *ex situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	2,496 / 9,321 **(27%)**	13,532 / 29,975 **(45%)**	37,599 / 63,129 **(60%)**	**44%**
Ecological coverage	5 / 5 **(100%)**	5 / 6 **(83%)**	6 / 6 **(100%)**	**94%**

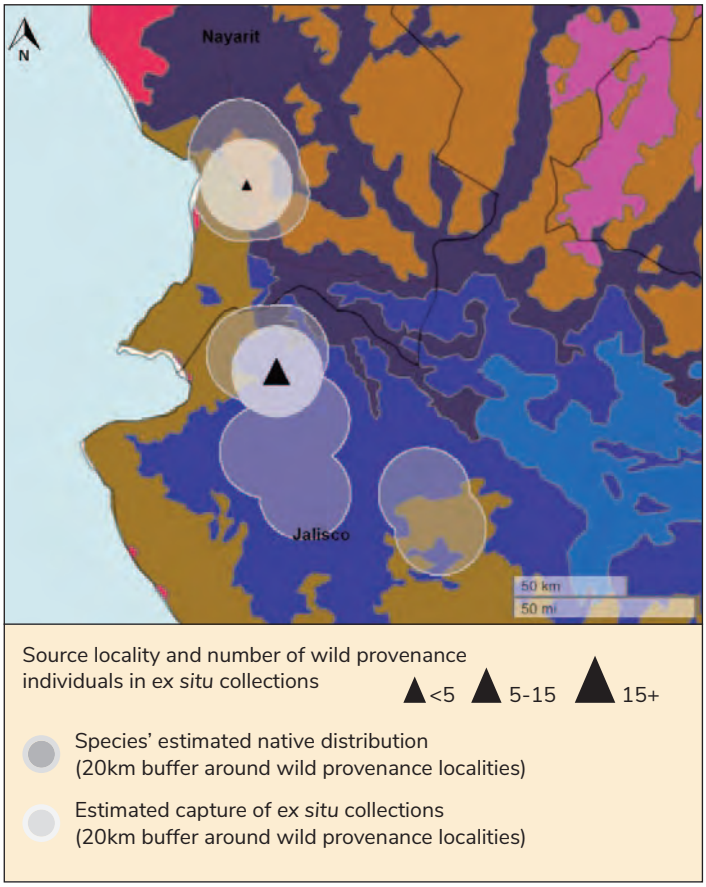

Figure 4. *Magnolia pacifica in situ* occurrence points and ex *situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Sierra Madre Occidental pine-oak forests, Sinaloan dry forests, Jalisco dry forests, Trans-Mexican Volcanic Belt pine-oak forests.

Research: Taxonomy:
Universidad de Guadalajara reports carrying out research on the taxonomy of *M. pacifica*.

Research: Genetics
Genetic analysis highlights populations of type locality (San Sebastian) and Bosque de Arce as targets for *in situ* and ex *situ* conservation (Muñiz-Castro et *al*. 2020). Universidad de Guadalajara reports carrying out research on the genetics of *M. pacifica*.

Protect and/or manage habitat
This species is found in the following protected areas: "Bosque de Arce" State Park, the "Sierra de San Juan" Biosphere Reserve, and in the Natural Resources Protection Area of the National Irrigation District 043.

Cryopreservation/micropropagation
The Huntington reports cryopreservation of *M. pacifica*.

Conservation horticulture
There have been several attempts to increase the number of ex *situ* individuals and localities of *M. pacifica*, but the results have been poor or of moderate magnitude. The main problem has been the lack of a strong and solid institutional program for the collection, cultivation and long-term monitoring at all levels: state, national and international. In the field, the main problem in collecting seeds for propagation has been the lack of trained arborists, equipment and financial resources for collecting expeditions, since the wild populations are in distant mountains and most of the fruits with seeds are found sparse and scarce in the highest area of the tree canopy, from the trees about 20-30 m high. At the plant nurseries the main problem has been the lack of trained people, the lack of money to hire and pay staff, and the lack of money to build, manage and maintain the nurseries. Propagation was investigated and germination improved through manual removal of the aril, however there is still dormancy which needs further study. The Huntington reports conservation horticulture activities for *M. pacifica*.

Collect and distribute germplasm
Universidad de Guadalajara and The Huntington report this activity for *M. pacifica*. *Ex situ* collections are reported from the Sierra Madre Occidental pine-oak forests and Trans-Mexican Volcanic Belt pine-oak forests ecoregions (Figure 4).

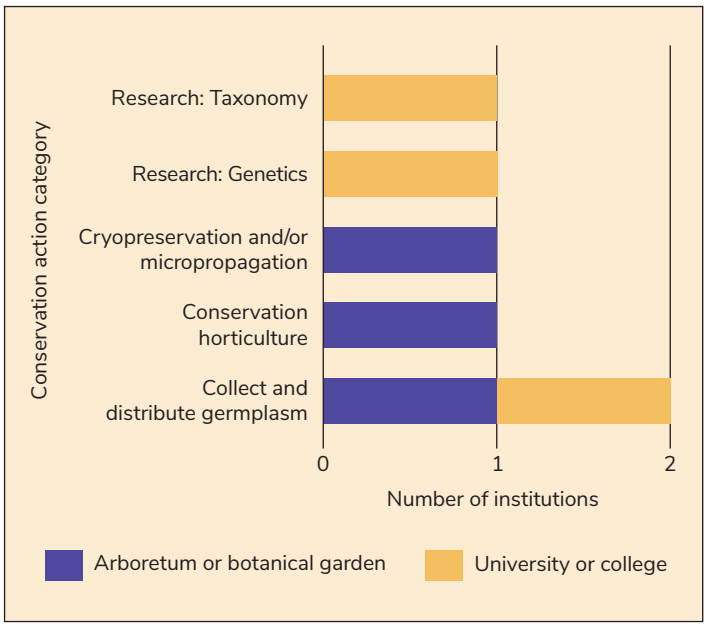

Figure 5. Number of institutions reporting conservation activities for *Magnolia pacifica* grouped by organization type. Two of 56 institutions reported activities focused on *M. pacifica* (see Appendix F for a list of all responding institutions).

Conservation Actions Needed

Is very necessary to create a specific institutional program for the collection of seeds, plant cultivation, nursery support and administration of ex-*situ* collections of the magnolias of western Mexico, and to obtain financial support to strengthen and provide follow-up and long-term support for the program. In recent years there has been some financial support by BGCI for seed collection, plant cultivation and organization of the 1st Symposium of Neotropical Magnolia Conservation Consortium, July 8-14, Guadalajara, Jalisco, Mexico-2019, and the academic staff of University of Guadalajara (IBUG-CUCBA) have been participating actively in all these activities, but reinforcement of the program is needed for long term success. As a result of the COVID-19 pandemic, the support of university students and professors has been significantly limited.

Major recommended activities include implementation of protection policies or regulations, protection and/or management of habitat, population reinforcement or introduction, habitat restoration and collection and distribution of germplasm.

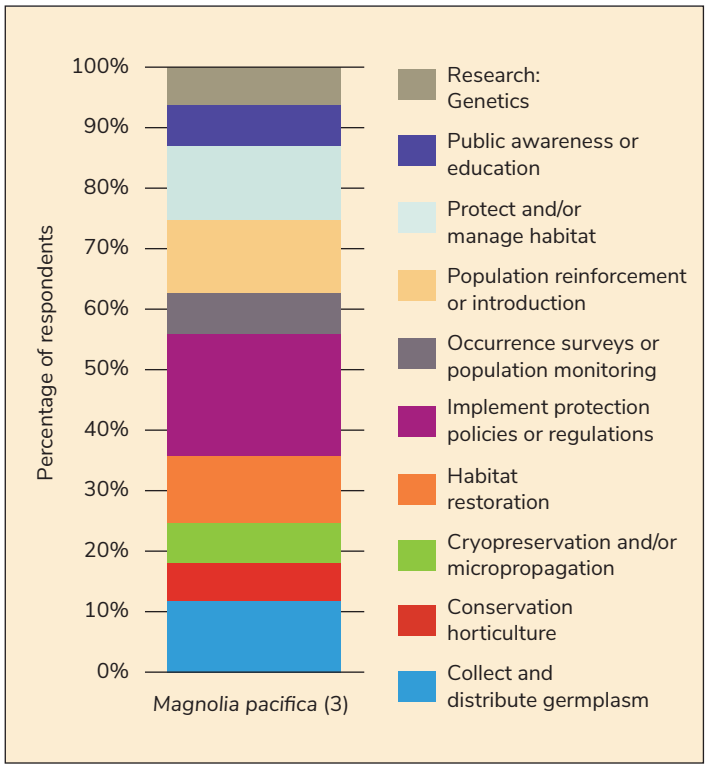

Figure 6. Responses from the Magnolia conservation action questionnaire for *M. pacifica* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Miguel Á. Muñiz Castro

Magnolia portoricensis Bello

Section: *Talauma* **Synonyms:** *Magnolia patoricensis* P.Parm, *Dugandiodendron portoricense* (Bello) Sima & S.G. Lu **Common names:** Alceiba, Alciba, anoncilla, anonillo, burro, burro mauricio, jagü(i)lla, laurel sabino (wood), mauricio, ortegón. **IUCN Red List Category and Criteria:** Endangered B1ab(iii,v)

Co-authors: Emily Veltjen, Ghent University Botanical Garden; Tim Thibault, The Huntington; Raquel Folgado, The Huntington.

Suggested citation: Linsky, J., Veltjen, E., Thibault, T., & Folgado, R. (2022). *Magnolia portoricensis* Bello. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia portoricensis is endemic to Puerto Rico where it is found in the central and western part of the upper region of the Cordillera Central. The species occurs in cloud forest habitat and has ten reported localities of which five are State Forests: the Carite, Toro Negro, Maricao, Tres Picachos and Guilarte State Forests. In 2016 during surveys, 291 individuals were counted in 22 active field exploration days (Veltjen 2020), however in surveys in 2021 some subpopulation groupings were reduced by 50% (Maricao) to 86% (Guilarte) following Hurricane Maria in 2017. Many trees could not be relocated or were inaccessible due to hurricane damage. Potentially, half of the remaining localities and trees exist in state forests, however very little regeneration or recruitment was observed following the hurricane.


Emily Veltjen


Emily Veltjen

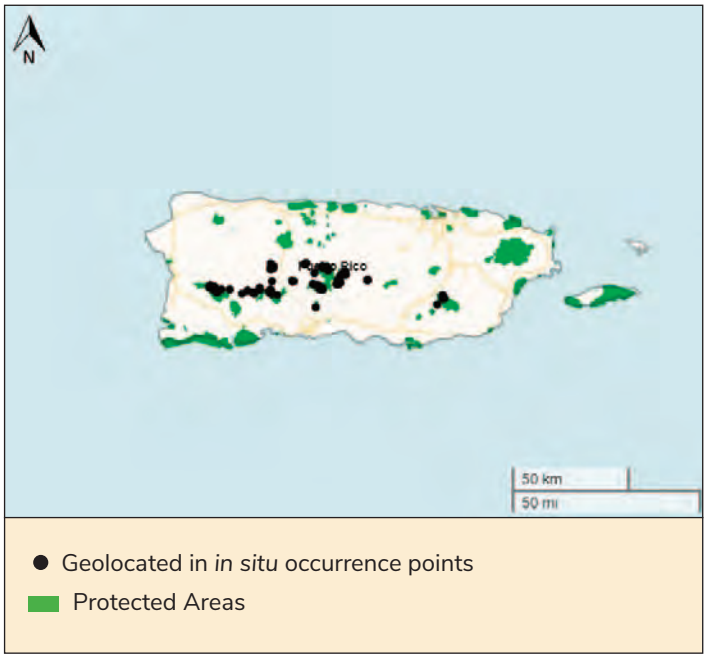

Figure 1. Documented *in situ* occurrence points for *Magnolia portoricensis* (GBIF 2021; Lahmeyer 2016; E. Veltjen pers. comm.). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia portoricensis*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	10
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	5
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	10
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	40
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	20
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	20
					Average vulnerability score		18

Threats to Wild populations

Previously, this species was a very important source of timber for furniture and it can serve as a shade plant in coffee plantations (Alemañy-Merly, 1999). Fragmentation of the species cloud forest habitat by coffee plantations and other agricultural purposes threatens *M. portoricensis*, however currently, about half of the known localities and trees are found in state forests and are protected from these types of threats. Climate change impacts, including the altered frequency and severity of hurricanes, is a main threat to this species. Threats from tourism or recreation; development, mining and or roads as well as climate change are identified as significant to this species from the questionnaire.

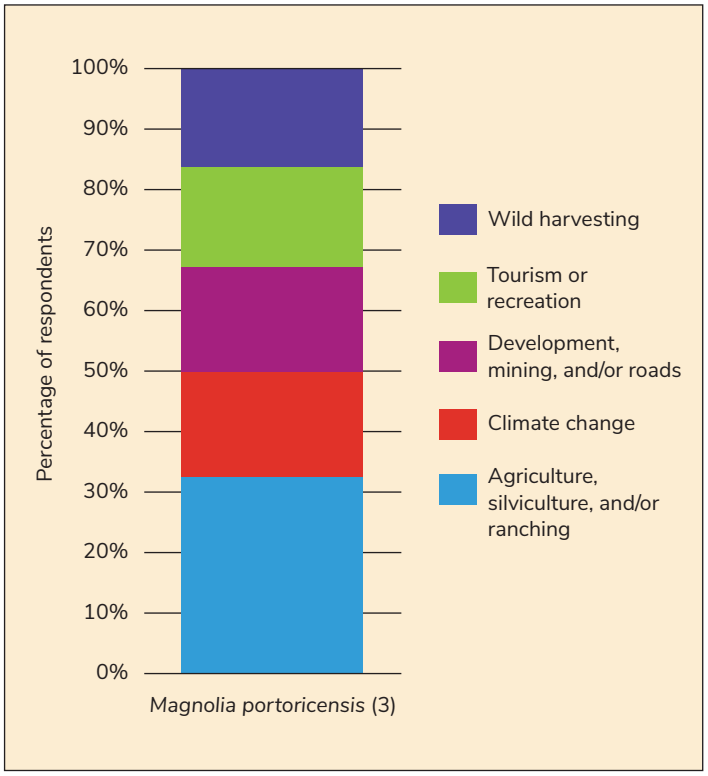

Figure 2. . Responses from the *Magnolia* conservation action questionnaire for *M. portoricensis* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	1
Number of plants in ex *situ* collections:	2
Average number of plants per institution:	2
Percent of ex *situ* plants of wild origin:	100%
Percent of wild origin plants with known locality:	100%

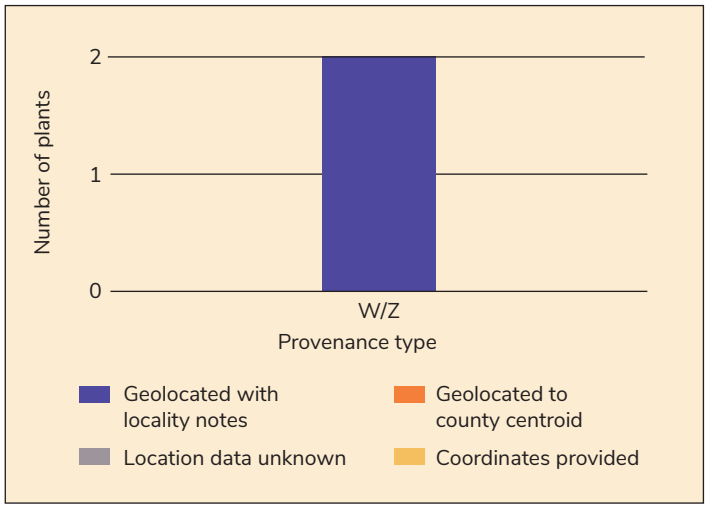

Figure 3. Number and origin of *Magnolia portoricensis* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

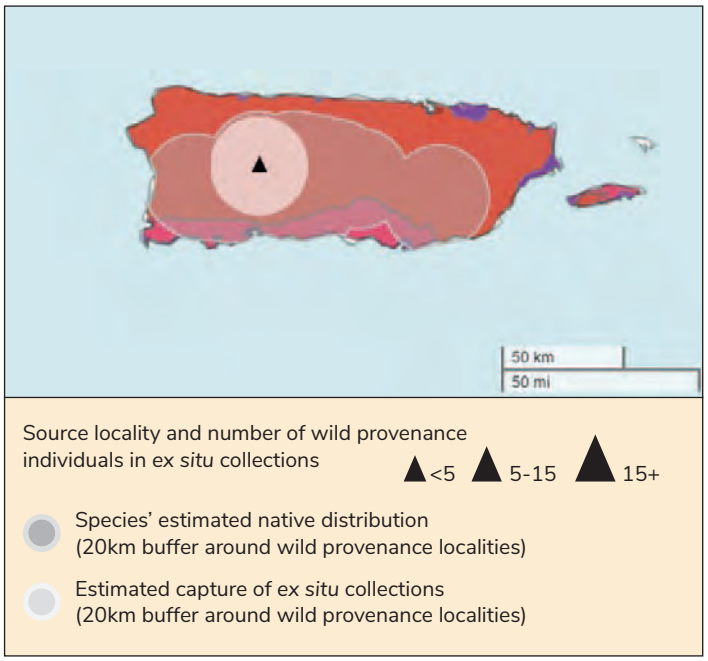

Figure 4. *Magnolia portoricensis in situ* occurrence points and ex *situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Puerto Rican moist forests ecoregion.

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	1,257 / 5,485 **(23%)**	5,781 / 8,999 **(64%)**	8,844 / 9,147 **(97%)**	**62%**
Ecological coverage	1 / 3 **(33%)**	3 / 3 **(100%)**	3 / 3 **(100%)**	**78%**

Research: Genetics

M. portoricensis was found to be diploid based on chromosome counts in root tips (Veltjen, 2020). Veltjen et *al*. (2019) included 2 localities (Maricao and Toro Negro) each represented by 20 indivdiuals, in a conservation genetic study on Caribbean *Magnolia*. The Toro Negro sampling locality showed genetic substructure and inbreeding. The overall allelic diversity score of *M. portoricensis* was moderate compared to the other Caribbean magnolias (Veltjen, 2020). The inbreeding and moderate allelic diversity, ranked *M. portoricensis* as the third Caribbean magnolia species (after *M. domingensis* and *M. pallescens*) in urgent need of a follow-up conservation genetic study. Population sampling of 2015 and 2016 is currently being processed at Ghent University for an in depth analysis of the pre-hurricanes genetic status of the species. Instituto de Ecología, A.C. reports carrying out research on the genetics and taxonomy of *M. portoricensis*, using representatives of Carite, Maricao and Toro Negro localities in a Hyb-Seq phylogenomic analysis.

Occurrence surveys or population monitoring

The Huntington reports this activity for *M. portoricensis*. In 2021, only a single seedling was observed during surveys post hurricane. Many sites were found to be inaccessible for survey in 2021.

Cryopreservation and/or micropropagation

The Huntington reports this activity for *M. portoricensis*. This work has been part of a conservation project supported by the APGA-USFS Tree Gene Conservation Partnership including collection of material for micropropagation, tissue banking and *ex situ* conservation (Lahmeyer et *al*. 2016). In 2016 budwoods of *M. portoricensis* were introduced in tissue culture (Lahmeyer et *al*. 2016). Even though some buds had contamination, others grew as microshoots, but they declined before they could start multiplying. Micropropagation was ultimately not successful in 2016. Plans were made to collect buds for genetic conservation from the two largest trees, El Gigante in Guilarte and El Campeon in Toro Negro, however these were inaccessible in 2021 and El Campeon is believed to no longer be surviving as it was in questionable condition in 2016 prior to the hurricane. Five trees were sampled for micropropagation in 2021 and while contamination is present, one sample is present at the Pontificia Universidad Catolica de Puerto Rico.

Conservation horticulture

The Huntington reports this activity for *M. portoricensis*. Informal germination experiments have been conducted at Ghent University Botanical Garden with good germination rates. The general workflow of these germination experiments was inspired by Mejía, M. (1990) and "the guide for *Magnolia cubensis* identification and management in the wild" a product of the MAGNOLIA project of Planta! (Planta 2020), which both reported high germination rates for Caribbean magnolias. Fruits were collected in the range of all carpels fully opened with seeds exposed hanging from their funiculi to at least one opening carpel, as this was used as an indication that the seeds were mature. If the carpels of the fruits were open at the time of collection, the seeds were removed and cleaned thoroughly by soaking them in water and manually removing all fleshy sarcotesta on the same day of collection. Fruits that had carpels which were not completely opened when collected, were dried using a fan (indoors) and seeds were collected once the fruits opened (e.g. one or two days later). The seeds collected after drying the fruits were cleaned in the same manner. For storage between washing and planting, the seeds were kept in a resealable bag which was kept humid on the inside using a small wet piece of paper towel, placed in the same bag, yet not touching the seeds. The seeds were monitored regularly during transit for humidity (some drops of water were added now and then) and checked for fungi (if caught early: the seeds were washed again and if recurrent, the moldy seeds were isolated from the others) and were stored this way for 1-3 weeks. The seeds were germinated on standard soil to which some perlite was added in a greenhouse at Ghent University Botanical Garden and watered daily. Germination rates were good and the seedlings continued to be watered daily. The seedlings grew to have 4-6 leaves, however mortality was high at this stage and the growth was not good compared to that reported in the *M. cubensis* guide. The reasons for this are still unclear, however, this may be due to too little water, soil, incorrectly sized containers or sun compared to the natural conditions or a lack of associated mycorrhizae within the *ex situ* conditions. The germination method described here was also applied to *M. dodecapetala* with similar results.

Collection and distribution of germplasm

The Huntington Botanical Garden reports this activity for *M. portoricensis*. Previous efforts to grow this species have been made by Arboretum Parc Dona Ines, in San Juan, however reportedly these individuals have not survived. The *ex situ* collection reported here is from the Puerto Rican moist forests ecoregion (Figure 4). From field work in 2021, seeds were collected and germinated at Naples Botanical Garden and the Virgin Island Rare Plant Initiative on St. Croix.

Conservation Actions Needed

The experience gained on the micropropagation of magnolias will help secure this endangered species and facilitate its distribution. Many conservation activities are recommended for *M. portoricensis* from the questionnaire. The most recommended are collection and distribution of germplasm, conservation horticulture, further cryopreservation and protection and or management of its habitat.

As half of *M. portoricensis* individuals exist in state forests, the protection and management of habitat within these areas is most important to conservation of this species. Sufficient staffing and resources to monitor and manage populations and facilitate reintroductions is necessary for the survival of *M. portoricensis*. Continued monitoring of the impacts of Hurricane Maria and other severe storms on the reproductive potential and population dynamics of *M. portoricensis* are required. Survey for and monitoring of populations both inside and outside of state forests is necessary for a comprehensive understanding of this species status.

Propagation and conservation horticulture research including mycorrhizal requirements for development are also recommended to improve both *ex situ* and *in situ* conservation initiatives.

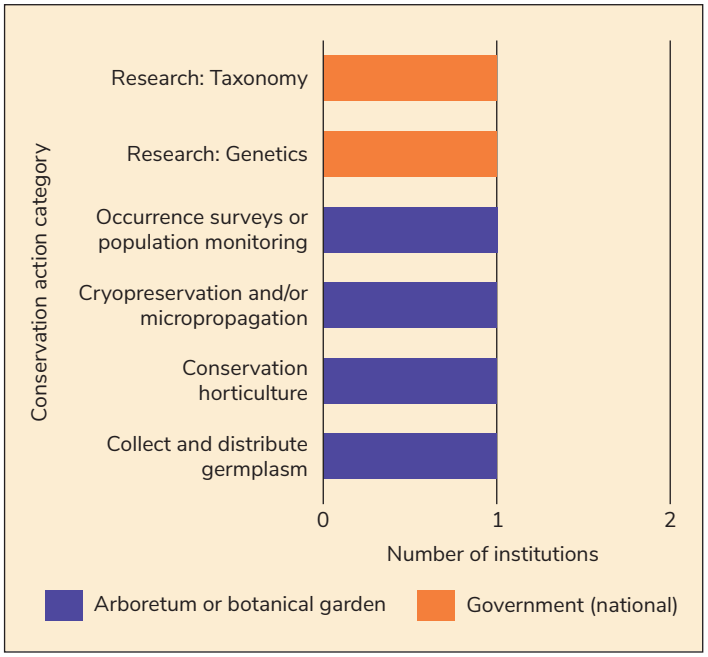

Figure 5. Number of institutions reporting conservation activities for *Magnolia portoricensis* grouped by organization type. Two of 56 institutions reported activities focused on *M. portoricensis* (see Appendix F for a list of all responding institutions).

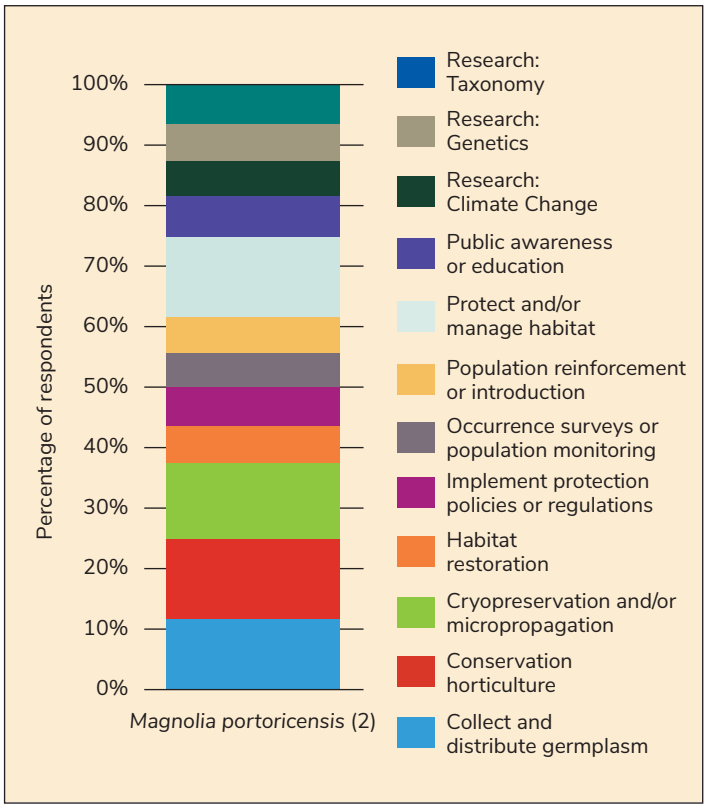

Figure 6. Responses from the Magnolia conservation action questionnaire for *M. portoricensis* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Emily Veltjen

Magnolia pugana (Iltis & A.Vázquez) A.Vázquez & Carvajal

Section: *Magnolia* **Synonyms:** *Magnolia pacifica* subsp. *pugana* Iltis & A.Vázquez
Common names: Almacasusco, Manolia **IUCN Red List Category and Criteria:** Endangered B1ab(iii)+2ab(iii)

Co-author: Miguel Ángel Muñiz Castro, Universidad de Guadalajara

Suggested citation: Linsky, J., & Muñiz Castro, M.Á. (2022). *Magnolia pugana* (Iltis & A.Vázquez) A.Vázquez & Carvajal. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia* Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia pugana is endemic to the center of the state of Jalisco and southern Zacatecas, Mexico, in the confluence of the Trans-Mexican Volcanic Belt and the southern end of the Sierra Madre Occidental physiographic provinces. This species, being nearly 170 - 215 km away from the sea, thrives mainly on the side of calm streams or springs, at the bottom of valleys or ravines, in a seasonally-dry temperate climate (annual accumulated precipitation ca. 833 - 980 mm, mainly from June to September), in gallery riparian forests, surrounded by tropical seasonal dry forests and pine-oak forests, usually exposed to high water stress (Vázquez-García et al. 2002). The main species with which *M. pugana* coexists are *Persea liebmanii*, *Oreopanax peltatus*, *Populus luziarum*, *Salix bonplandiana*, *Salix microphylla*, *Lysiloma acapulcense*, *Clethra rosei*, *Toxicodendron radicans*, *Serjania mexicana*, *Pinus oocarpa*, *Quercus resinosa*, *Piper hispidum*, *Chusquea circinata*. *Magnolia pugana* shares the canopy dominance of the riparian forest mainly with *Persea liebmanii*, *Populus luziarum* and *Salix bonplandiana*.


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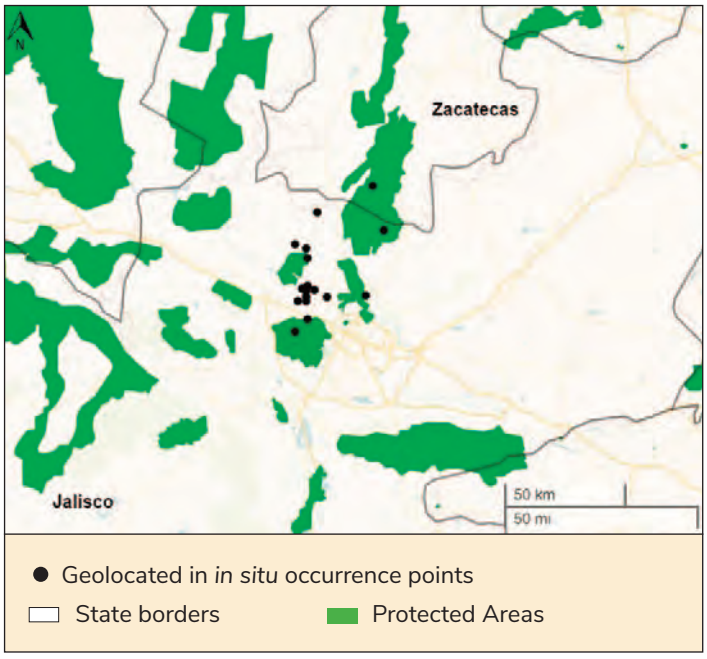

Figure 1. Documented *in situ* occurrence points for *Magnolia pugana* (GBIF 2021; Muñiz-Castro 2020). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia pugana*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	20
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	20
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	40
						Average vulnerability score	23

Threats to Wild populations

The current threats for wild populations of *M. pugana* are high fragmentation and isolation of populations and habitats, high deforestation rate, low regeneration, changes in land use (mainly forest conversion to pasture lands and agriculture), forest fires, and growth of urban and rural settlements (Vázquez-García et *al.* 2021). On the one hand, the water phreatic tables and water of springs are being overexploited, which leads to a decrease in the flow of water in the streams, and on the other hand, the global climate change, causing less rain and more heat, is also affecting the flow of the streams. Once the streams where the trees of *M. pugana* live become dry, their populations will become extinct as the trees of this species are completely dependent on water from springs and streams. This species does not have other moisture input such as fog or mist, which does frequently reach other species, such as *M. pacifica* and *M. vallartensis*, even in the season when it doesn't rain.

Another potential threat for *M. pugana* is the extensive and intensive use of agrochemical pesticides in the surrounding agricultural crops, this problem has been augmenting in the last years in the landscapes where *M. pugana* live, and could produce a depletion in populations of the beetles that pollinate their flowers. Potential inbreeding or introgression is also identified as a threat to this species.

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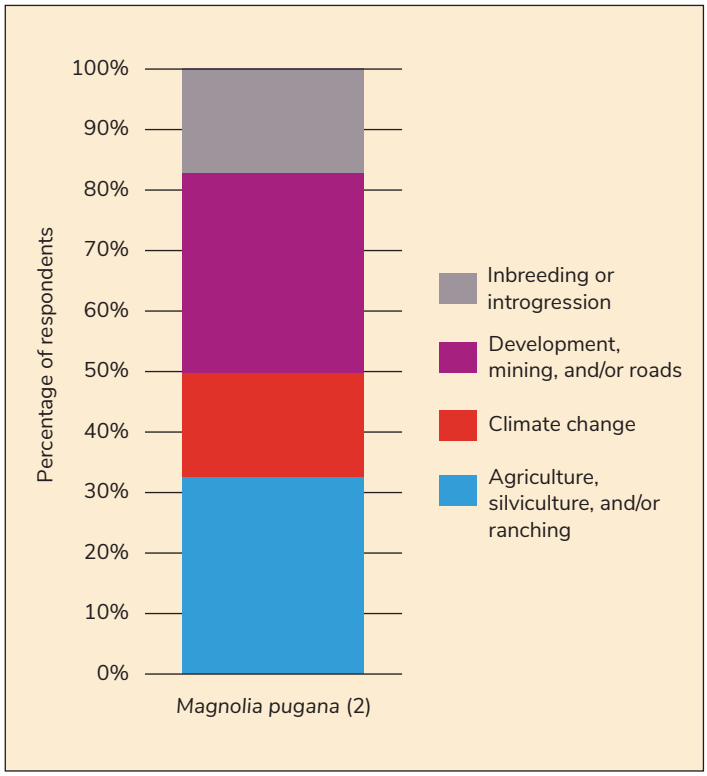

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. pugana* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

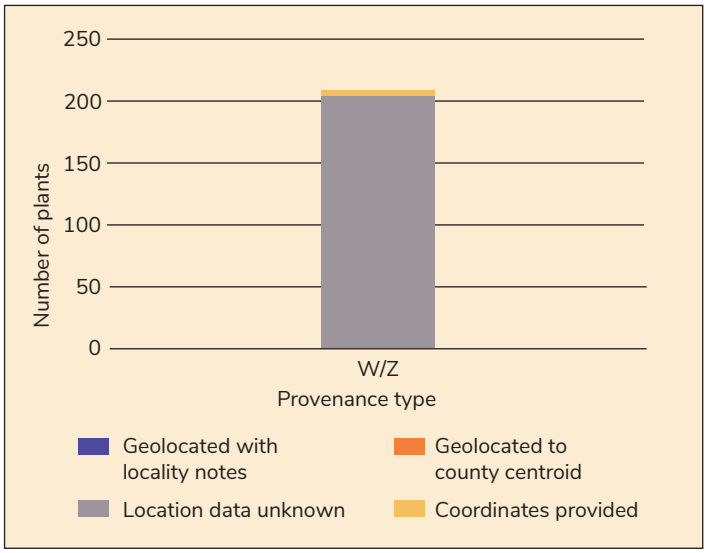

Figure 3. Number and origin of *Magnolia pugana* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	2
Number of plants in ex *situ* collections:	208
Average number of plants per institution:	104
Percent of ex *situ* plants of wild origin:	100%
Percent of wild origin plants with known locality:	1%

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	1,257 / 5,788 **(22%)**	7,854 / 17,474 **(45%)**	31,414 / 49,321 **(64%)**	**43%**
Ecological coverage	4 / 5 **(80%)**	5 / 5 **(100%)**	6 / 6 **(100%)**	**93%**

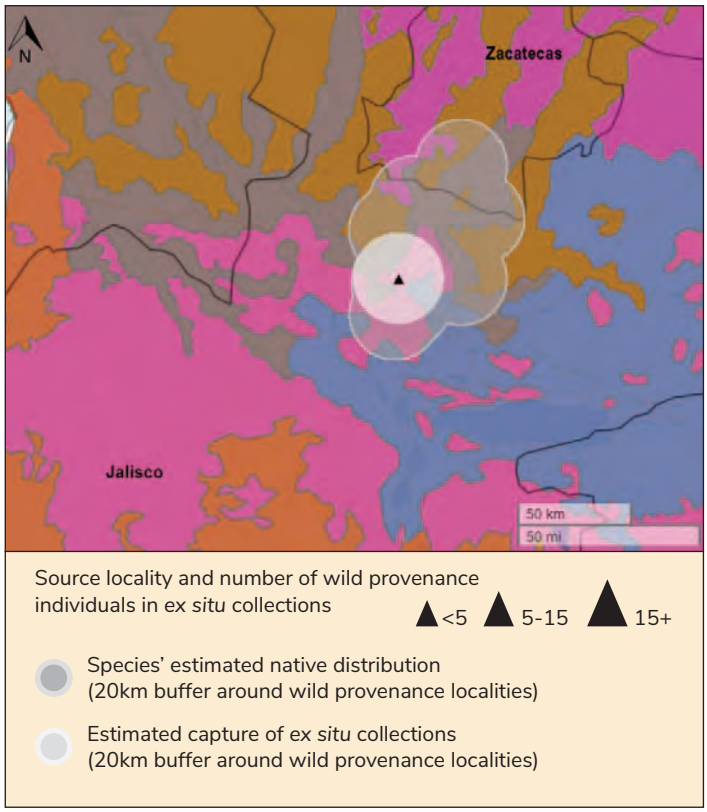

Figure 4. *Magnolia pugana in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Trans-Mexican Volcanic Belt pine-oak forests, Sinaloan dry forests and Sierra Madre Occidental pine-oak forests ecoregions.

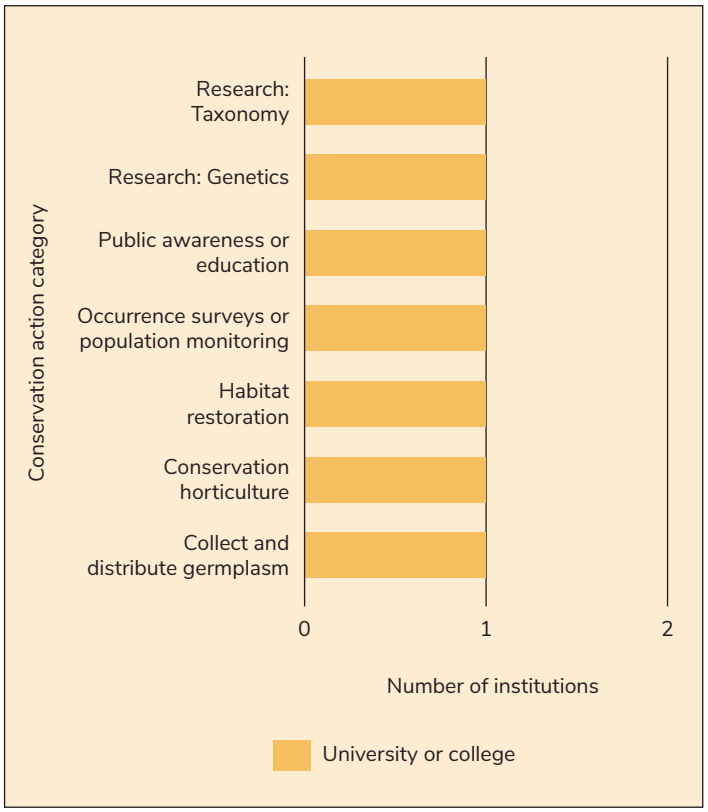

Figure 5. Number of institutions reporting conservation activities for *Magnolia pugana* grouped by organization type. One of 56 institutions reported activities focused on *M. odora* (see Appendix F for a list of all responding institutions).

Research: Taxonomy
Universidad de Guadalajara reports carrying out research on the taxonomy of *M. pugana*.

Research: Genetics
A study on *M. pugana* reveals that it has low genetic diversity (Muñiz-Castro et *al*. 2020). *M. pugana* is under greater water stress and is more threatened by fires than closely related species. It exists in isolated and fragmented habitats facing deforestation. Universidad de Guadalajara reports this activity for *M. pugana*.

Public awareness/education
Universidad de Guadalajara reports this activity for *M. pugana*.

Population reinforcement or introduction
Growth and reintroduction of the species has taken place in Zapopan, Jalisco. Since 2013 over 3000 individuals have been grown and 300 planted in Bosque La Primavera Biosphere Reserve, Colomos Park, and other private lands (Vázquez-García et *al*. 2021).

Occurrence surveys or population monitoring
Universidad de Guadalajara reports this activity for *M. pugana*.

Habitat restoration
Universidad de Guadalajara reports this activity for *M. pugana*.

Conservation horticulture
Studies on germination recommend treatments of aril removal and sowing in greenhouse conditions for propagation of this species (Jacobo-Pereira et al. 2016). Universidad de Guadalajara reports this activity for *M. pugana*.

Collection and distribution of germplasm
Universidad de Guadalajara reports this activity for *M. pugana*. *Ex situ* collections are reported from the Trans-Mexican Volcanic Belt pine-oak forests ecoregion (Figure 4).

Conservation Actions Needed

Is very necessary to create a specific institutional program for the collection of seeds, plant cultivation, nursery support and administration of ex *situ* collections of the magnolias of western Mexico, and to obtain financial support to strengthen and provide follow-up and long-term support for the program. In recent years there has been some financial support by BGCI for seed collection, plant cultivation and organization of the 1st Symposium of Neotropical *Magnolia* Conservation Consortium, July 8-14, 2019 in Guadalajara, Jalisco, Mexico, and the academic staff of University of Guadalajara (IBUG-CUCBA) have been participating actively in all these activities, but reinforcement of the program is needed for long term success. With the COVID-19 pandemic, the support of university students and professors has been significantly limited.

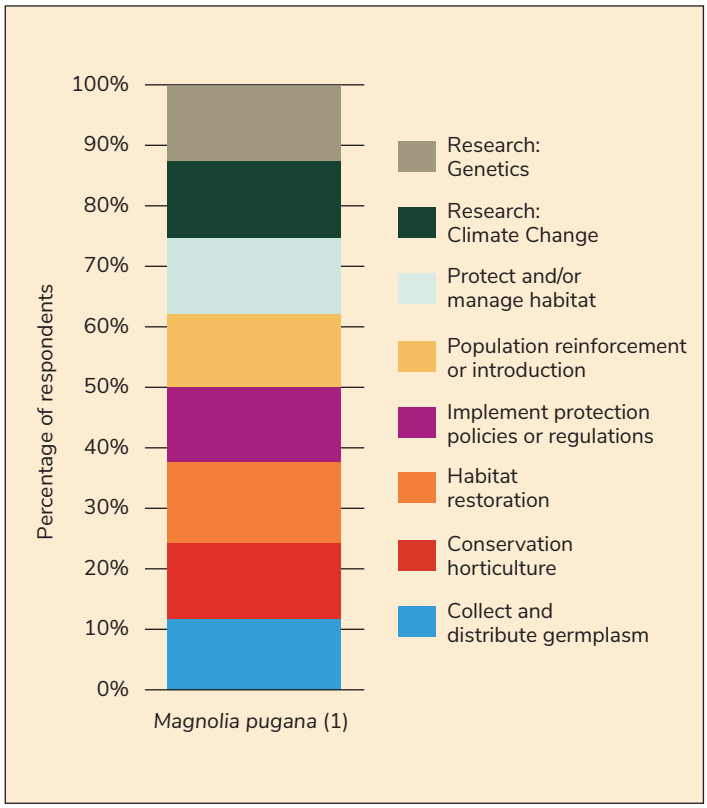

Figure 6. Responses from the Magnolia conservation action questionnaire for *M. pugana* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.


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Miguel Á. Muñiz Castro

Magnolia rajaniana (Craib) Figlar

Section: *Michelia* **Synonyms:** *Michelia rajaniana* Craib **Common names:** Champi Ratchani
IUCN Red List Category and Criteria: Vulnerable B1ab(iii,v)

Co-author: Wattana Tanming, Queen Sirikit Botanic Garden

Suggested citation: Linsky, J., & Tanming, W. (2022). *Magnolia rajaniana* (Craib) Figlar. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia rajaniana is endemic to northern Thailand and is found in lower montane forests. This species is used for building materials (Fukushima et *al*. 2008). The species is found in mountain forest habitat which is fragmented by surrounding agricultural areas in the plains. This species is assessed as Vulnerable due to its restricted extent and decline in habitat area and quality as well a number of mature individuals (Global Tree Specialist Group 2014).

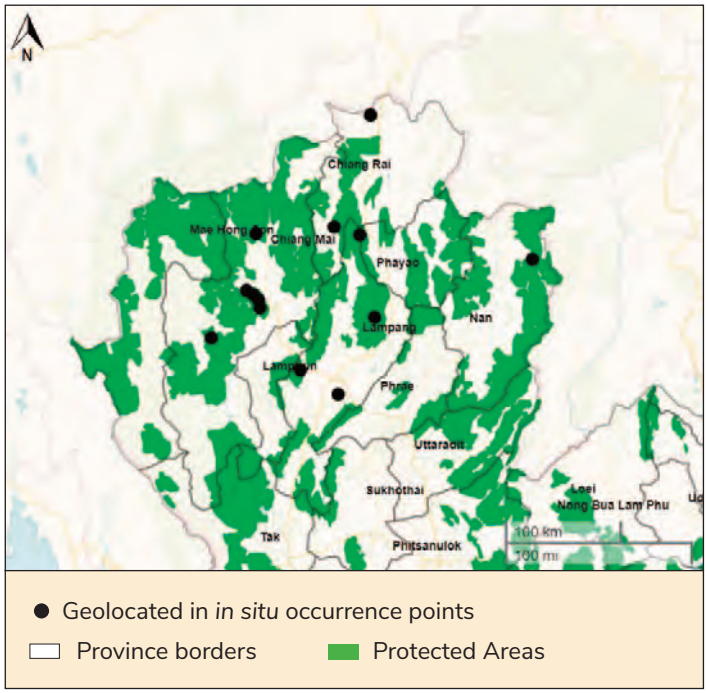

Figure 1. Documented *in situ* occurrence points for *Magnolia rajaniana* (GBIF 2021; GTSG 2014; Tanming Pers. Comm.) Protected areas are from Protected Planet (UNEP-WCMC 2021).

Threats to Wild populations

Selective logging for its timber is likely to be a significant threat. Forest fires commonly occur in Northern Thailand every year. These events can be a threat to seedling recruitment and population dynamics. Threats to M. rajaniana identified from the questionnaire include climate change; wild harvesting, disturbance regime modification; development, mining and/or roads; agriculture, silviculture and/or ranching and potential inbreeding or introgression.

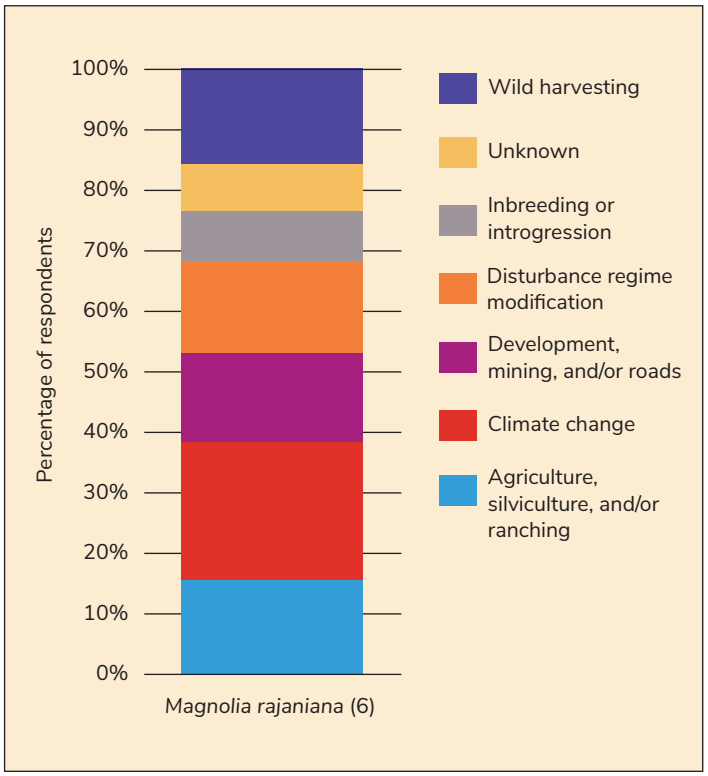

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. rajaniana* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia rajaniana*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	5
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	10
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
					Average vulnerability score		8

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	6
Number of plants in ex *situ* collections:	26
Average number of plants per institution:	4
Percent of ex *situ* plants of wild origin:	77%
Percent of wild origin plants with known locality:	10%

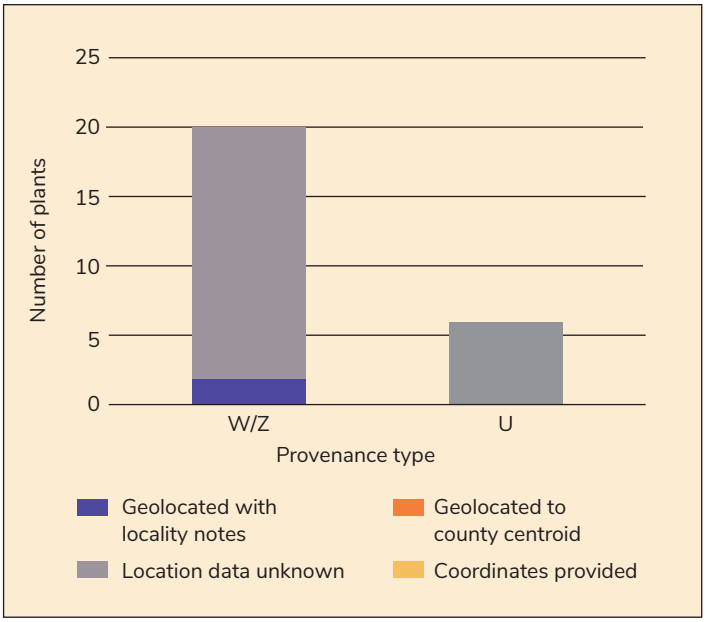

Figure 3. Number and origin of *Magnolia rajaniana* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in *ex situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The *ex situ* buffer area represents the native range "captured" in *ex situ* collections, or "combined area *ex situ*" (CAE20, CAE50, CAE100). Geographic coverage of *ex situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

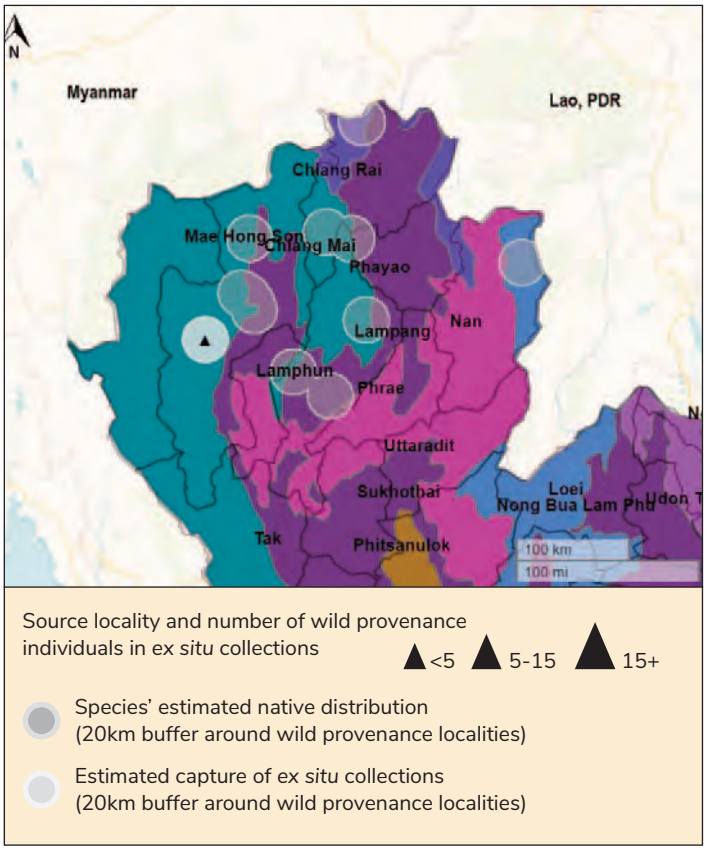

Figure 4. *Magnolia rajaniana in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the World (Olson 2001) are coloured; the recorded distribution is included in the Northern Indochina subtropical forests, Kayah-Karen montane rain forests, Central Indochina dry forests and Luang Prabang montane rain forests ecoregions.

Estimated *ex situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	1,257 / 12,338 **(10%)**	7,854 / 50,889 **(15%)**	29,030 / 88,782 **(33%)**	**19%**
Ecological coverage	2 / 5 **(40%)**	3 / 5 **(60%)**	3 / 5 **(60%)**	**53%**

Research: Taxonomy and Climate Change
One institution reports research on the taxonomy and climate change for *M. rajaniana*.

Public awareness/education
Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation (Thailand), Gardens of the Big Bend at University of Florida, Queen Sirikit Botanic Garden and one other institution report this activity for *M. rajaniana*.

Protect and/or manage habitat
Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation (Thailand) and Queen Sirikit Botanic Garden report this activity for *M. rajaniana*.

Population reinforcement/introduction
Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation (Thailand) and Queen Sirikit Botanic Garden report this activity for *M. rajaniana*.

Occurrence surveys or population monitoring
Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation (Thailand), Queen Sirikit Botanic Garden and one other institution report this activity for M. *rajaniana*.

Implement protection policies or regulations
Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation (Thailand) reports this activity for *M. rajaniana*.

Habitat restoration
Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation (Thailand) and Queen Sirikit Botanic Garden report this activity for *M. rajaniana*.

Conservation horticulture
Gardens of the Big Bend at University of Florida, Global Biodiversity Conservancy and Queen Sirikit Botanic Garden report conservation horticulture activities for *M. rajaniana*.

Collect and distribute germplasm
Queen Sirikit Botanic Garden reports this activity for *M. rajaniana*. *Ex situ* collections are reported from the Kayah-Karen montane rain forests ecoregion (Figure 4).

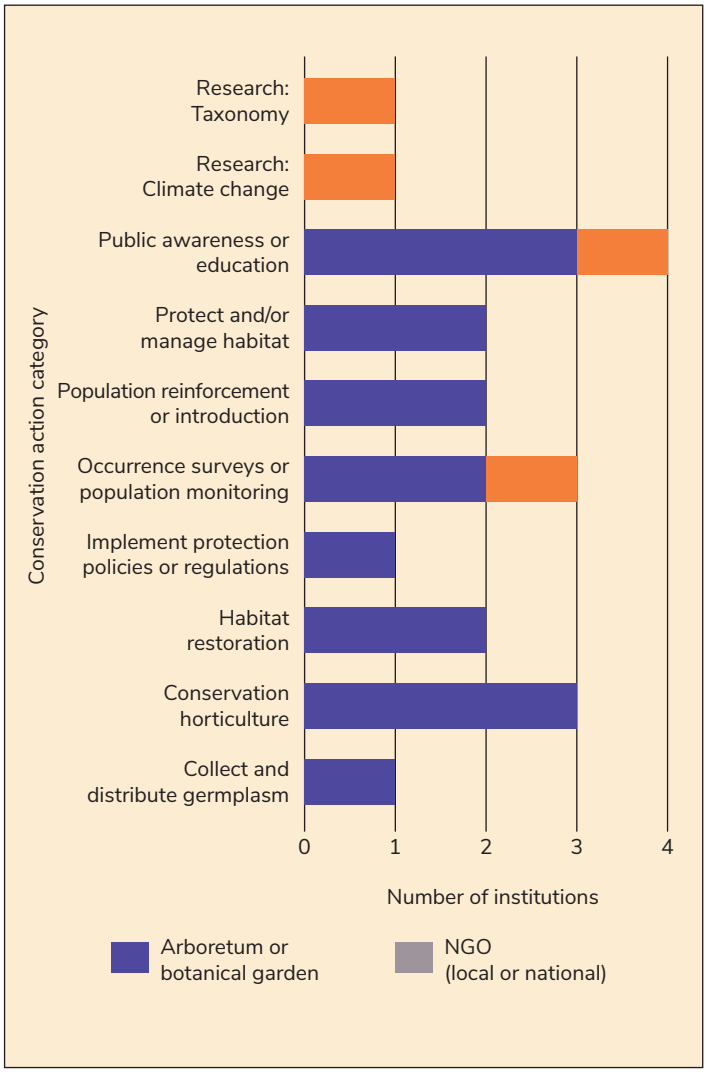

Figure 5. Number of institutions reporting conservation activities for *Magnolia rajaniana* grouped by organization type. Five of 56 institutions reported activities focused on *M. rajaniana* (see Appendix F for a list of all responding institution


Wattana Tanming

Conservation Actions Needed

Further development of a genetically representative ex situ collection of this species is recommended. Other suggestions for conservation activities include further research on climate change, public awareness and education, occurrence surveys/ population monitoring, and habitat restoration.

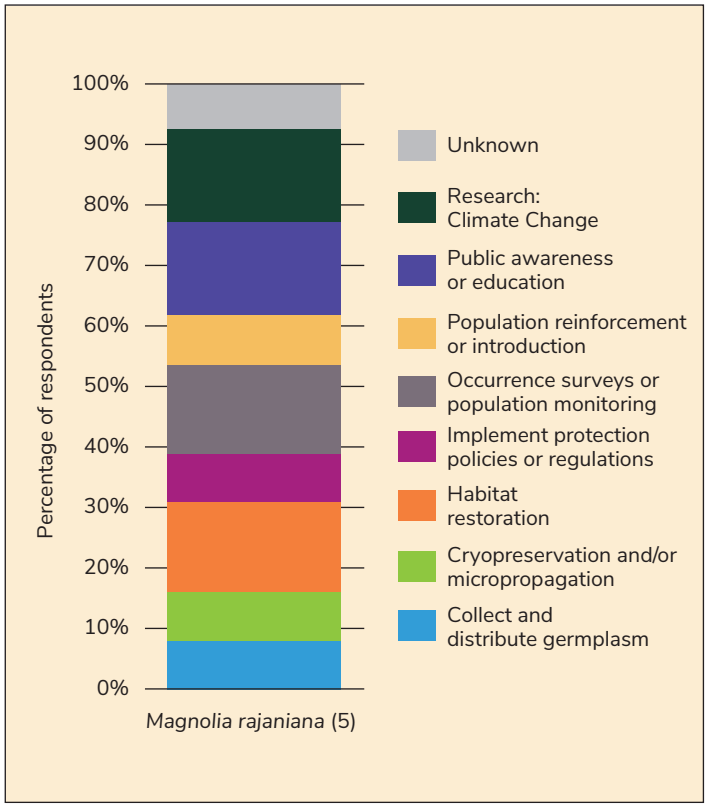

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. rajaniana* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia rzedowskiana
A.Vázquez, Domínguez-Yescas & R.Pedraza

Section: *Macrophylla* **Synonyms:** None **Common names:** Magnolia, Eloxóchitl (flor de elote), flor de mayo
IUCN Red List Category and Criteria: Endangered B1ab(v)

Co-authors: Marisol Gutiérrez-Lozano & Arturo Sánchez-González, Universidad Autónoma del Estado de Hidalgo

Suggested citation: Linsky, J., Gutiérrez-Lozano, M., & Sánchez-González, A. (2022). *Magnolia rzedowskiana* A.Vázquez, Domínguez-Yescas & R.Pedraza. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

The natural populations of *Magnolia rzedowskiana* are distributed in the Cloud Forest (CF) of the northeast of the states of Hidalgo (Acomulco and Chilijapa) and Querétaro (La Yesca), southeast of San Luis Potosí (Xilitla), within the Sierra Madre Oriental de México. In all the localities where the populations are distributed, the topographic conditions of the terrain are abrupt and the individuals of *M. rzedowskiana* are scattered and distant from each other, since the density is very low. The largest population (La Yesca, Querétaro) is around 300 trees; although it is probable that in the surroundings, within the Sierra Gorda Biosphere Reserve, there are populations with a higher density of individuals, but the possibility of accessing them for research purposes, is being restricted; in Chilijapa (Tepehuacán de Guerrero, Hidalgo) and La Trinidad (Xilitla, San Luis Potosí), there are about 100 adult individuals, together. It is likely that populations have been reduced at these localities from historical sizes.

In Acomulco (Xochicoatlán, Hidalgo), Apantlazol (Tlanchinol, Hidalgo) and Agua de la Calabaza (Huayacocotla, Veracruz), less than 10 individuals were counted in each locality, distributed within gardens, cultivated in family gardens or isolated in the forest, but close to the houses (Gutiérrez-Lozano et al., 2020).

M. rzedowskiana is assessed as Endangered due to its restricted range and impact from land use change and over-use of the flowers and bark of the tree often leading to felling of trees.

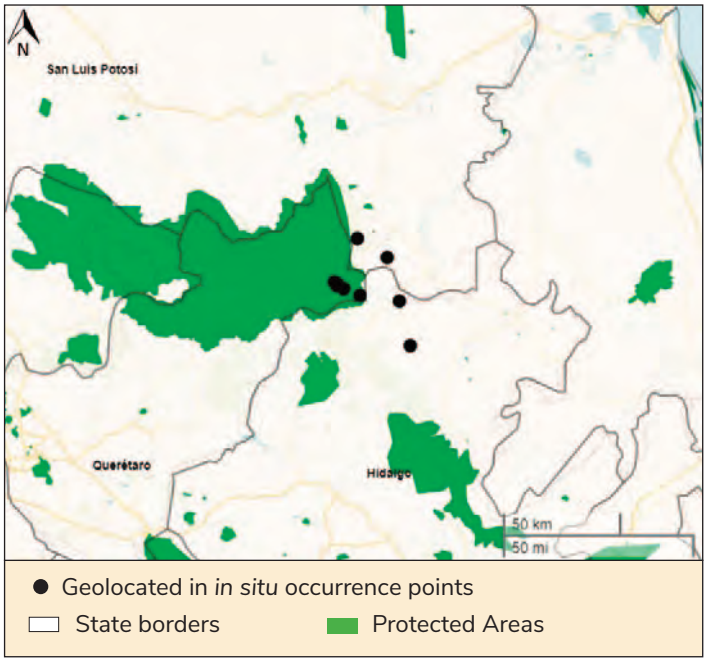

Figure 1. Documented *in situ* occurrence points for *Magnolia rzedowskiana* (Chávez-Cortázar et al. 2021; Vázquez García et al. 2015). Protected areas are from Protected Planet (UNEP-WCMC 2021).


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Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia rzedowskiana*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	20
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	-
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	5
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	10
					Average vulnerability score		12

Threats to Wild populations

The main problem affecting the populations of *M. rzedowskiana* is disturbance caused by human activities, which include in order of importance: change in land use, uncontrolled sale of magnolia flowers in local markets, use of the bark of the trees to prepare infusions to prevent or treat different conditions and the felling of trees to use them as firewood or as wood for construction. In addition, natural disturbances such as wind and torrential rains are the main cause of falling trees; some animals, such as gophers feed on the seedlings, insects consume the petals, and birds and squirrels consume all or part of the seeds. Therefore, it is urgent to develop in the short term, conservation and restoration programs at the local level of the populations of *M. rzedowskiana*; the first step is to avoid or reduce the rate of loss and fragmentation of its habitat, the CF (Gutiérrez-Lozano et *al*., 2020). Additional threats include potential inbreeding or introgression and disturbance regime modification.

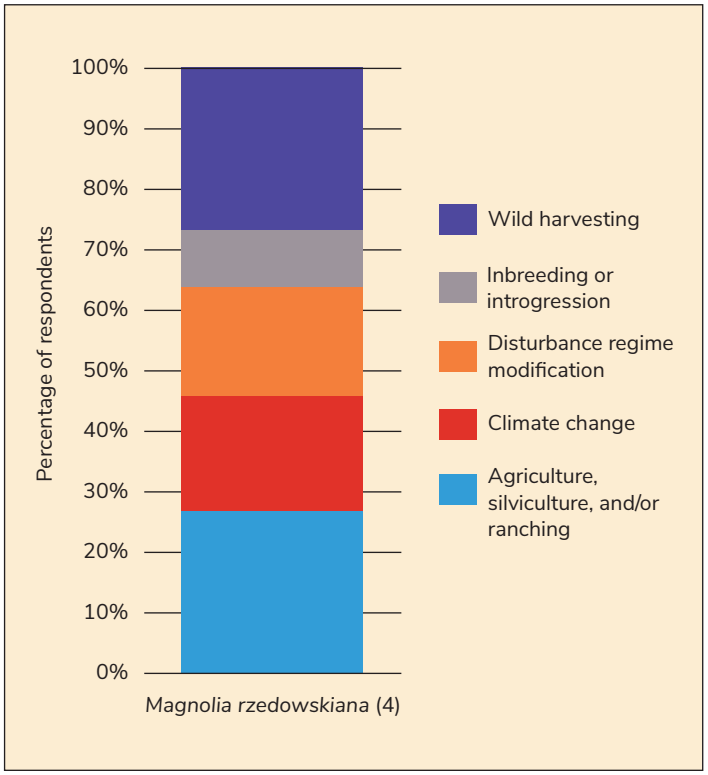

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. rzedowskiana* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	1
Number of plants in ex *situ* collections:	4
Average number of plants per institution:	4
Percent of ex *situ* plants of wild origin:	100%
Percent of wild origin plants with known locality:	100%

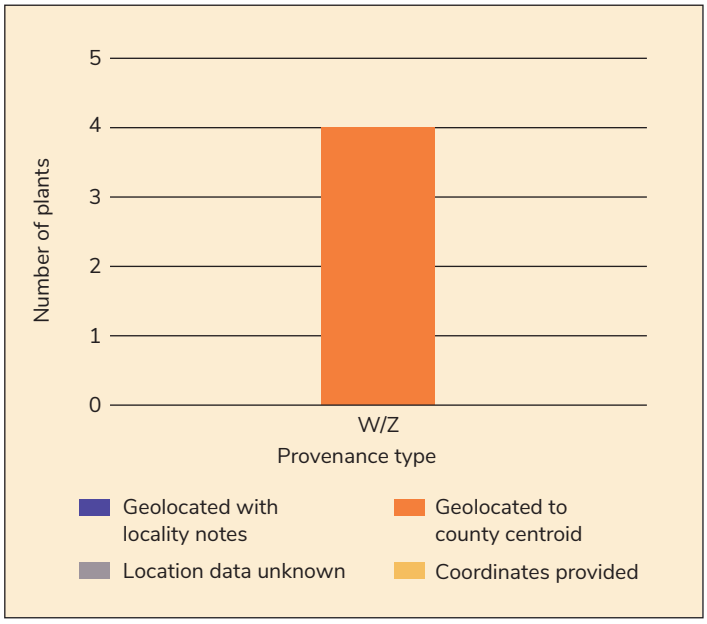

Figure 3. Number and origin of *Magnolia rzedowskiana* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.


Marisol Gutiérrez Lozano and Arturo Sánchez González

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	1,257 / 4,219 **(30%)**	7,854 / 14,782 **(53%)**	31,414 / 44,801 **(70%)**	**51%**
Ecological coverage	4 / 4 **(100%)**	4 / 5 **(80%)**	6 / 7 **(86%)**	**89%**

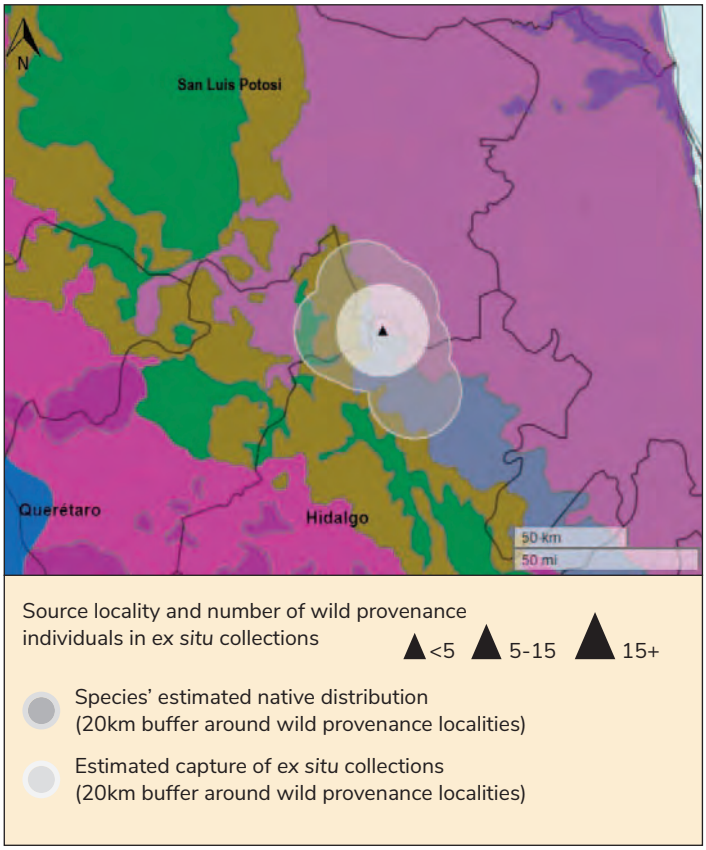

Figure 4. *Magnolia rzedowskiana in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Veracruz moist forests, Veracruz montane forests and Sierra Madre Oriental pine-oak forests ecoregions.

Research: Genetics
Studies on genetic diversity of *M. rzedowskiana* populations showed that 2 subpopulations in Querétaro had very low genetic diversity. These were identified as genetically eroded populations in need of conservation (Chávez Cortázar et *al*. 2021). A study on the morphological differentiation of *M. rzedowskiana* subpopulations may be showing a loss of adaptive potential due to fragmentation and isolation of subpopulations (Gutiérrez-Lozano et *al*. 2020).

Protect and/or manage habitat
The establishment of a private protected area which excluded livestock and the removal of trees has led to the regeneration of seedlings and a local increase in the population in that area. The species has been planted in some parts of Hidalgo and Veracruz (Vázquez-García et *al*. 2015). Grupo Ecológico Sierra Gorda is working to protect the habitat of this species as well as carry out habitat restoration.

Population reinforcement or introduction
In the locality of Acomulco (Xochicoatlán), and Chilijapa (Hidalgo), there are *in situ* conservation actions, of the species, undertaken by only one of the inhabitants of the place, mainly through the germination of seeds, but the initiative has not prospered due to the indifference of most people. The seedlings obtained have been planted in other localities near Chilijapa.

Occurrence surveys or population monitoring
Grupo Ecológico Sierra Gorda and one other institution report this activity for *M. rzedowskiana*.

Implement protection policies or regulations
Grupo Ecológico Sierra Gorda reports this activity for *M. rzedowskiana*.

Habitat restoration
Grupo Ecológico Sierra Gorda is working to carry out habitat restoration for *M. rzedowskiana*.

Collection and distribution of germplasm
One institution reports this activity for *M. rzedowskiana*. *Ex situ* collections are reported from the Veracruz montane forests ecoregion (Figure 4). The *ex situ* collection source locality mapped here is based on state level information and estimated within the known range of the species.

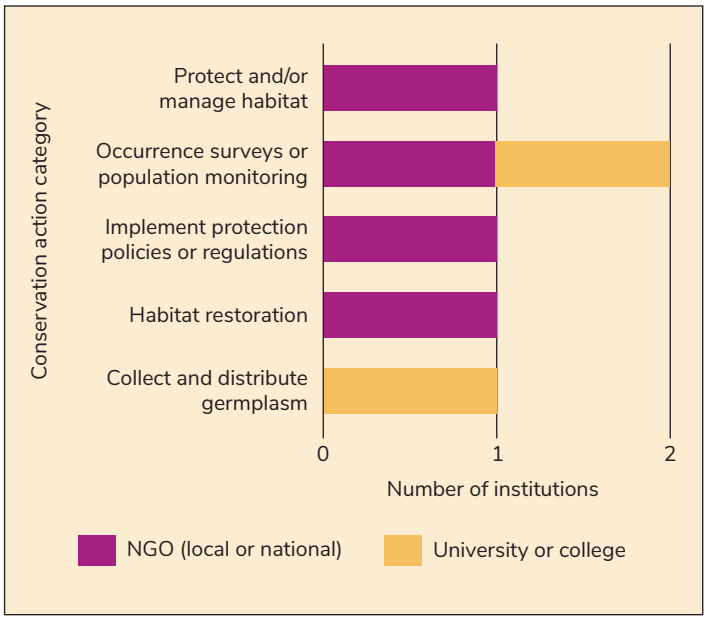

Figure 5. Number of institutions reporting conservation activities for *Magnolia rzedowskiana* grouped by organization type. Three of 56 institutions reported activities focused on *M. rzedowskiana* (see Appendix F for a list of all responding institutions).

Conservation actions needed

Based on the above, it is proposed that it is necessary to develop *in situ* and *ex situ* conservation strategies to safeguard the species, open lines of research on germination, propagation and reforestation issues; accompanied by environmental education workshops, on the use of magnolia flowers and wood in a controlled way, and on the importance of conserving the species and the CF in general (Gutiérrez-Lozano et *al*., 2020).

It is suggested that it is necessary that the people of the localities where there are populations of *M. rzedowskiana*, have access to information on the importance of the management and conservation of biodiversity, both from an economic and ecological point of view; mainly through environmental education workshops. The survival of the species depends to a great extent on the inhabitants of the surrounding localities recognizing its importance and being directly involved in the management and conservation programs that are implemented.

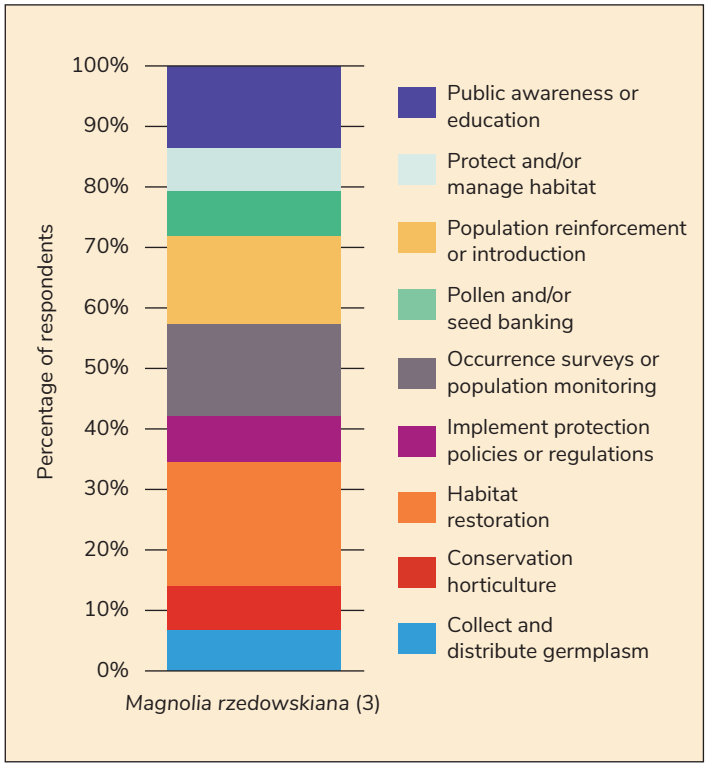

Figure 6. Responses from the Magnolia conservation action questionnaire for *M. rzedowskiana* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia sapaensis (N.H.Xia & Q.N.Vu) Grimshaw & Macer

Section: *Manglietia* **Synonyms:** *Manglietia sapaensis* N.H.Xia & Q.N.Vu **Common names:** None
IUCN Red List Category and Criteria: Vulnerable D2

Co-authors: Vu Quang Nam, Vietnam National University of Forestry; Scott McMahan, Atlanta Botanical Garden

Suggested citation: Linsky, J., Vu, Q.N., & McMahan, S. (2022) *Magnolia sapaensis* (N.H.Xia & Q.N.Vu) Grimshaw & Macer. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia sapaensis is described from the Hoang Lien National Park in Lao Cai Province in northern Viet Nam. These evergreen trees of up to 10 m in height are found in secondary tropical rain broad-leaved forests habitats at altitudes of 2199-2275m a.s.l. *M. sapaensis* flowers in April and May and fruits in August to November (Vu and Xia 2010). These evergreen trees are found in very exposed areas which have been opened by fire. This is different from other evergreen species which generally are found in more dense understory. The species is also reported to have been collected in China near the border with Viet Nam (pers. comm. with Vu 2021), however records of presence in China are lacking from the present analysis.


Vu Quang Nam


Scott McMahan

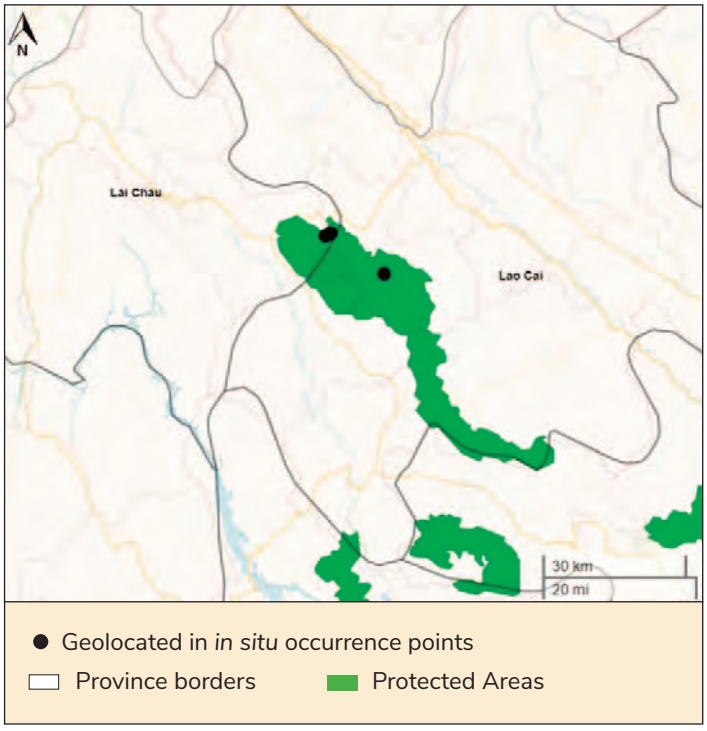


Figure 1. Documented *in situ* occurrence points for *Magnolia sapaensis* (GBIF, 2021; Vu Quang Nam pers. comm. 2021). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia sapaensis*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	-
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
						Average vulnerability score	10

Threats to Wild populations

A moderate to high threat to the wild populations found on Fan Xi Pan mountain is the cable car that now runs from near Sa Pa to the summit. Not only was the construction very destructive, but it now allows easy access for thousands of people to areas of Hoang Lien Son National Park that had previously been well protected by how difficult it was to reach them. Cardamom farming, requiring thinning of the forest and clearing of the understory, also poses a threat to wild populations. Additional threats identified include disturbance regime modification and climate change.

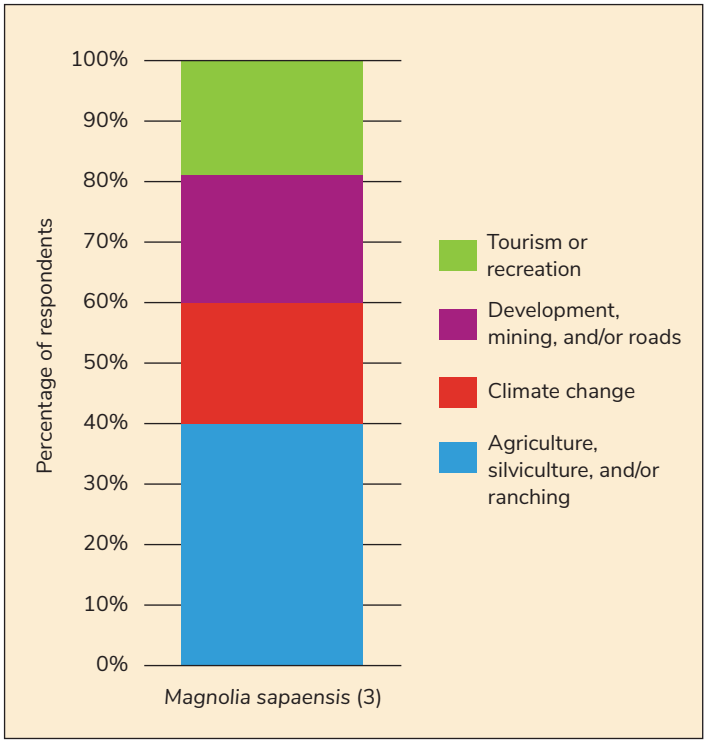


Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. sapaensis* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	20
Number of plants in ex *situ* collections:	39
Average number of plants per institution:	2
Percent of ex *situ* plants of wild origin:	62%
Percent of wild origin plants with known locality:	83%

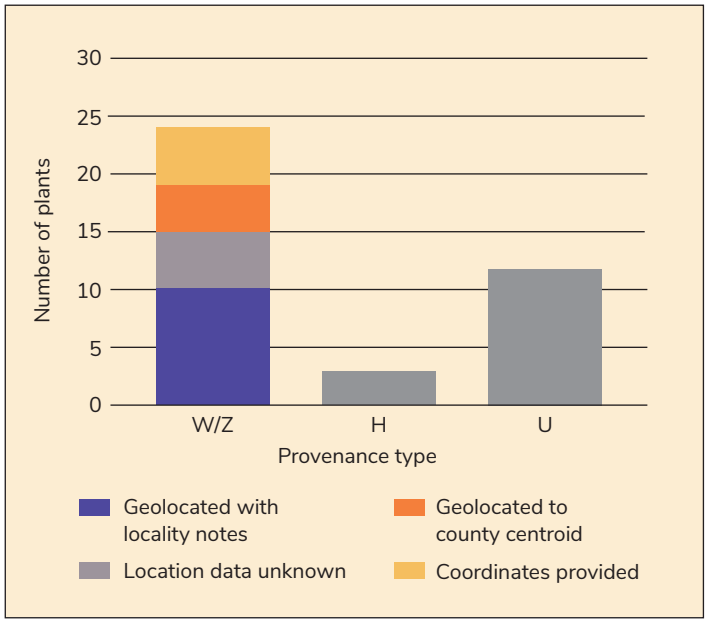
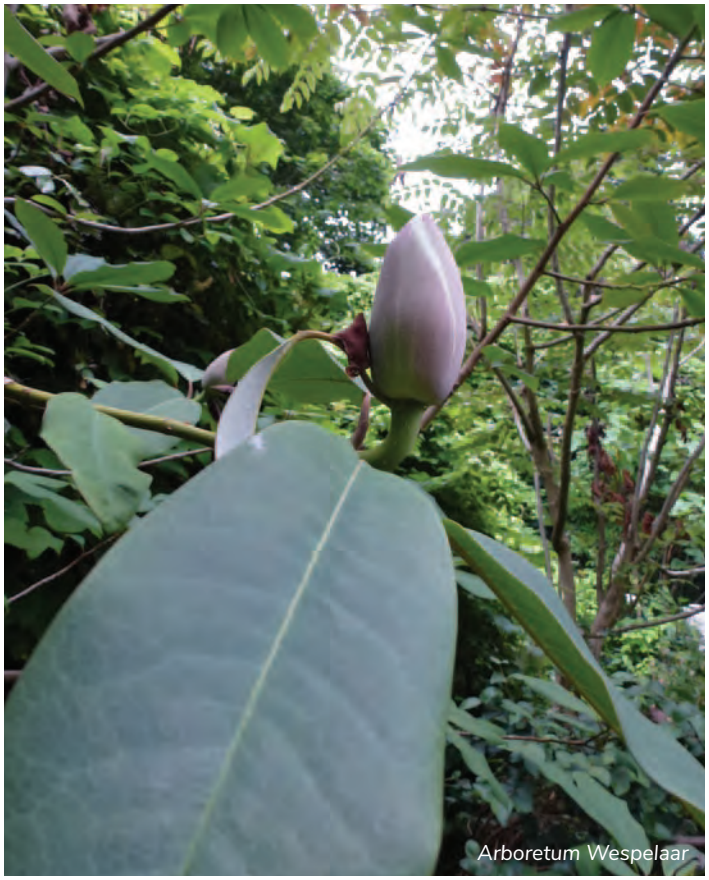


Figure 3. Number and origin of *Magnolia sapaensis* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.


Arboretum Wespelaar

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	2,596 / 2,924 **(89%)**	9,750 / 10,444 **(93%)**	27,203 / 28,451 **(96%)**	**93%**
Ecological coverage	1 / 1 **(100%)**	1 / 1 **(100%)**	1 / 1 **(100%)**	**100%**

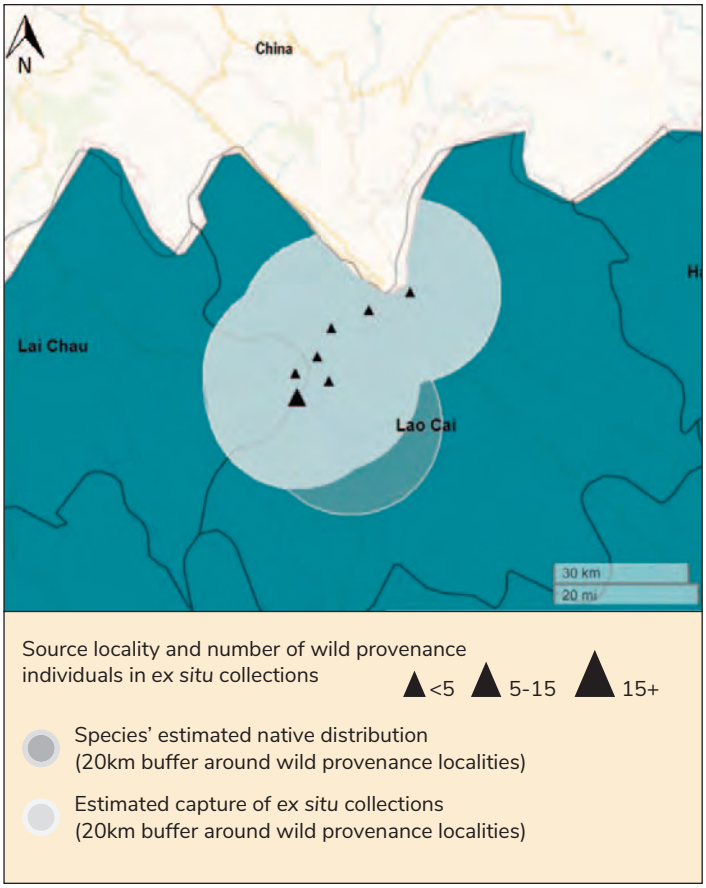


Figure 4. . *Magnolia sapaensis in situ* occurrence points and ex *situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Northern Indochina subtropical forests ecoregion.

Pollen and/or seedbanking

Vietnam National University of Forestry and University of British Columbia Botanical Garden report pollen and/or seed banking of *M. sapaensis*.

Occurrence surveys or population monitoring

Vietnam National University of Forestry reports this activity for *M. sapaensis*.

Conservation horticulture

University of British Columbia Botanical Garden reports conservation horticulture activities for *M. sapaensis*. This species is reported from a number of ex *situ* collections, globally, however, *M. sapaensis* is not subject to ex *situ* conservation via living collections within Viet Nam.

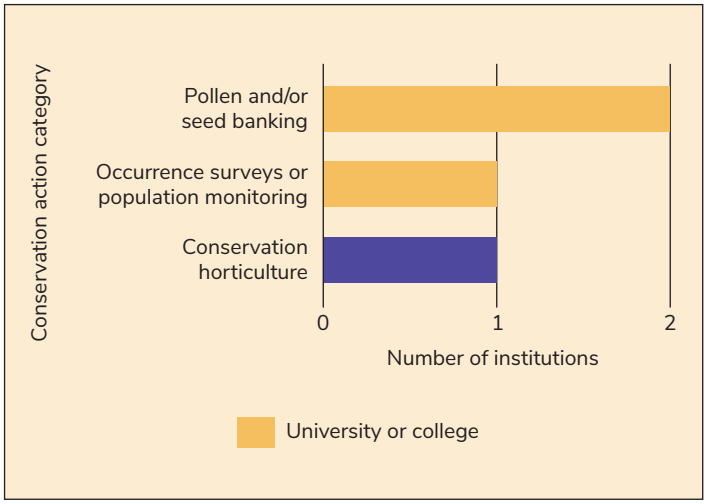


Figure 5. Number of institutions reporting conservation activities for *Magnolia sapaensis* grouped by organization type. Two of 56 institutions reported activities focused on *M. sapaensis* (see Appendix F for a list of all responding institutions.

Conservation Actions Needed

Further surveys to confirm the population size and distribution range in Hoang Lien National Park as well as possible presence in China are needed. Research on phenology, ecology and regeneration are needed as well as propagation for reinforcement plants and restoration. Additional ex *situ* methods including further pollen and/or seed banking and cryopreservation/ micropropagation are recommended.

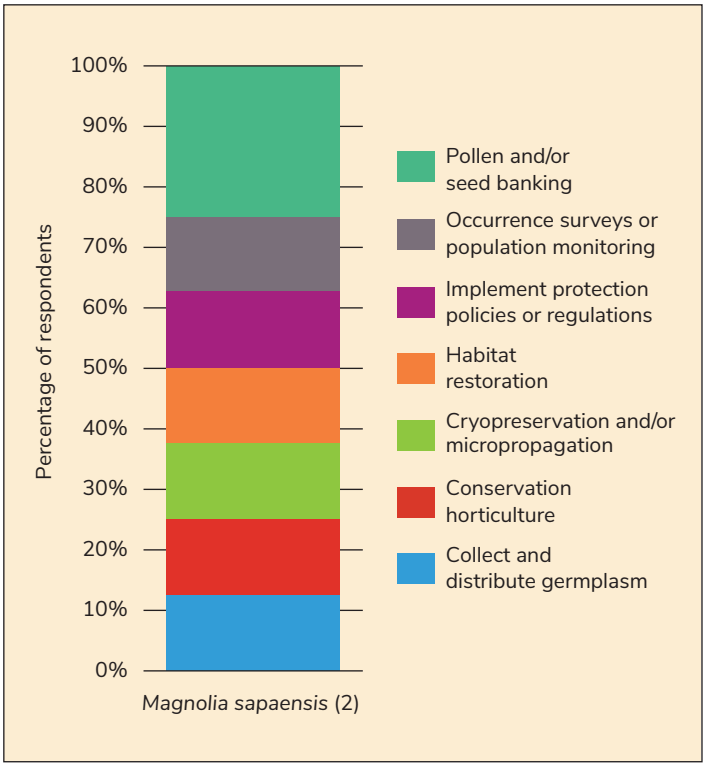


Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. sapaensis* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Arboretum Wespelaar

Magnolia sargentiana Rehder & E.H.Wilson

Section: *Yulania* **Synonyms:** *Magnolia conspicua* Salisb. subsp. *emarginata* Finet & Gagnep., *Magnolia denudata* Desr. subsp. *emarginata* (Finet & Gagnep.) Pamp., *Magnolia emarginata* (Finet & Gagnep.) W.C.Cheng, *Magnolia sargentiana* Rehder & E.H.Wilson subsp. *robusta* Rehder & E.H.Wilson, *Yulania sargentiana* (Rehder & E.H.Wilson) D.L.Fu **Common names:** None **IUCN Red List Category and Criteria:** Vulnerable B2ab(iii,v)

Suggested citation: Linsky, J. (2022). *Magnolia sargentiana* Rehder & E.H.Wilson. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia sargentiana is endemic to China where it has a fragmented distribution in Sichuan and Yunnan. Following surveys in 2006, the population of this species is estimated to be around 20,000 individuals (Global Tree Specialist Group 2014). Some of the population is in well protected reserves and has good regeneration. The species bark and flowers were historically used at a large scale for medicinal purposes but is now restricted to smaller scale use (Wang et *al*. 2009). The species is assessed as Vulnerable due to the continuing decline of the unprotected habitat and use of the species for medicinal purposes.

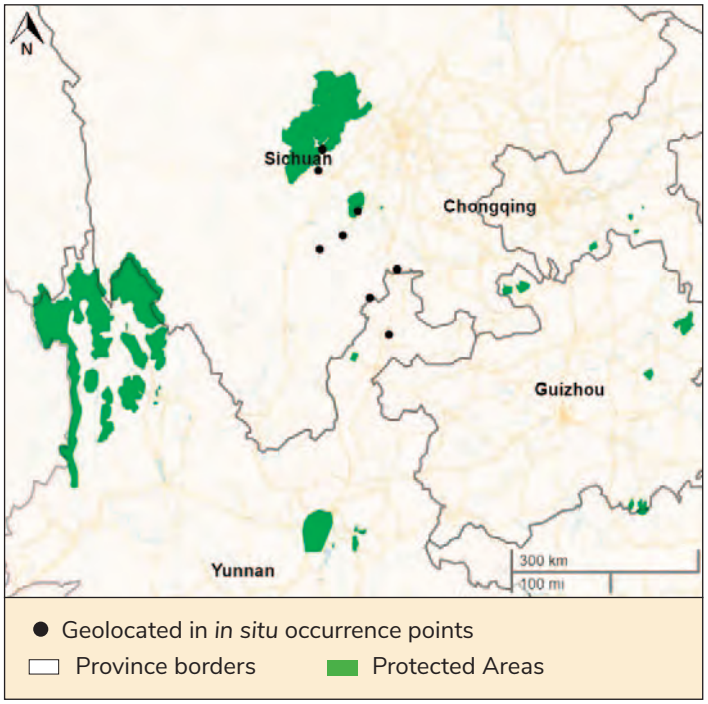

Figure 1. Documented *in situ* occurrence points for *Magnolia sargentiana* (GBIF 2021). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia sargentiana*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	0
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	5
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	0
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	10
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
						Average vulnerability score	4

Threats to Wild populations

M. sargentiana is threatened by forest clearance; cutting for wood and gathering of its bark for use in traditional medicines. Poor regeneration and possible reduction of gene flow is predicted due to unfavorable climatic conditions and anthropomorphic pressure on flower production and pollination. The seeds quickly lose germination ability if not planted quickly after dispersal (Wang et *al.* 2009). Agriculture, silviculture and/or ranching as well as climate change are also identified as threats to this species.


Arboretum Wespelaar

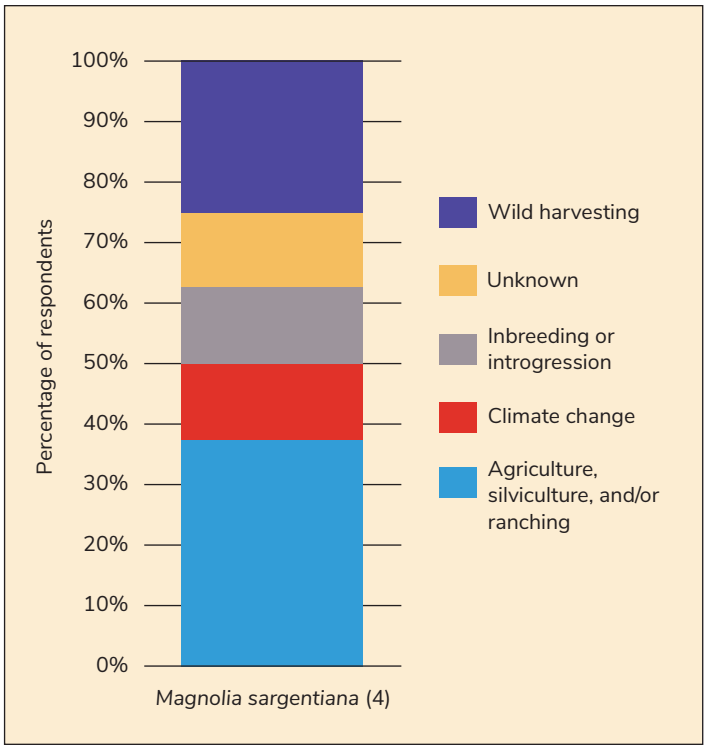

Figure 2. Responses from the Magnolia conservation action questionnaire for *M. sargentiana* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex situ collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of *ex situ* survey

Number of *ex situ* collections reporting this species:	64
Number of plants in *ex situ* collections:	193
Average number of plants per institution:	3
Percent of *ex situ* plants of wild origin:	7%
Percent of wild origin plants with known locality:	57%

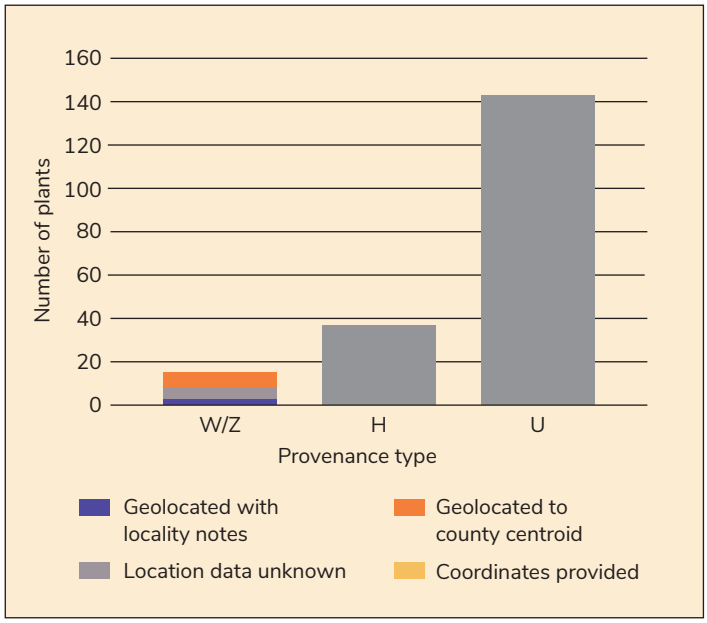

Figure 3. Number and origin of *Magnolia sargentiana* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in *ex situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The *ex situ* buffer area represents the native range "captured" in *ex situ* collections, or "combined area *ex situ*" (CAE20, CAE50, CAE100). Geographic coverage of *ex situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.


Arboretum Wespelaar

Estimated *ex situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	6,283 / 15,200 **(41%)**	36,058 / 66,047 **(55%)**	113,796 / 141,982 **(80%)**	**59%**
Ecological coverage	5 / 6 **(83%)**	7 / 7 **(100%)**	7 / 7 **(100%)**	**94%**

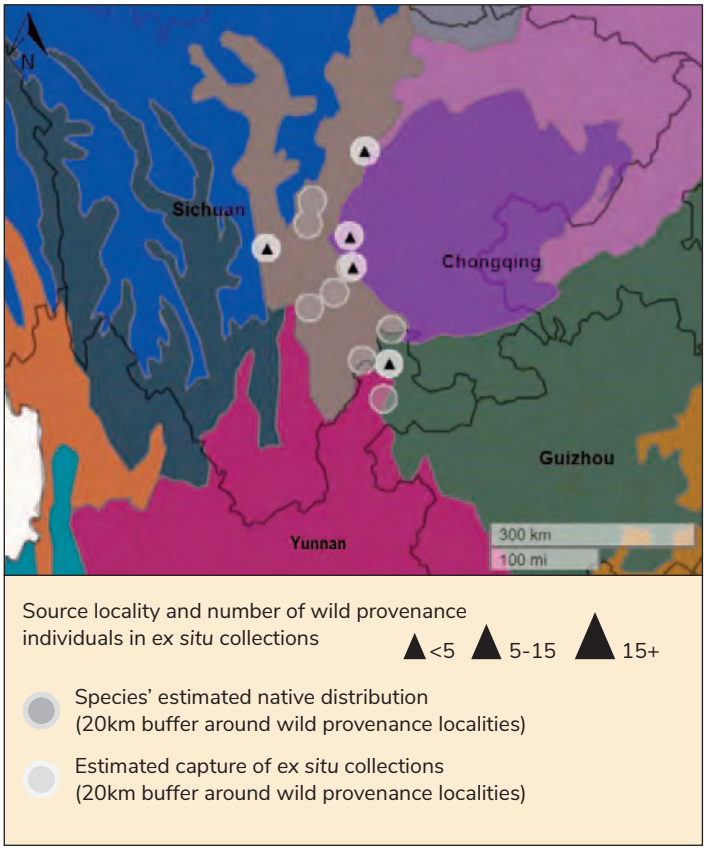

Figure 4. *Magnolia sargentiana in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Qionglai-Minshan conifer forests, Sichuan Basin evergreen broadleaf forests, Guizhou Plateau broadleaf and mixed forests, Yunnan Plateau subtropical evergreen forests ecoregions.

Public awareness/education
Shenzhen Fairy Lake Botanical Garden reports carrying out public awareness or education activities for *M. sargentiana*.

Protect and/or manage habitat
Trees are protected in reserves including Provincial Mamize Nature Reserve and the National Meigu Dafengding Nature Reserve in Sichuan Province. Shenzhen Fairy Lake Botanical Garden reports this activity for *M. sargentiana*.

Pollen and/or seed banking
Research on seed biology has shown that M. sargentiana exhibits intermediate seed storage behavior (Tang 2014). Shenzhen Fairy Lake Botanical Garden and University of British Columbia Botanical Garden report carrying out pollen and/or seed banking of *M. sargentiana*.

Occurrence surveys or population monitoring
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. sargentiana*.

Implement protection policies or regulations
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. sargentiana*.

Habitat restoration
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. sargentiana*.

Cryopreservation/micropropagation
The Huntington reports cryopreservation of *M. sargentiana*.

Conservation horticulture
Shenzhen Fairy Lake Botanical Garden, The Huntington, University of British Columbia Botanical Garden and one other institution report conservation horticulture activities for *M. sargentiana*.

Collection and distribution of germplasm
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. sargentiana*. *Ex situ* collections are reported from the Qionglai-Minshan conifer forests, Sichuan Basin evergreen broadleaf forests and Guizhou Plateau broadleaf and mixed forests ecoregions (Figure 4).


Arboretum Wespelaar

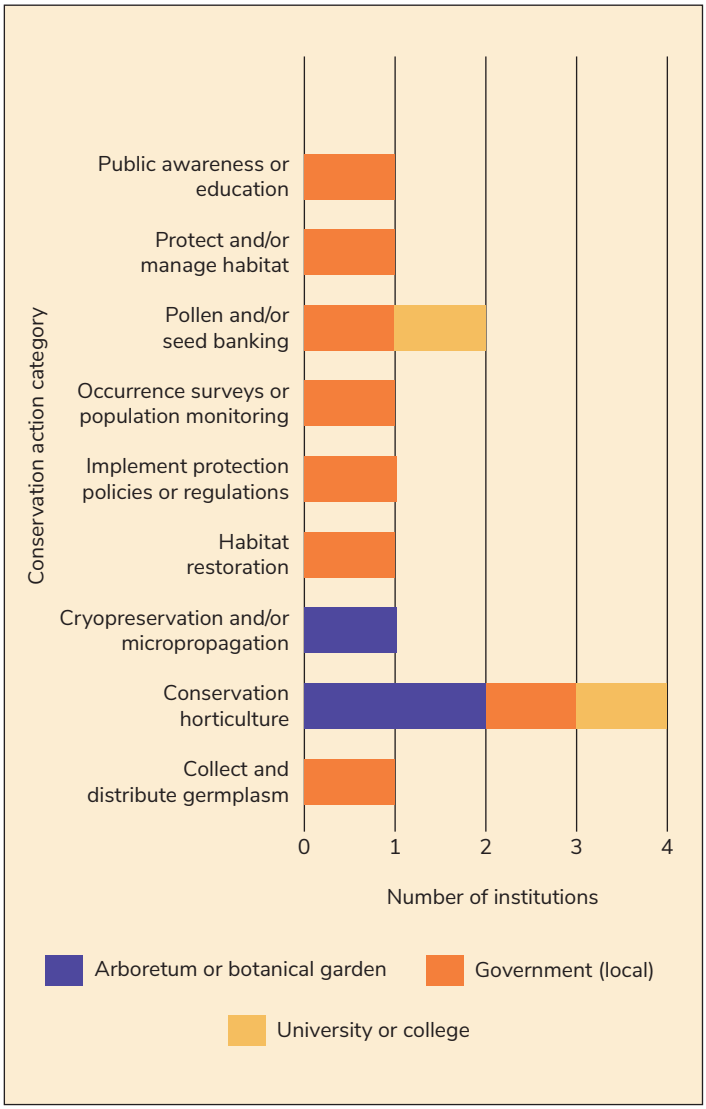

Figure 5. Number of institutions reporting conservation activities for *Magnolia sargentiana* grouped by organization type. Four of 56 institutions reported activities focused on M. sargentiana (see Appendix F for a list of all responding institutions).

Conservation Actions Needed

Development of management systems to improve regeneration of the species, through exclusion of livestock and sustainable use strategies for the wood and flowers are recommended for the species (Wang et al. 2009). Other key recommendations are further conservation horticulture, collection and distribution of germplasm and cryopreservation/micropropagation.

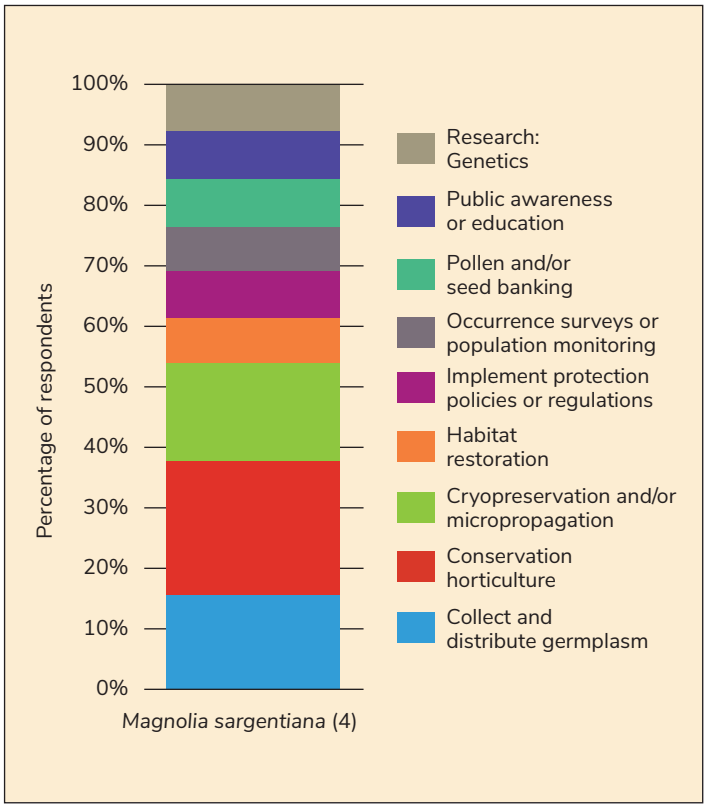

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. sargentiana* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Philippe de Spoelberch


Philippe de Spoelberch


Philippe de Spoelberch

Magnolia sharpii V.V.Miranda

Section: *Magnolia* **Synonyms:** None **Common names:** Tajchac, Tojchó
IUCN Red List Category and Criteria: Endangered B1ab(iii,v)

Suggested citation: Linsky, J. (2022). *Magnolia sharpii* V.V.Miranda. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia sharpii is endemic to Mexico and is found in the central plateau in Chiapas between elevations of 1,950 - 2,940 m asl. It is found in cloud forest, moist oak forest and pine-oak forest. It is currently assessed as Endangered due to its restricted range and continuing decline in habitat (Luna-Vega et *al*. 2014).

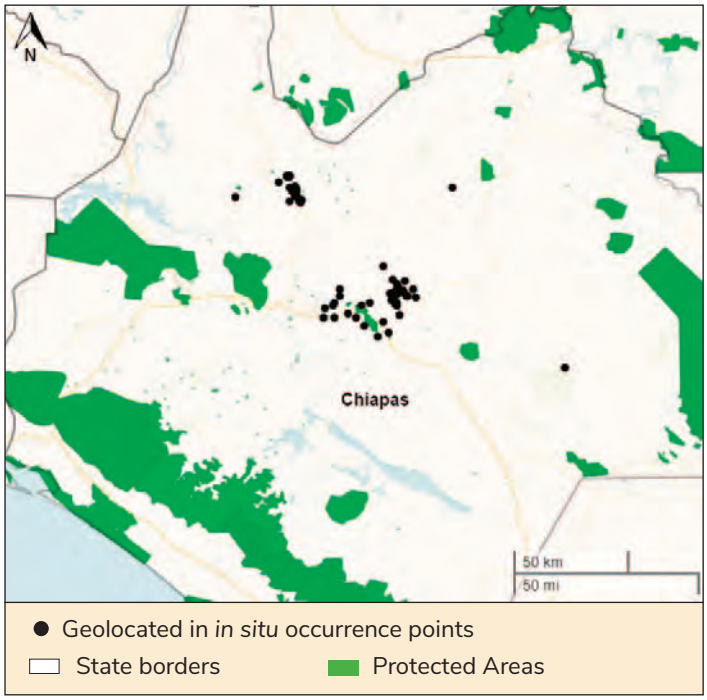

Figure 1. Documented *in situ* occurrence points for *Magnolia sharpii* (GBIF 2021; UCR 2021). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Threats to Wild populations

The species is threatened mainly by wood extraction, cattle grazing and fire and these kinds of disturbances impact the regeneration, survival and growth of naturally established tree seedlings (Luna-Vega et *al*. 2014). Climate change is also indicated as a threat to this species.

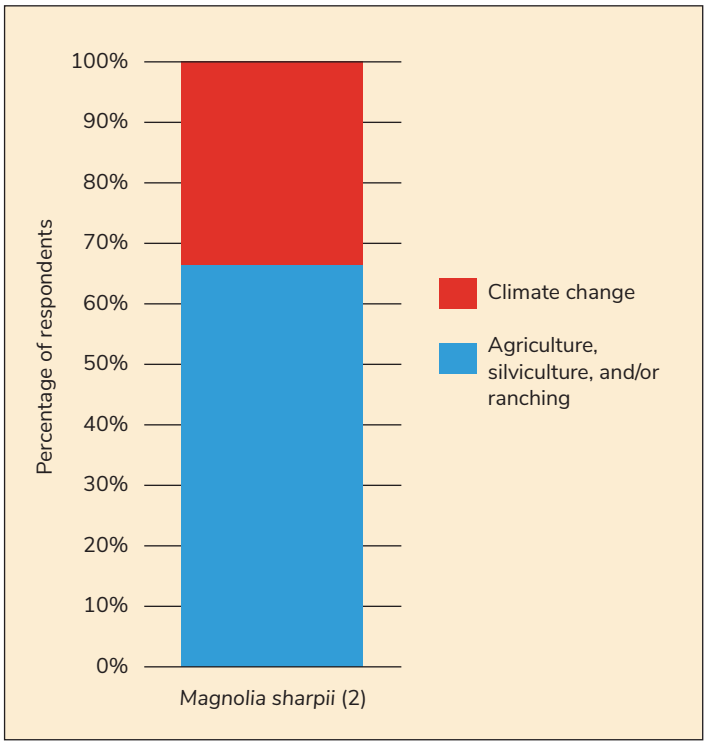

Figure 2. Responses from the Magnolia conservation action questionnaire for *M. sharpii* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia sharpii*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	40
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	5
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	10
					Average vulnerability score		16

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of *ex situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the Magnolia Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of *ex situ* survey

Number of *ex situ* collections reporting this species:	4
Number of plants in *ex situ* collections:	7
Average number of plants per institution:	2
Percent of *ex situ* plants of wild origin:	71%
Percent of wild origin plants with known locality:	100%

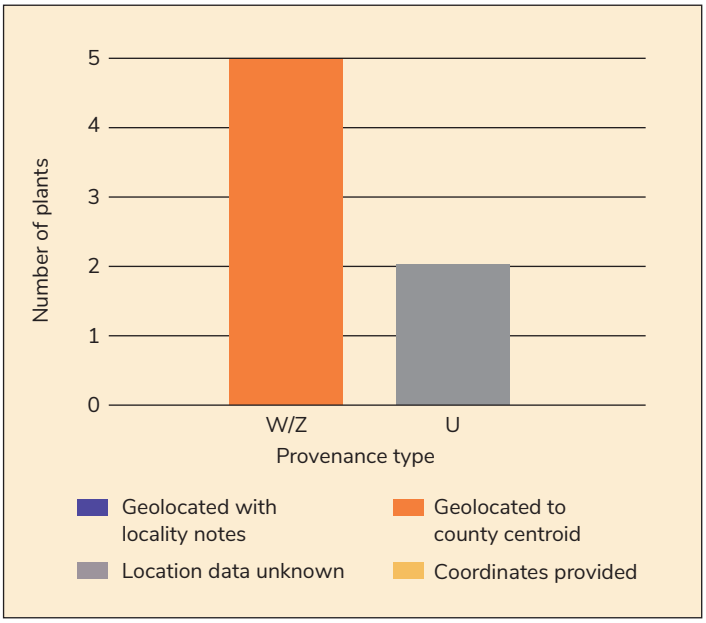

Figure 3. Number and origin of *Magnolia sharpii* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in *ex situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The *ex situ* buffer area represents the native range "captured" in *ex situ* collections, or "combined area *ex situ*" (CAE20, CAE50, CAE100). Geographic coverage of *ex situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.


Philippe de Spoelberch

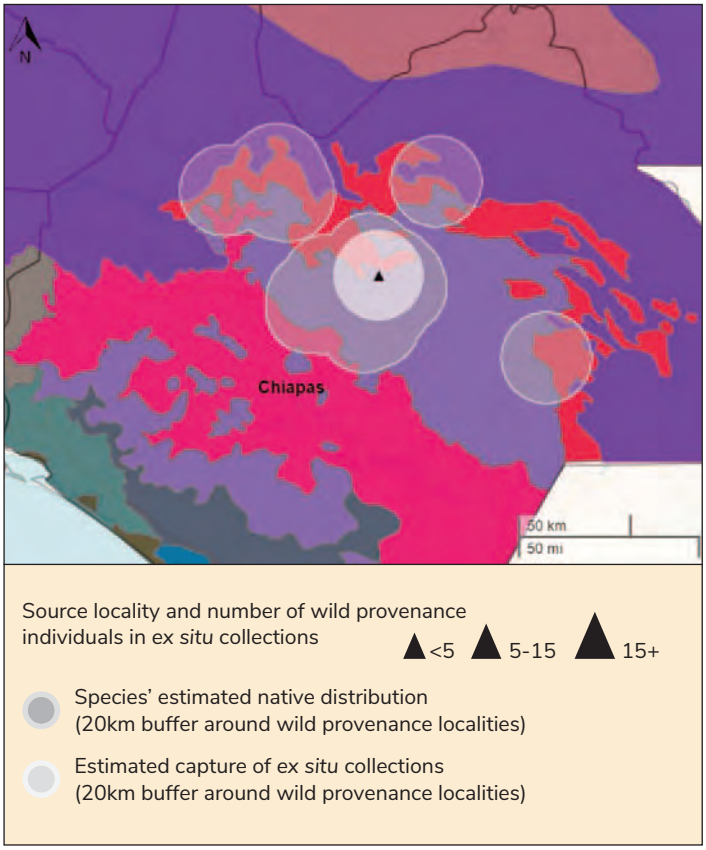

Figure 4. *Magnolia sharpii in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Central American pine-oak forests, Chiapas montane forests and Petén-Veracruz moist forests ecoregions.


Neptali Ramirez Marcial

Estimated *ex situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	1,257 / 9,112 **(14%)**	7,854 / 29,829 **(26%)**	31,414 / 67,976 **(46%)**	**29%**
Ecological coverage	2 / 4 **(50%)**	4 / 4 **(100%)**	5 / 7 **(71%)**	**74%**

Research: Genetics
Studies on genetic diversity have shown large variation within populations but low differentiation between populations indicating that there has potentially been gene flow between populations (Newton et al 2008). ECOSUR reports carrying out genetic research on *M. sharpii*.

Public awareness or education
ECOSUR reports carrying out this activity for *M. sharpii*.

Protect and/or manage habitat
ECOSUR reports carrying out this activity for *M. sharpii*.

Population reinforcement or introduction
ECOSUR reports carrying out this activity for *M. sharpii*.

Occurrence surveys or population monitoring
ECOSUR reports carrying out this activity for *M. sharpii*. Studies on population structure show varying levels of regeneration in different populations. One had a high frequency of small individuals (Bazom) and the other showed no new individuals being recruited (El Retiro) (Vásquez-Morales & Ramírez-Marcial 2019).

Habitat restoration
ECOSUR reports carrying out this activity for *M. sharpii*.

Conservation horticulture
Seed germination trials show that mechanical scarification and incubation in warm water are conducive for germination (Vásquez-Morales & Ramírez-Marcial 2019).

Collect and distribute germplasm
Ex situ collections are reported from the Central American pine-oak forests (Figure 4).


Neptali Ramirez Marcial


Neptali Ramirez Marcial

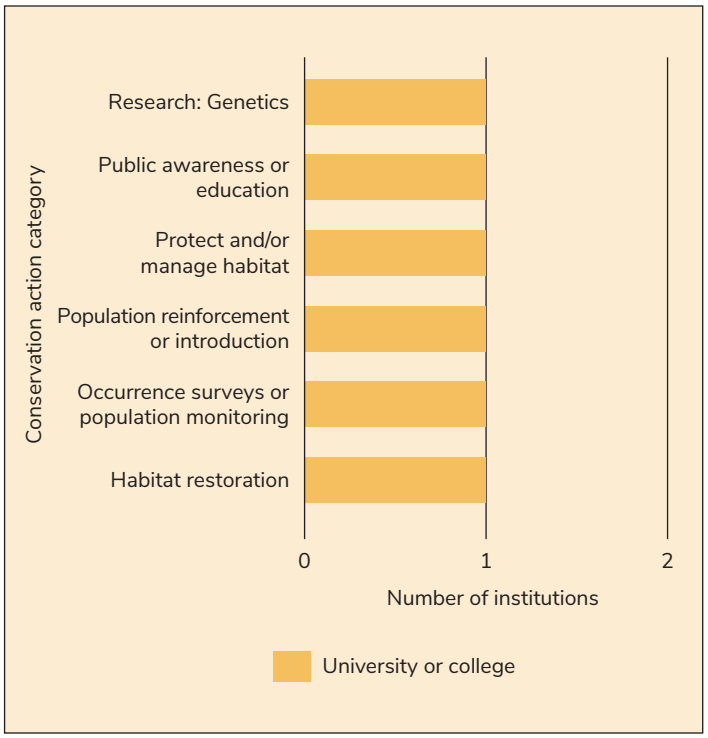

Figure 5. Number of institutions reporting conservation activities for *Magnolia sharpii* grouped by organization type. One of 56 institutions reported activities focused on *M. sharpii* (see Appendix F for a list of all responding institutions.

Conservation Actions Needed

The implementation of protection policies or regulations is recommended for this species.

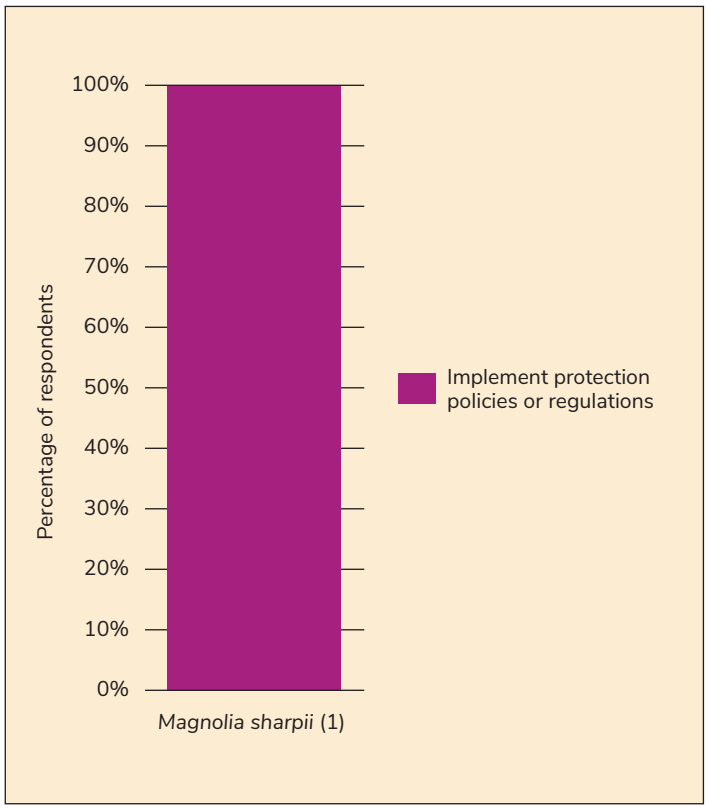

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. rzedowskiana* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia sinica (Y.W.Law) Noot.

Section: *Manglietiastrum* **Synonyms:** *Manglietia sinica* (Y.W.Law) B.L.Chen & Noot., *Manglietiastrum sinicum* Y.W.Law, *Pachylarnax sinica* (Y.W. Law) N.H. Xia & C.Y. Wu **Common names:** Huagaimu
IUCN Red List Category and Criteria: Critically Endangered D

Co-author: Weibang Sun, Kunming Botanical Garden, CAS

Suggested citation: Linsky, J., & Sun, W.B. (2022). *Magnolia sinica* (Y.W.Law) Noot. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia sinica is endemic to China and occurs in south-east Yunnan on forested slopes between 1,300 and 1,700 m asl. *M. sinica* are large trees growing up to 42m in height. It is known from a very small number of individuals in the wild, and the latest population survey recorded only 52 plants (42 mature trees) (Wang et *al*. 2016; Chen, 2017). Few seedlings have been found and limited seedset lead researchers to believe limited pollination and seed dispersal are impacting this species (Chen et *al*. 2016). The species is identified as a "Plant Species with Extremely Small Populations (PSESP)" in China and has been subject to *ex situ* conservation in China's major botanical gardens and abroad and population reinforcements/reintroductions. Expansion of existing reserves and diversification of seed source for *ex situ* and reinforcement planting have been recommended for this species (Wang et *al*. 2016; Chen, 2017).

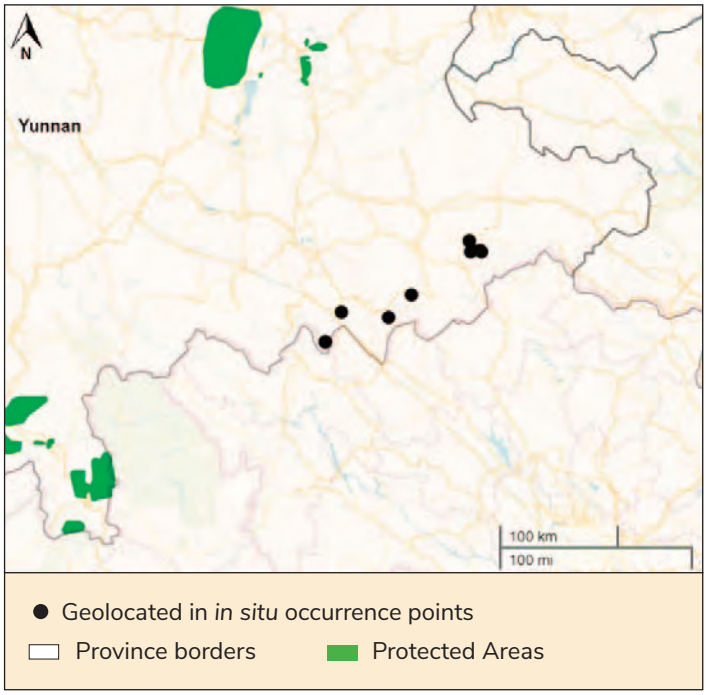

Figure 1. Documented geographic distribution of *Magnolia sinica* (GBIF 2021; Wang et *al*. 2016). Protected areas are from Protected Planet (UNEP-WCMC (2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia sinica*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	40
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	0
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	5
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	40
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	5
						Average vulnerability score	17

Threats to wild populations

Studies suggest barriers to seed dispersal due to potential lack of animal populations in the habitat. A lack of seedlings observed in the wild indicates loss of natural regeneration.

Ten of the 52 recorded individuals are located outside the national or provincial nature reserves, and they are facing threats from the plantation of *Amomum tsaoko* and other economic plants. The illegal collection of fruits and seeds of the species sometimes occurs. *In situ* conservation plots have been established for protecting the individuals and the habitats, however effective and efficient management of these plots is difficult. Other threats identified include pests or pathogens, disturbance regime modification, development, miniang and/or roads and climate change.

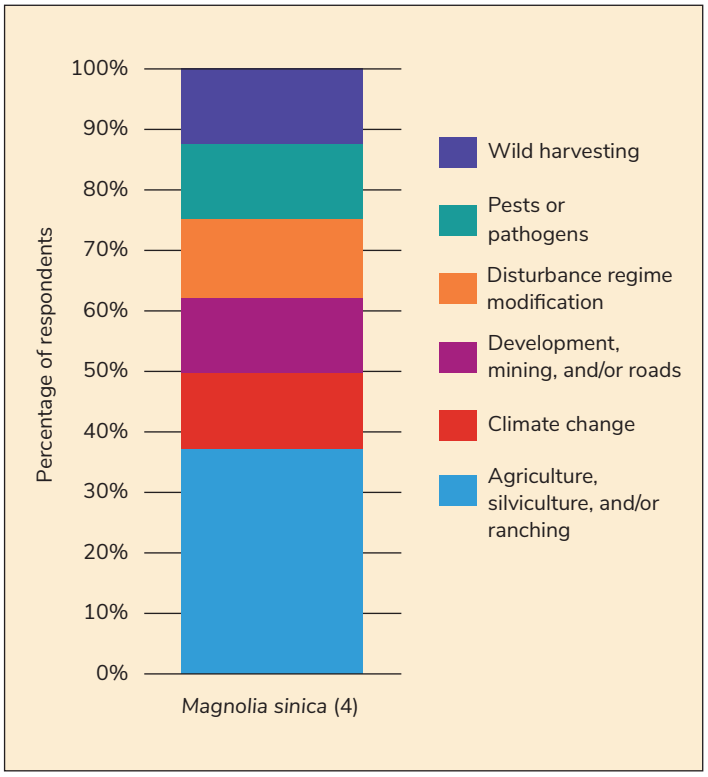

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. sinica* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities:

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	12
Number of plants in ex *situ* collections:	95
Average number of plants per institution:	8
Percent of ex *situ* plants of wild origin:	92%
Percent of wild origin plants with known locality:	94%

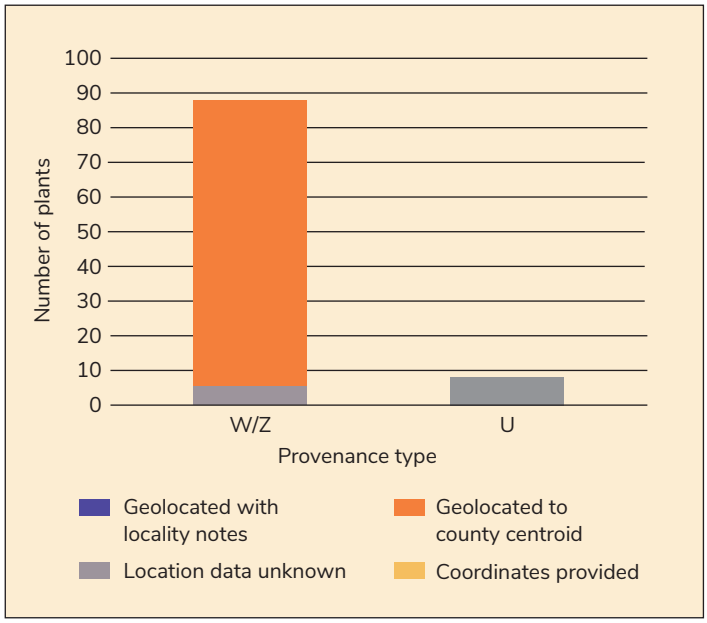

Figure 3. Number and origin of *M. sinica* plants in ex *situ* collections Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.


Weibang Sun

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	4,794 / 8,128 **(59%)**	14,938 / 20,505 **(73%)**	35,432 / 42,957 **(82%)**	**71%**
Ecological coverage	2 / 2 **(100%)**	2 / 2 **(100%)**	3 / 3 **(100%)**	**100%**

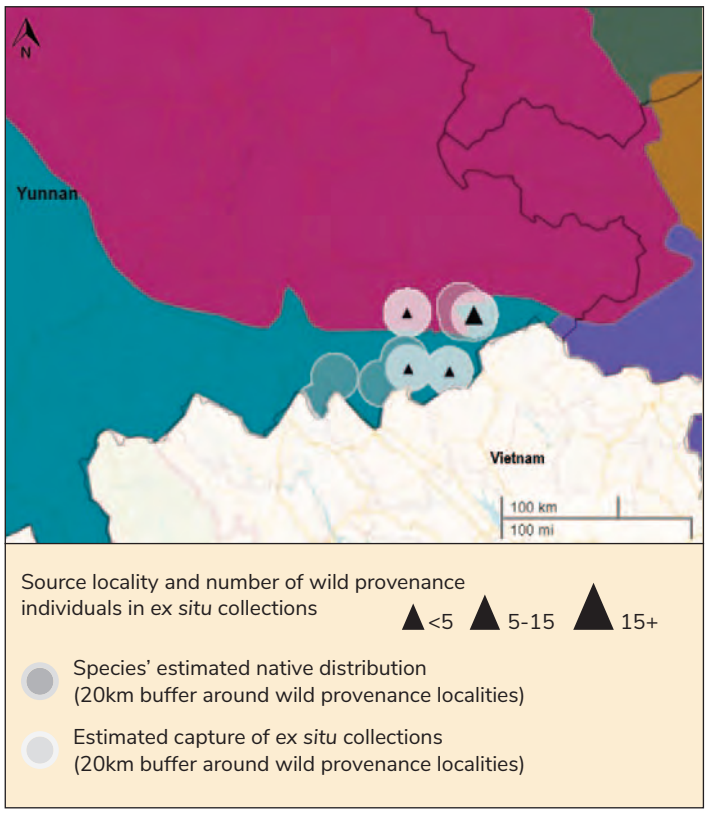

Figure 4. *Magnolia sinica* native distribution and ex *situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Yunnan Plateau subtropical evergreen forests and Northern Indochina subtropical forests ecoregions.

Research: climate change
One institution reports research on climate change for *M. sinica*.

Research: Genetics
The genetic diversity of six wild, four reintroduced and two ex *situ* populations in China were studied and results showed that around 74.77% of genetic variance in the wild is represented in ex *situ* collections in 6 Chinese botanic gardens (Chen, 2017). Information on the source localities of these ex *situ* collections will help guide new collecting expeditions and expansion of the genetic diversity of the species conserved ex *situ*.

Public awareness or education
South China Botanical Garden, Chinese Academy of Sciences, Shenzhen Fairy Lake Botanical Garden and one other institution report this activity for *M. sinica*.

Protect and/or manage habitat
While the protected areas map for this species (Figure 1) does not show national protected areas of China, thirty individuals of *M. sinica* are found in protected areas including nature reserves and state-owned forests (Wang et *al.* 2016). Shenzhen Fairy Lake Botanical Garden reports this activity for *M. sinica*.

Population reinforcement and introduction
M. sinica is a major focus of conservation in China. In 2011, with support from the Global Trees Campaign a conservation action plan was developed for this species. The species is present in at least four nature reserves where projects to replant and monitor trees have been undertaken in collaboration between forestry bureau, reserve and botanic garden staff. To date a total of 600 individuals have been reintroduced in 4 sites at the two range counties' natural or semi-natural habitats. It is recommended that wild protection is increased through the establishment of conservation units. South China Botanic Garden reports carrying out reinforcement and introduction of this species.

Pollen and/or seed banking
Shenzhen Fairy Lake Botanical Garden reports pollen and/or seed banking of *M. sinica*.

Occurrence surveys or population monitoring
Shenzhen Fairy Lake Botanical Garden and South China Botanical Garden, Chinese Academy of Sciences report this activity for *M. sinica*.


Keming Yang, South China Botanical Garden

Implement protection policies or regulations

Shenzhen Fairy Lake Botanical Garden reports this activity for *M. sinica*.

Habitat restoration

Shenzhen Fairy Lake Botanical Garden reports this activity for *M. sinica*.

Cryopreservation and/or micropropagation

A study shows that *M. sinica* seeds may have morpho-physiological dormancy. Results of desiccation and cold storage indicate that seed banking and cryopreservation may have potential as long term *ex situ* methods (Lin et *al*. 2021).

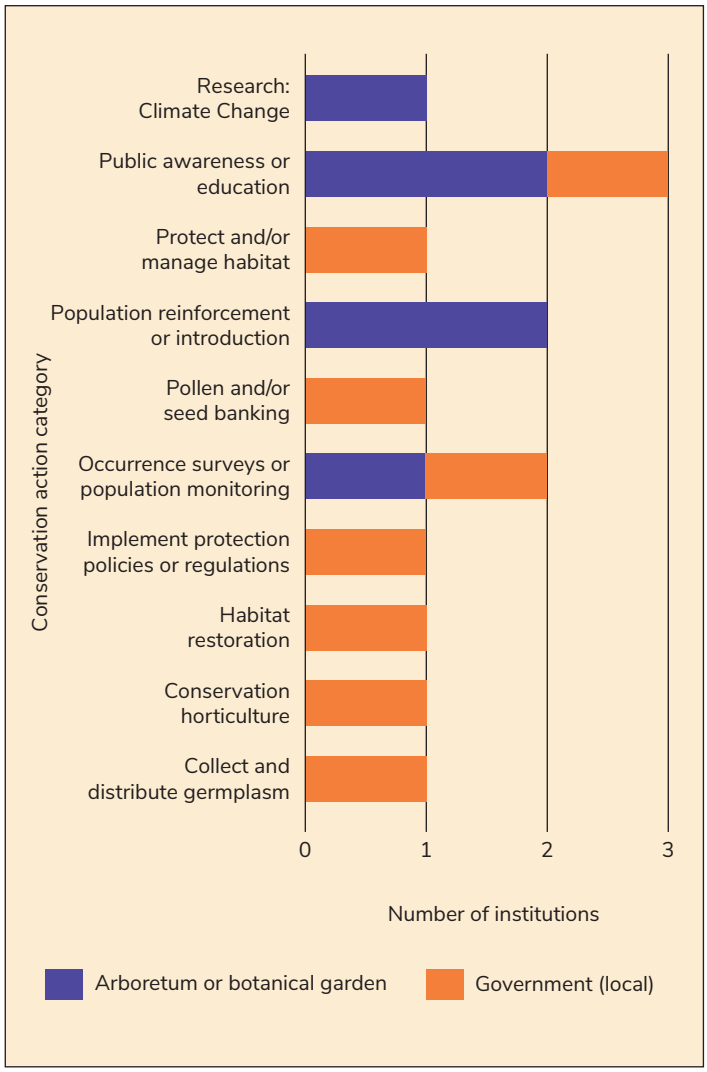

Figure 5. Number of institutions reporting conservation activities for *Magnolia sinica* grouped by organization type. Three of 56 institutions reported activities focused on *M. sinica* (see Appendix F for a list of all responding institutions).

Conservation horticulture

Shenzhen Fairy Lake Botanical Garden reports conservation horticulture activities for *M. sinica*.

Collect and distribute germplasm

M. sinica is known to be held in at least seven botanic gardens in China and all wild collected individuals in China are from known localities. The propagated number of individuals in China is believed to be around 20,000 (Sun, W. pers. comm. 2021). Kunming Botanical Garden holds 77 individuals and some propagated from seed produced flowers after 30 years at the garden. Shenzhen Fairy Lake Botanical Garden reports this activity for *M. sinica*. *Ex situ* collections are reported from both the Yunnan Plateau subtropical evergreen forests and Northern Indochina subtropical forests ecoregions (Figure 4).

Keming Yang, South China Botanical Garden

Conservation actions needed

Recommendations are to collect and preserve the remaining wild diversity of the species into ex *situ* and in reintroduction plots (Chen 2017). Other main activities recommended for this species are public awareness/education, protection/management of its habitat, pollen/seed banking, habitat restoration and conservation horticulture. Development of areas protected as nature reserves and renaturalization of farmland to create new habitat are recommended (Wang et *al*. 2016).

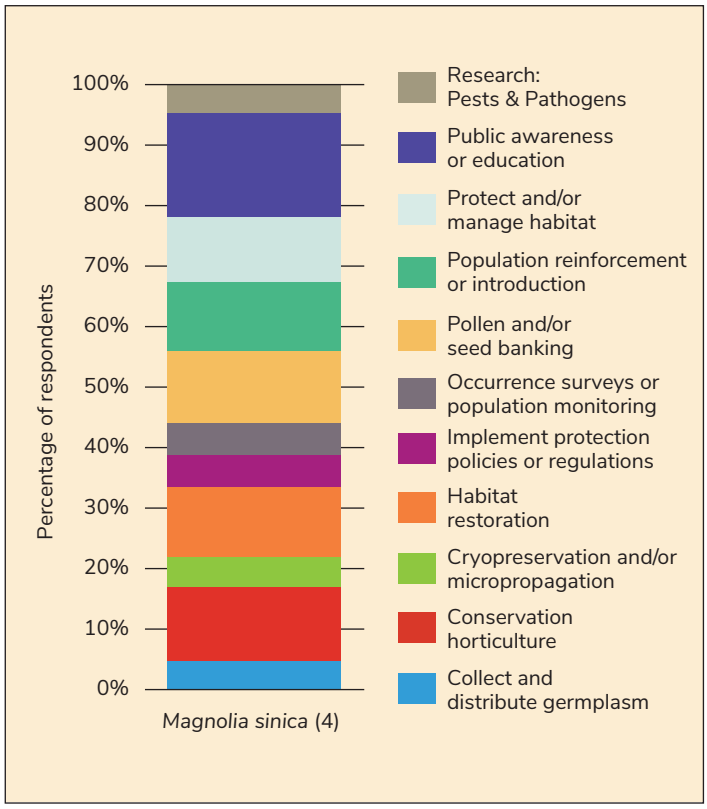

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. sinica* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia stellata (Siebold & Zucc.) Maxim.

Section: *Yulania* **Synonyms:** *Magnolia kobus* var. *stellata* (Siebold & Zucc.) Blackburn, *Yulania stellata* (Maxim.) N.H.Xia **Common names:** Star Magnolia **IUCN Red List Category and Criteria:** Endangered A2c

Co-author: Ichiro Tamaki, Gifu Academy of Forest Science and Culture

Suggested citation: Linsky, J., & Tamaki, I. (2022). *Magnolia stellata* (Siebold & Zucc.) Maxim. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia stellata is endemic to Japan where it is restricted to a narrow area in Central Honshu around Nagoya in three regions: southeastern Gifu Prefecture to central Aichi Prefecture, Atsumi Peninsula in Aichi Prefecture; and northern Mie Prefecture (Tamaki et *al.* 2016). It is found in marshes of hilly areas below 600 m asl., which characterizes this area. It is assessed as Endangered on the IUCN Red List due to severe population declines in recent decades (Harvey-Brown 2019).

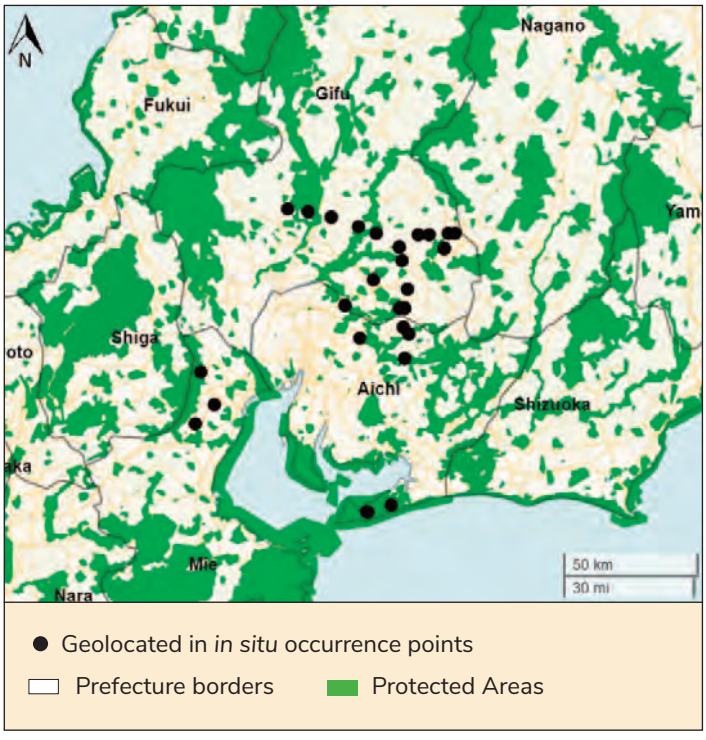

Figure 1. Documented *in situ* occurrence points for *Magnolia stellata*. Protected areas are from Protected Planet (UNEP-WCMC 2021).


Arboretum Wespelaar


Philippe de Spoelberch

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia stellata*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	10
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	10
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	20
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	10
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	10
					Average vulnerability score		12

Threats to Wild populations

Residential and urban development and forest succession due to the abandonment of forest use are threatening the habitat of this species. A study on the pollination dynamics in various population sizes of *M. stellata* showed that pollen shortage, selfing and genetic deterioration in adults was potentially leading to limited seed production in small populations of the species (Hirayama et *al*. 2007). Climate change is also identified as a threat to this species.

Philippe de Spoelberch

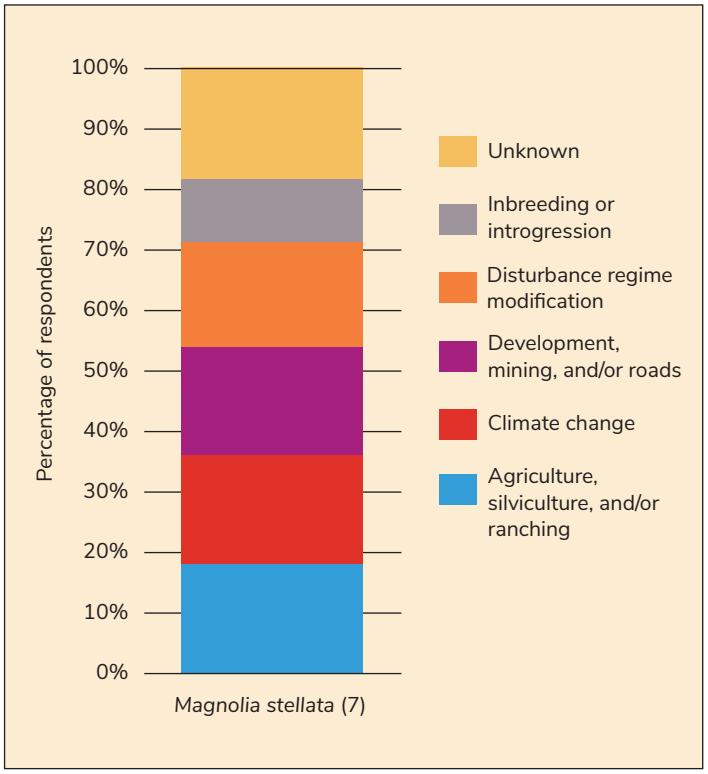

Figure 2. .Responses from the *Magnolia* conservation action questionnaire for *M. stellata* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities:

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	271
Number of plants in ex *situ* collections:	1,857
Average number of plants per institution:	7
Percent of ex *situ* plants of wild origin:	21%
Percent of wild origin plants with known locality:	69%

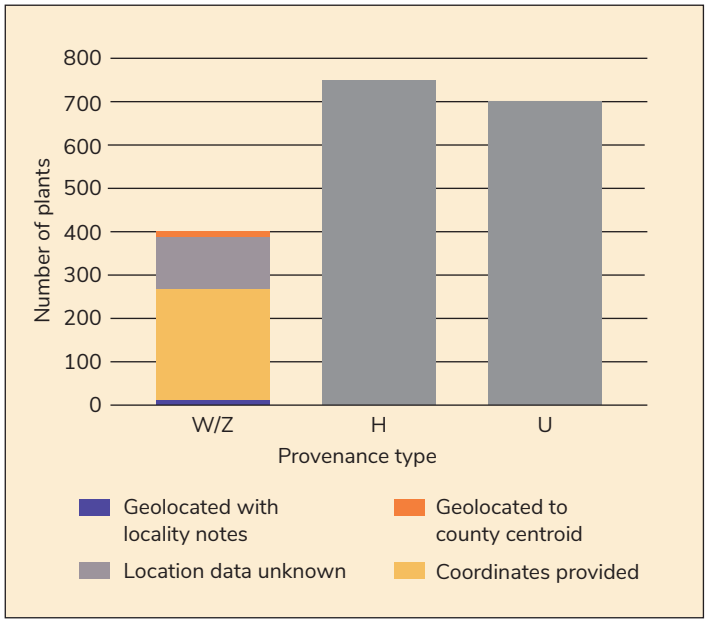

Figure 3. Number and origin of *Magnolia stellata* plants in ex situ collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	7,798 / 7,808 **(100%)**	21,857 / 21,863 **(100%)**	49,419 / 49,430 **(100%)**	**100%**
Ecological coverage	2 / 2 **(100%)**	5 / 5 **(100%)**	5 / 5 **(100%)**	**100%**

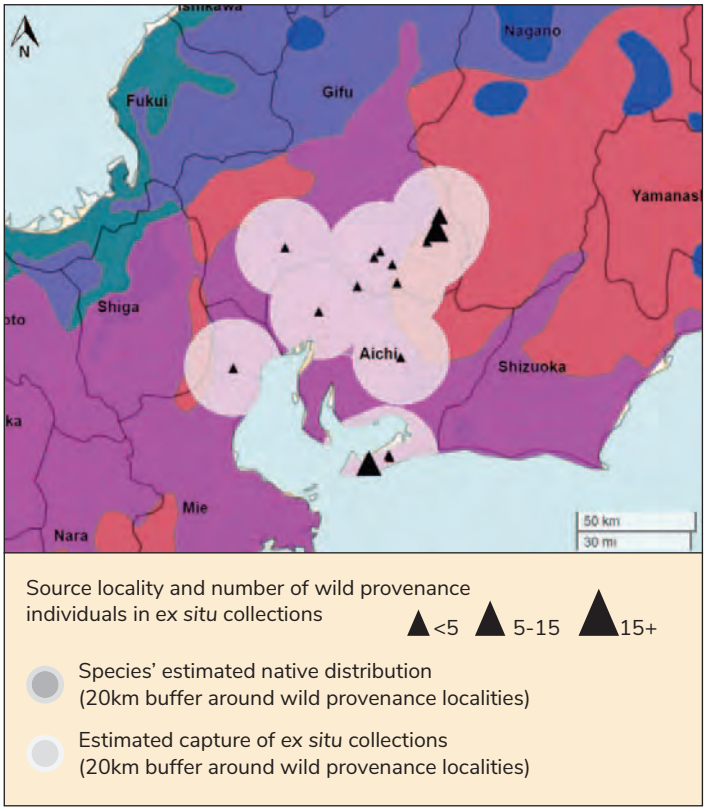

Figure 4. *Magnolia stellata in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Taiheiyo montane deciduous forests and Taiheiyo evergreen forests ecoregions.

Research: Genetics
Studies on the genetics of the species show isolation between subpopulations. Recommendations for assisted reproduction between populations and restoration of suitable habitats are made for this species. Subpopulations in Mie prefecture are unique and should be given high priority in conservation. Further fragmentation of populations in Mie prefecture should be avoided to ensure there is adequate gene flow (Tamaki et *al*. 2016). The Gifu Academy of Forest Science and Culture reports carrying out genetic research.

Research: Climate change
One institution reports carrying out climate change research for *M. stellata*

Public awareness or education
Gifu Academy of Forest Science and Culture, Lewis Ginter Botanical Garden, Shenzhen Fairy Lake Botanical Garden and one other institution report this activity for *M. stellata*

Protect and manage habitat
Gifu Academy of Forest Science and Culture reports this activity for *M. stellata*.

Population reinforcement or introduction
Gifu Academy of Forest Science and Culture and one other institution report this activity for *M. stellata*.

Pollen and/or seed banking
Shenzhen Fairy Lake Botanical Garden and University of British Columbia Botanical Garden report pollen and/or seed banking of *M. stellata*.

Occurrence surveys or population monitoring
Gifu Academy of Forest Science and Culture and Shenzhen Fairy Lake Botanical Garden report this activity for *M. stellata*.

Implement protection policies or regulations
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. stellata*.

Habitat restoration

The establishment of an *in situ* conservation programme by clearcutting of its habitat is now ongoing in Tajimi City, Gifu Prefecture, Japan (Tamaki et *al*. 2015; Tamaki et *al*. 2018; Tamaki et al. 2021). This project is managed by the local government, local people and researchers. The other groups also have interests about this project and a similar clearcutting conservation programme has started in Seto City, Aichi Prefecture, Japan. Thinning increased growth and survival as well as flower and seed production in M. stellata (Matsushita et *al*. 2016). Gifu Academy of Forest Science and Culture reports habitat restoration for *M. stellata*.

Cryopreservation and/or micropropagation

Zhejiang A&F University reports cryopreservation or micropropagation of *M. stellata*.

Conservation horticulture

The Filoli Center, Lewis Ginter Botanical Garden, Shenzhen Fairy Lake Botanical Garden, University of British Columbia Botanical Garden and one other institution report conservation horticulture activities for *M. stellata*.

Collection and distribution of germplasm

Lewis Ginter Botanical Garden and Shenzhen Fairy Lake Botanical Garden report this activity for *M. stellata*. *Ex situ* collections are reported from both the Taiheiyo montane deciduous forests and Taiheiyo evergreen forests ecoregions (Figure 4).

Arboretum Wespelaar

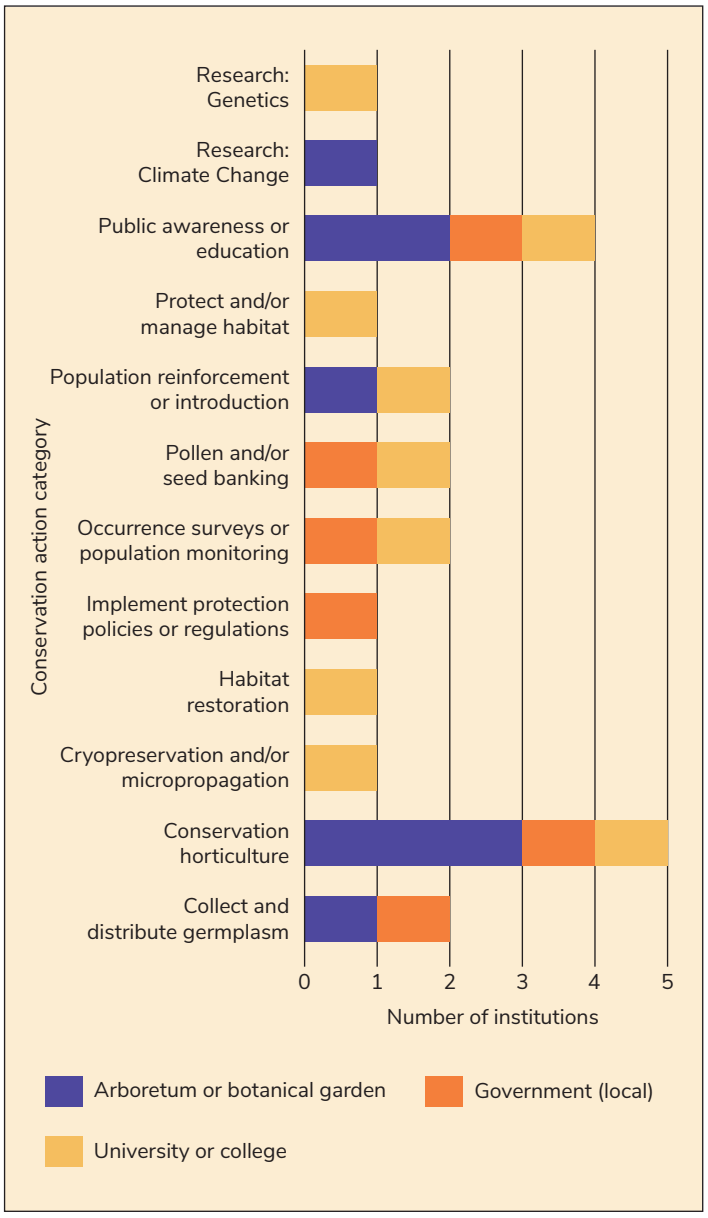

Figure 5. Number of institutions reporting conservation activities for *Magnolia stellata* grouped by organization type. Eight of 56 institutions reported activities focused on *M. stellata* (see Appendix F for a list of all responding institutions).

Conservation Actions Needed

Many activities are recommended for *M. stellata* with further habitat restoration, public awareness, population monitoring, and cryopreservation being suggested most.

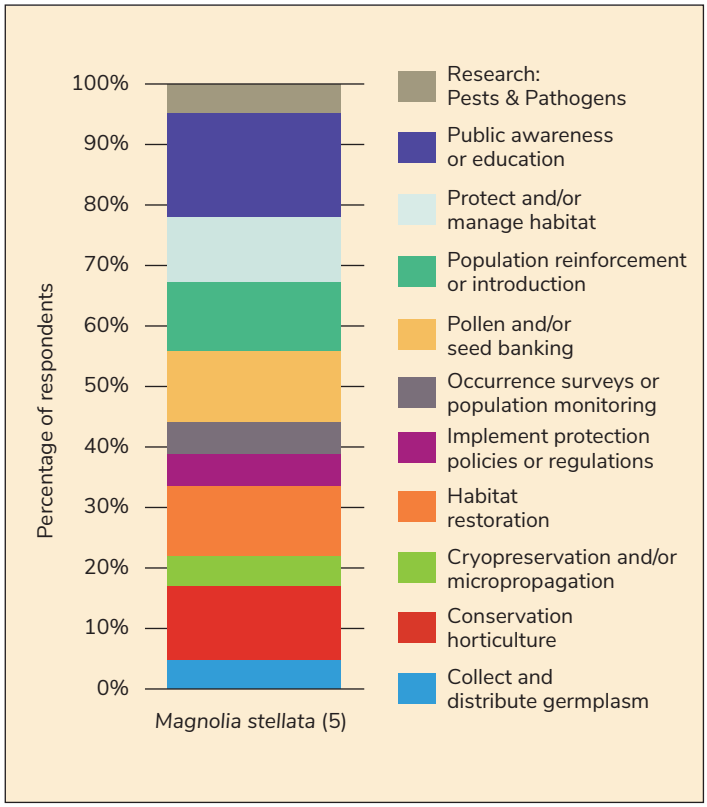

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. stellata* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.


Ichiro Tamaki


Ichiro Tamaki

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Philippe de Spoelberch

Magnolia tamaulipana Vázquez

Section: *Magnolia* **Synonyms:** None **Common names:** None
IUCN Red List Category and Criteria: Endangered B1ab(iii)

Co-author: Sergio Ignacio Gallardo Yobal, Instituto Tecnologico de Huatusco

Suggested citation: Linsky, J., & Gallardo Yobal, S.I. (2022). *Magnolia tamaulipana* Vázquez. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia tamaulipana is endemic to Mexico. It is known from the states of Nuevo Leon and Tamaulipas in the El Cielo Reserve. Recent surveys indicate a total of 221 adult individuals counted throughout the El Cielo Biosphere Reserve (pers. Comm. with S.I. Gallardo Yobal). Twenty sites were surveyed; however, few adult individuals predominate in each of the evaluated sites. The species has little production of flowers and fruits, but good production of sprouts. Studies on pollination show highly specialized beetle pollination (Dieringer et al. 1999). The species is currently assessed as Endangered due to its restricted range and continuing decline in habitat.

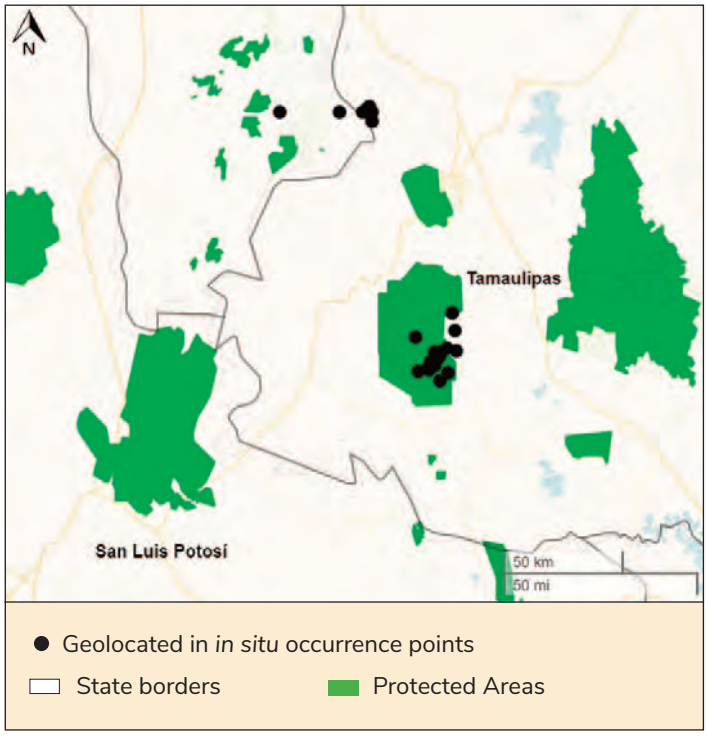

Figure 1. Documented *in situ* occurrence points for *Magnolia tamaulipana* (GBIF 2021). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Threats to Wild populations

The population structure of *M. tamaulipana* indicates no regeneration or recruitment of plants. The death of the adult individuals could cause the extinction of the species in the area of occurrence, due to lack of natural regeneration. The habitat of the species is impacted by hurricanes, urbanization and deforestation. Other threats facing this species include pests/pathogens, invasive species competition, and disturbance regime modification.

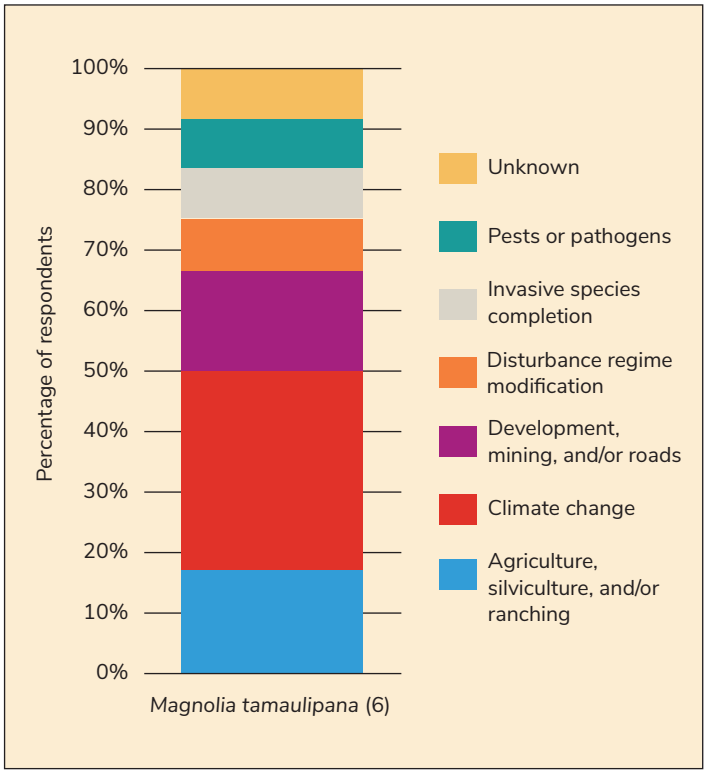

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. tamaulipana* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia tamaulipana*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	-
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	40
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	10
						Average vulnerability score	20

Conservation Activities:

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	20
Number of plants in ex *situ* collections:	57
Average number of plants per institution:	3
Percent of ex *situ* plants of wild origin:	21%
Percent of wild origin plants with known locality:	67%

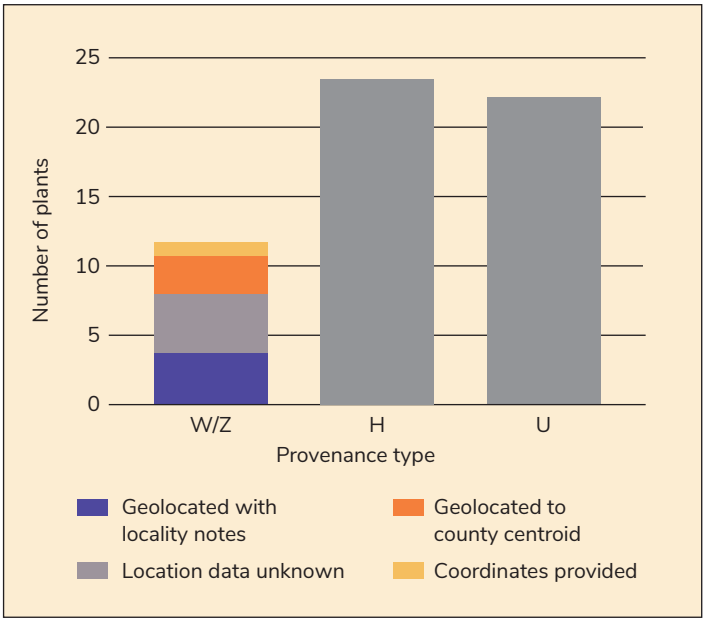

Figure 3. Number and origin of *Magnolia tamaulipana* plants in ex situ collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

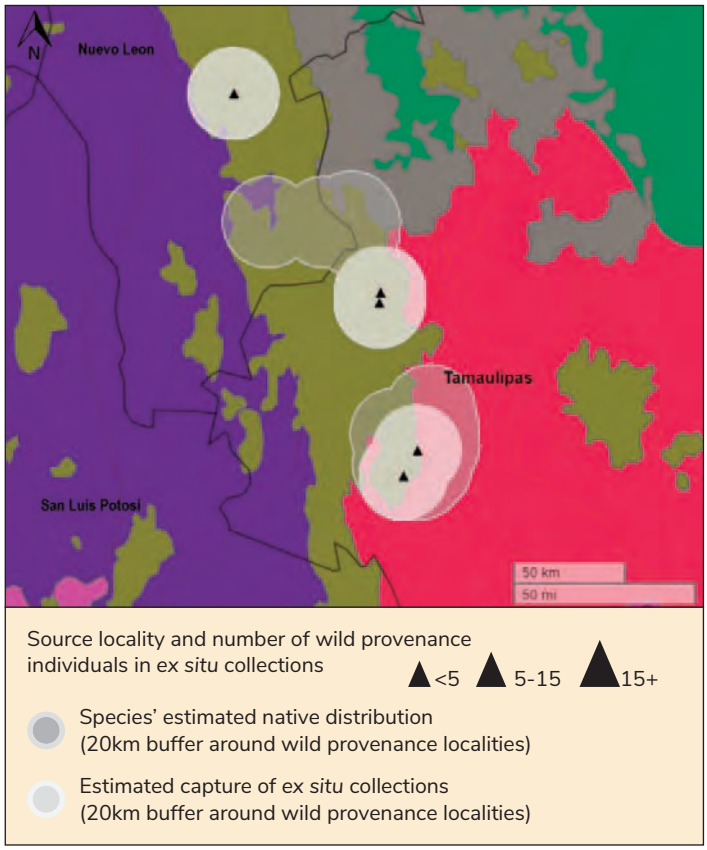

Figure 4. *Magnolia tamaulipana in situ* occurrence points and ex *situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Sierra Madre Oriental pine-oak forests and Veracruz moist forests ecoregions.


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Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	4,470 / 8,524 **(52%)**	24,518 / 31,914 **(77%)**	74,364 / 79,744 **(93%)**	**74%**
Ecological coverage	3 / 4 **(75%)**	5 / 5 **(100%)**	5 / 5 **(100%)**	**92%**

Research: Pests & Pathogens
One institution reports carrying out research on pests and pathogens of *M. tamaulipana*.

Public awareness or education
Houston Botanic Garden and one other institution report carrying out public awareness or education for *M. tamaulipana*.

Protect and/or manage habitat
The species is found within the El Cielo Biosphere Reserve. Grupo Ecológico Sierra Gorda reports the protection and management of the habitat of *M. tamaulipana*.

Pollen and/or seed banking
One institution reports pollen and/or seed banking of M. tamaulipana.

Occurrence surveys or population monitoring
One institution reports this activity for *M. tamaulipana*.

Implement protection policies or regulations
Grupo Ecológico Sierra Gorda reports this activity for *M. tamaulipana*.

Habitat restoration
Grupo Ecológico Sierra Gorda and one other institution report habitat restoration activities.

Cryopreservation and/or micropropagation
The Huntington reports cryopreservation of *M. tamaulipana*.

Conservation horticulture
Gardens of the Big Bend at University of Florida, Houston Botanic Garden, The Huntington and one other institution report conservation horticulture activities for *M. tamaulipana*.

Collection and distribution of germplasm
The Huntington and one other institution report this activity for *M. tamaulipana*. *Ex situ* collections are reported from the Sierra Madre Oriental pine-oak forests ecoregion (Figure 4).

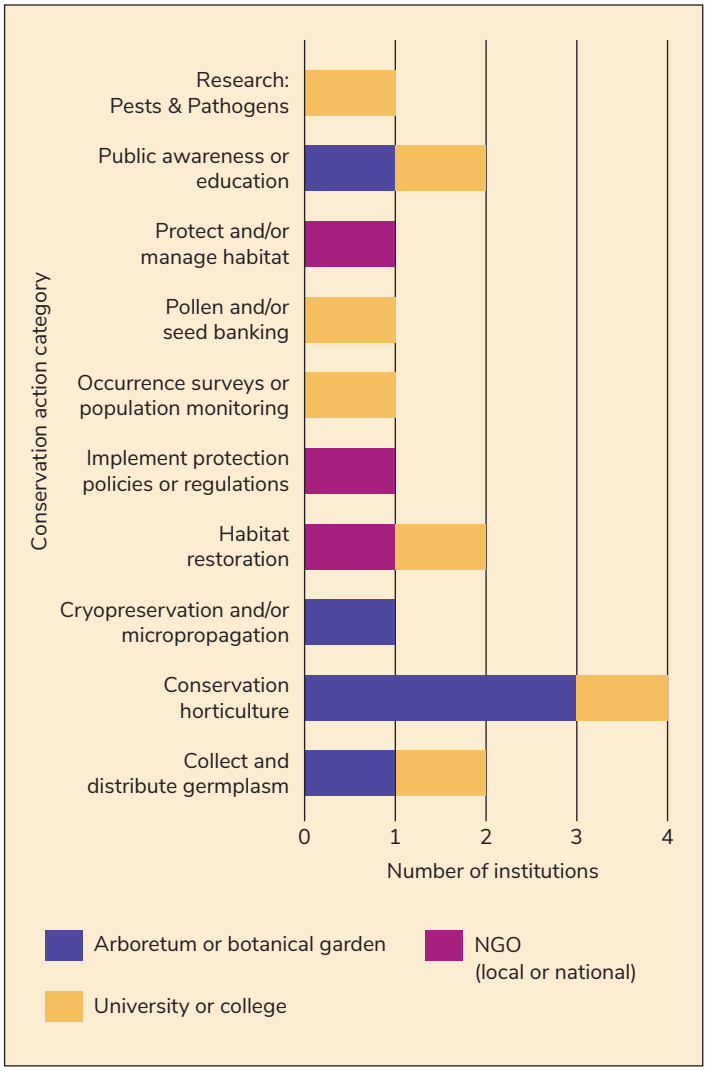

Figure 5. Number of institutions reporting conservation activities for *Magnolia tamaulipana* grouped by organization type. Five of 56 institutions reported activities focused on *M. tamaulipana* (see Appendix F for a list of all responding institutions).


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Conservation actions needed

Research on reproduction by seed or by regrowth is proposed for the conservation of this species. While the population in El Cielo has been well surveyed the populations of this species in the rest of its range require further survey. Other key activities recommended for this species include implementation of protection policies or regulations and habitat restoration.

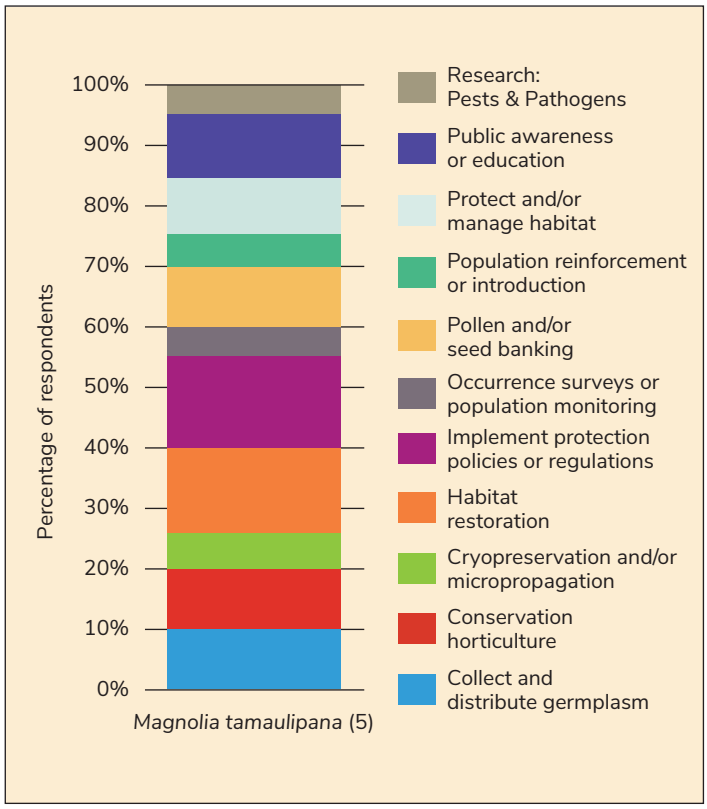

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. tamaulipana* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Magnolia vallartensis A.Vázquez & Muñiz-Castro

Section: *Magnolia* **Synonyms:** None **Common names:** None
IUCN Red List Category and Criteria: Critically Endangered B1ab(iii)

Co-author: Miguel Ángel Muñiz Castro, Universidad de Guadalajara

Suggested citation: Linsky, J., & Muñiz Castro, M.Á. (2022). Magnolia vallartensis A.Vázquez & Muñiz-Castro. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

This species is endemic to the regions of Puerto Vallarta and Cabo Corrientes in western Jalisco, Mexico. It is only known from five little coastal watersheds of the small rivers or streams ("Arroyos" in spanish) El Nogalito, Palo María, Mismaloya (in Puerto Vallarta municipality), Las Juntas y Veranos, and Provincia (in Cabo Corrientes municipality). It is found in riparian forest, tropical montane cloud forest, pine-oak forest, and the ecotone between tropical sub-evergreen forest and tropical montane cloud forest. The main species with which *M. vallartensis* coexists are *Podocarpus matudae*, *Crysophila nana*, *Aechmea novoae*, *Couepia polyandra*, *Calophyllum brasiliense* ("Palo María" tree), *Clusia salvinii*, *Miconia vallartensis*, *Hymenaea courbaril*, *Inga eriocarpa*, *Ardisia revoluta*, *Quercus* spp., *Pinus vallartensis*, *Rhipidocladum racemiflorum*, *Chusquea liebmannii*, *Sommera grandis*, *Dioon tomaselli*, *Zamia loddigesii*. This species prefers humid ravines, near streams, but also tolerates more exposed habitats as low mountain ridges with shallow soils derived from granite rock. *M. vallartensis* populations live closer to the sea than its sister species *M. pacifica*, and in lower elevations of 100-1000 m (Vázquez-García et al. 2012), where the climate is a special mixture of temperate and tropical, with a very strong influence of the marine humidity.


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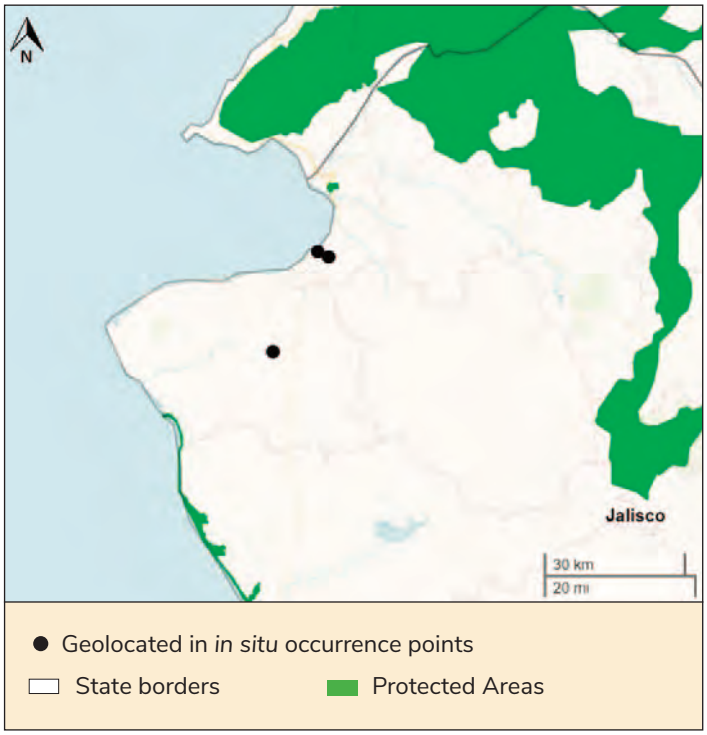

Figure 1. Documented *in situ* occurrence points for *Magnolia vallartensis* (GBIF 2021; Vázquez-García 2012) . Protected areas are from Protected Planet (UNEP-WCMC 2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia vallartensis*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators). Source: IUCN Red List assessment

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	20
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	5
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	20
					Average vulnerability score		14

Threats to Wild populations

One of the main threats to *M. vallartensis* is the small range of the entire population. Although the Extent of Occurrence of *M. vallartensis* is 124 km^2 and the Area of Occupancy is 44 km^2 (corresponding to the Moderate vulnerability category) (Vázquez-García et *al.* 2021), in the application of the criteria Range/endemism we should consider that these ranges are very near the High vulnerability category.

The forest habitat of *M. vallartensis* is declining due to forest fires, logging and rapid conversion for pasture. Climate change has also been mentioned as a potential threat to this species due to an increase in forest tropical plagues and forest fires (Vazquez-García et *al.* 2013). In response to global climate change, migration to higher parts of the mountains by tropical trees such as *Dendropanax arboreus*, *Brosimum alicastrum*, *Bursera simaruba*, *Ficus* spp., *Nectandra* sp., *Attalea cohune*, *Aphananthe monoica*, *Hymenaea courbaril*, *Lonchocarpus spp.*, *Guarea glabra*, and others will confer greater pressure on *M. vallartensis* due to the high competitiveness for light and resources of these tall tree species. Other threats which are reported to impact this species include tourism or recreation, invasive species competition and inbreeding/introgression.


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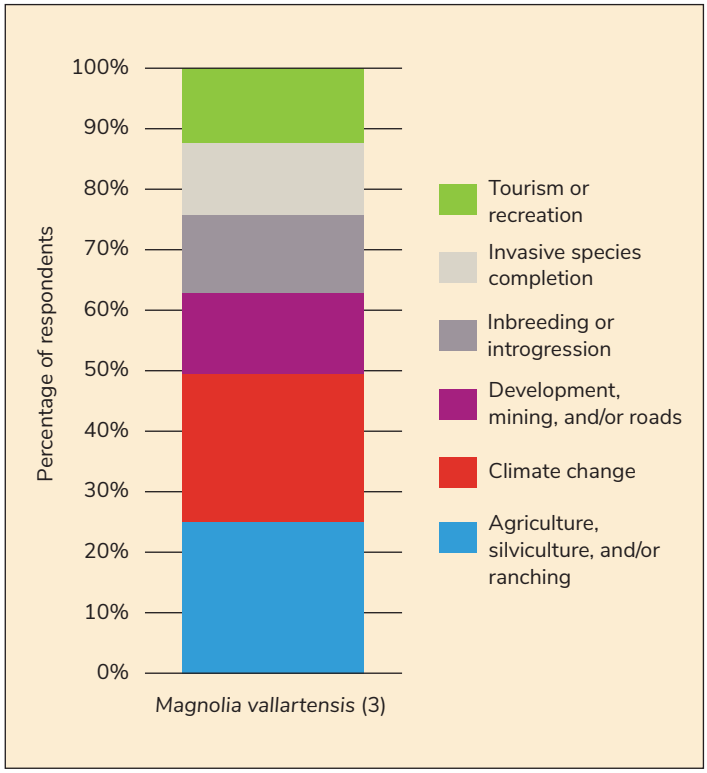

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. vallartensis* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

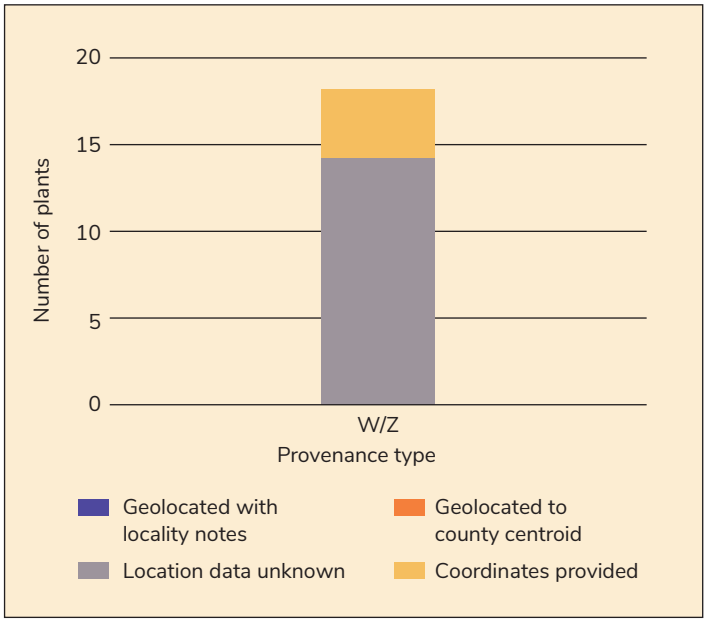

Figure 3. Number and origin of *Magnolia vallartensis* plants in ex situ collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown

Conservation Activities:

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	2
Number of plants in ex *situ* collections:	18
Average number of plants per institution:	9
Percent of ex *situ* plants of wild origin:	100%
Percent of wild origin plants with known locality:	22%

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

Estimated *ex situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	910 / 1,847 **(49%)**	5,925 / 7,251 **(82%)**	18,814 / 20,134 **(93%)**	**75%**
Ecological coverage	3 / 3 **(100%)**	4 / 4 **(100%)**	5 / 5 **(100%)**	**100%**

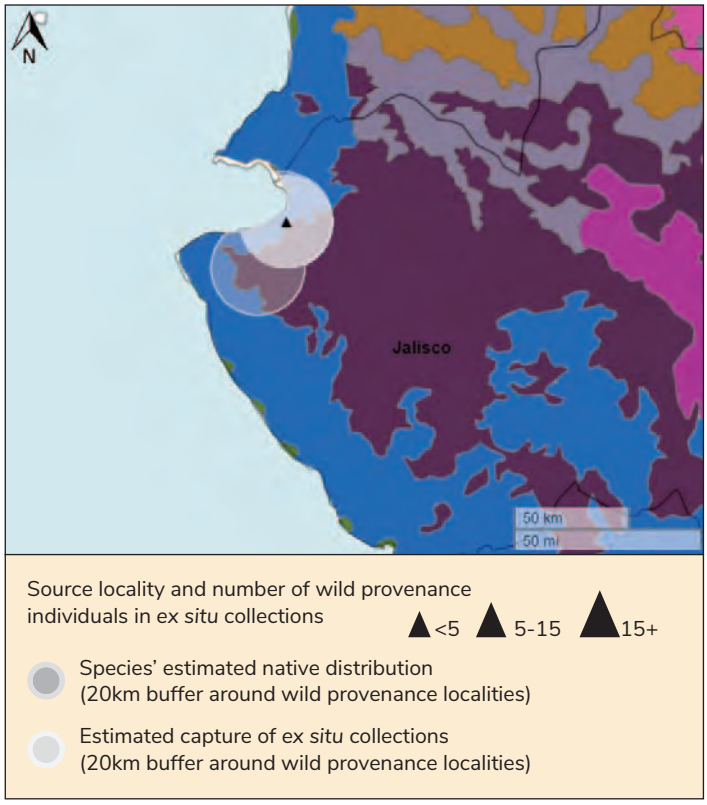

Figure 4. *Magnolia vallartensis in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Jalisco dry forests and Trans-Mexican Volcanic Belt pine-oak ecoregions.

Research: Taxonomy
Universidad de Guadalajara reports research on the taxonomy of this *M. vallartensis*.

Research: Genetics
A study, carried out at Universidad de Guadalajara, of population genetics of the *M. pacifica* species complex showed *M. vallartensis* grouping with *M. pacifica* as a sister group (Muñiz-Castro et *al*. 2020). Geographical boundaries to gene flow between *M. vallartensis* and *M. pacifica* were shown, supporting the isolation by distance and by geographical barriers of the Canyons of the rivers Ameca, Mascota, Pitillal and Cuale. Key populations in Arroyo Palo Maria and Provincia should be targets for conservation.

Research: Climate change
Habitat suitability modelling showed high suitability both in the area close to the known habitat and further north where currently the species is unknown. In future climate change based habitat suitability modelling there is a complete predicted loss of the habitat of *M. vallartensis*. While there is some uncertainty in this modeling the general trend of loss of habitat is detected (Vázquez-García et *al*. 2021).

Occurrence surveys or population monitoring
The Huntington reports occurrence surveys or population monitoring of this species.

Conservation horticulture
Removal of the aril improved germination of the seeds of *M. vallartensis*, however seed collection has been very difficult due to the scarce seed production by individual trees and the phenological irregularity in seed production (Vázquez-García et *al*. 2021). In the case of *M. vallartensis* and *M. pacifica*, their populations are usually surrounded by high and dense canopy cloud forest and tropical semi-evergreen forest trees that overshadow many *Magnolia* trees, which limits their fruit and seed productivity due to the scarcity of sunlight throughout the year (Vázquez-García et *al*. 2021). Further phenological and germination studies are recommended. Universidad de Guadalajara reports conservation horticulture activities for this species.

There have been attempts of asexual propagation with air layerings or simple layering of *M. vallartensis* stems from Arroyo Palo María, by gardeners of Garza Blanca Hotel and Vallarta Botanical Gardens, respectively, since November, 2013, but the layers failed to root and to produce new cloned plants.

Collect and distribute germplasm

There have been several attempts to increase the number of *ex situ* individuals and localities of *M. vallartensis*, but the results have been poor or of moderate magnitude. The main problem has been the lack of a strong and solid institutional program for the collection, cultivation and long-term monitoring at all levels: state, national and international. In the field, the main problem in collecting seeds for propagation has been the lack of trained arborists, equipment and financial resources for collecting expeditions, since the wild populations are in distant mountains and most of the fruits with seeds are found sparse and scarce in the highest area of the tree canopy, from the trees about 20-30 m high. At the plant nurseries the main problem has been the lack of trained people, the lack of money to hire and pay staff, and the lack of money to build, manage and maintain the nurseries. Universidad de Guadalajara reports this activity for *M. vallartensis*. *Ex situ* collections are reported from the Jalisco dry forests ecoregion (Figure 4).

Conservation Actions Needed

Recommendation to decree a protection zone in the Palo Maria stream basin.

Is very necessary to create a specific institutional program for the collection of seeds, plant cultivation, nursery support and administration of *ex situ* collections of the magnolias of western Mexico, and to obtain financial support to strengthen and provide follow-up and long-term support for the program. In recent years there has been some financial support by BGCI for seed collection, plant cultivation and organization of the 1st Symposium of Neotropical *Magnolia* Conservation Consortium, July 8-14, 2019 in Guadalajara, Jalisco, Mexico, and the academic staff of University of Guadalajara (IBUG-CUCBA) have been participating actively in all these activities, but reinforcement of the program is needed for long term success. With the COVID-19 pandemic, the support of university students and professors has been significantly limited.

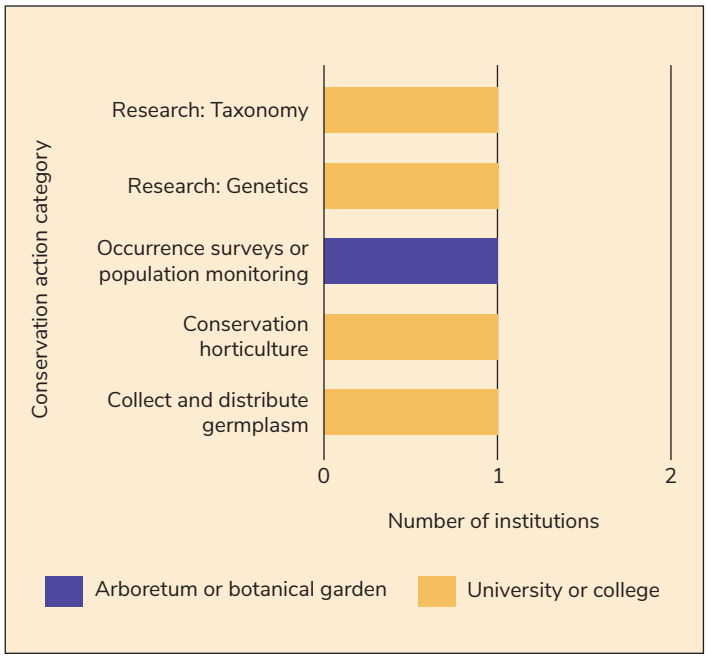

Figure 5. Number of institutions reporting conservation activities for *Magnolia portoricensis* grouped by organization type. Two of 56 institutions reported activities focused on *M. portoricensis* (see Appendix F for a list of all responding institutions).

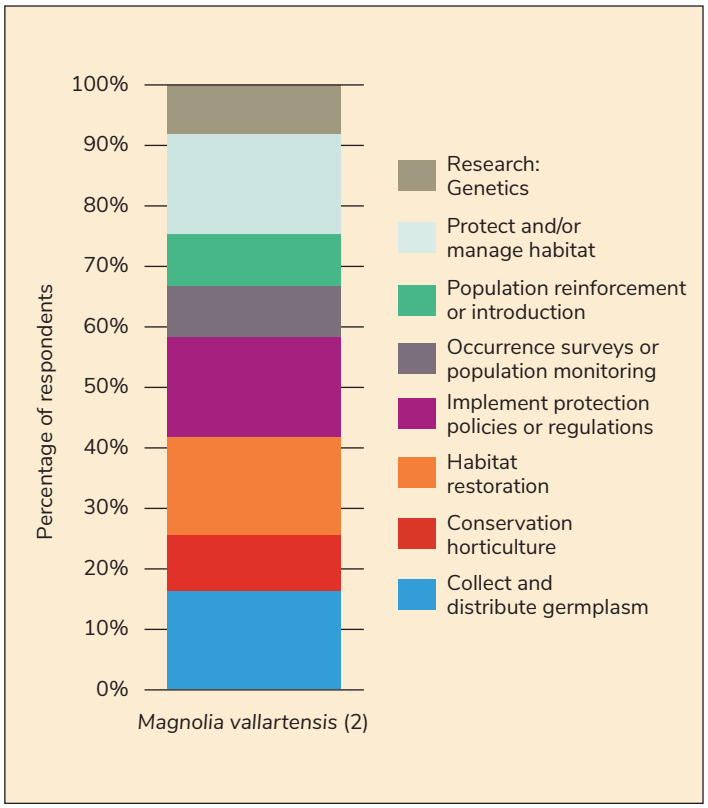

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. vallartensis* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Miguel Á. Muñiz Castro

Magnolia vovidesii
A.Vázquez, Domínguez-Yescas & L.Carvajal

Section: *Macrophylla* **Synonyms:** None **Common names:** None
IUCN Red List Category and Criteria: Endangered B1ab(iii,v)

Co-author: Dulce Maria Galván-Hernández, Autonomous University of Hidalgo

Suggested citation: Linsky, J., & Galván-Hernández D.M. (2022). Magnolia vovidesii A.Vázquez, Domínguez-Yescas & L.Carvajal. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia vovidesii is endemic to Veracruz, Mexico. It is found between 600 to 1,700 m asl. It was separated from a number of other species of the *M. dealbata* complex based on morphological characteristics in 2013. There are estimated to be less than 250 individuals of *M. vovidesii* in its fragmented cloud forest habitat (Galván-Hernández *et al.* 2020). The species was assessed as Endangered in 2015 due to its small range and the continued decline of the extent and quality of its habitat, however there is evidence that suggests that this species should be considered Critically Endangered due to recent population size decline and fluctuation in the number of mature individuals (Galván-Hernández *et al.* 2020).

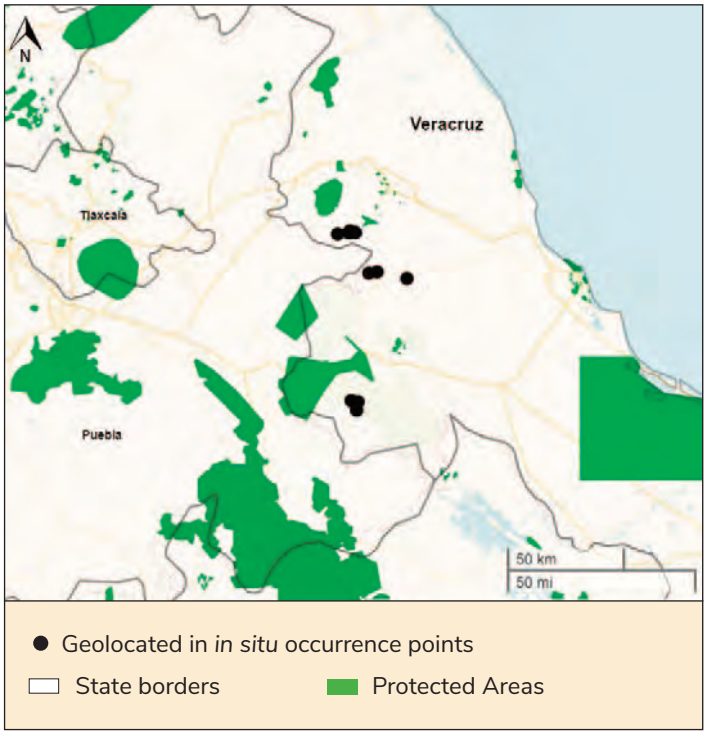

Figure 1. Documented *in situ* occurrence points for *Magnolia vovidesii* (GBIF 2021; Vázquez-García *et al.* 2013; Chávez-Cortázar et al. 2021) . Protected areas are from Protected Planet (UNEP-WCMC 2021).

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia vovidesii*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	20
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	20
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	5
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	-
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	10
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	10
					Average vulnerability score		13

Threats to Wild populations

A study by Galván-Hernández et al. (2020) showed that the appearance of the parasitic species *Psittachanthus schiedeanus* has had a great impact on the population structure and is a high threat to this species. Removal of the parasitic species is carried out by cutting down afflicted trees thereby removing reproductive individuals from the population. Also, the use of trails by people and cattle affects the recruitment of seedlings, leading to high mortality of small size classes . Fuel wood extraction and herbivory are moderate threats that affect 7-10% of the area where *M. vovidesii* grows. Finally, cattle dung, erosion, fire and soil compaction do not impact a great area of *M. vovidesii* habitat and are not greatly impacting the survival of this species.

Other threats identified for this species include wild harvesting, inbreeding/introgression, disturbance regime modification, and climate change.

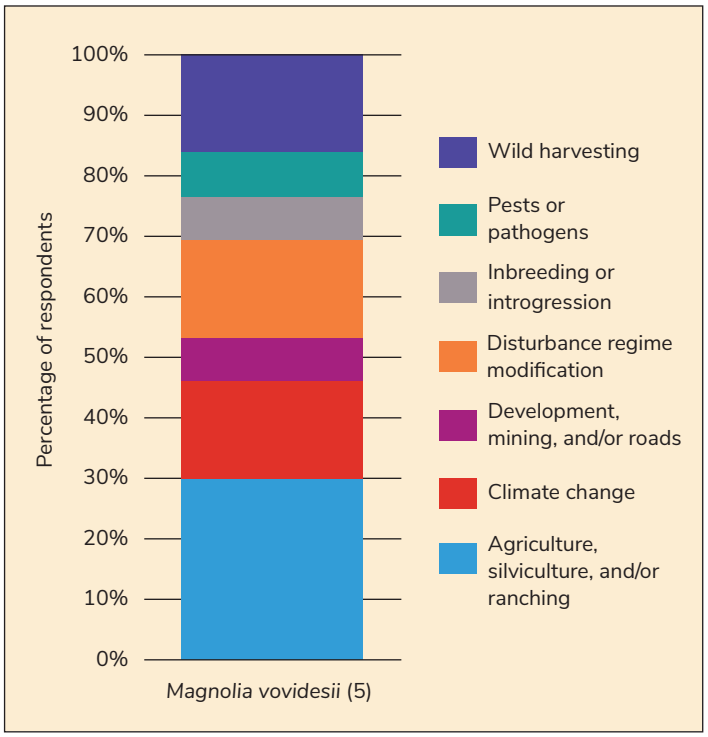

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. vovidesii* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities:

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	3
Number of plants in ex *situ* collections:	3
Average number of plants per institution:	1
Percent of ex *situ* plants of wild origin:	67%
Percent of wild origin plants with known locality:	50%

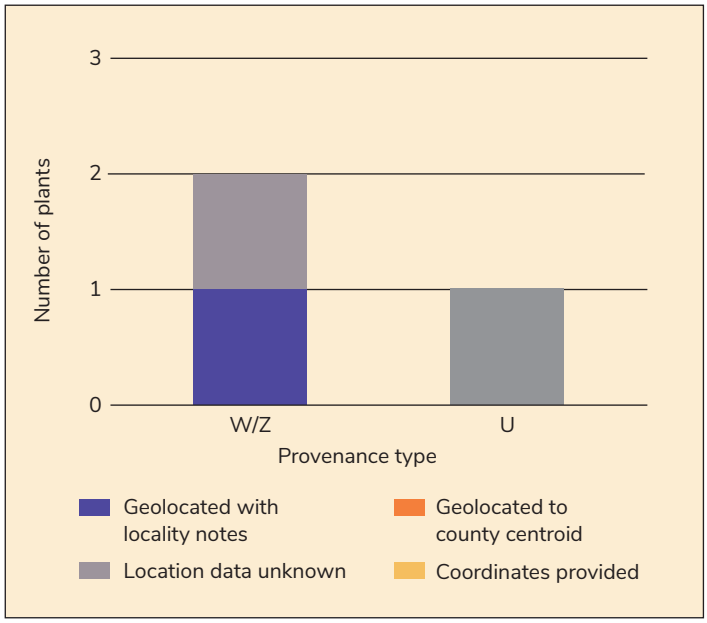

Figure 3. Number and origin of *Magnolia vovidesii* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.


Dulce Maria Galván-Hernández

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	1,257 / 4,476 **(28%)**	7,854 / 18,047 **(44%)**	31,414 / 47,060 **(67%)**	**46%**
Ecological coverage	3 / 7 **(43%)**	7 / 8 **(88%)**	10 / 11 **(91%)**	**74%**

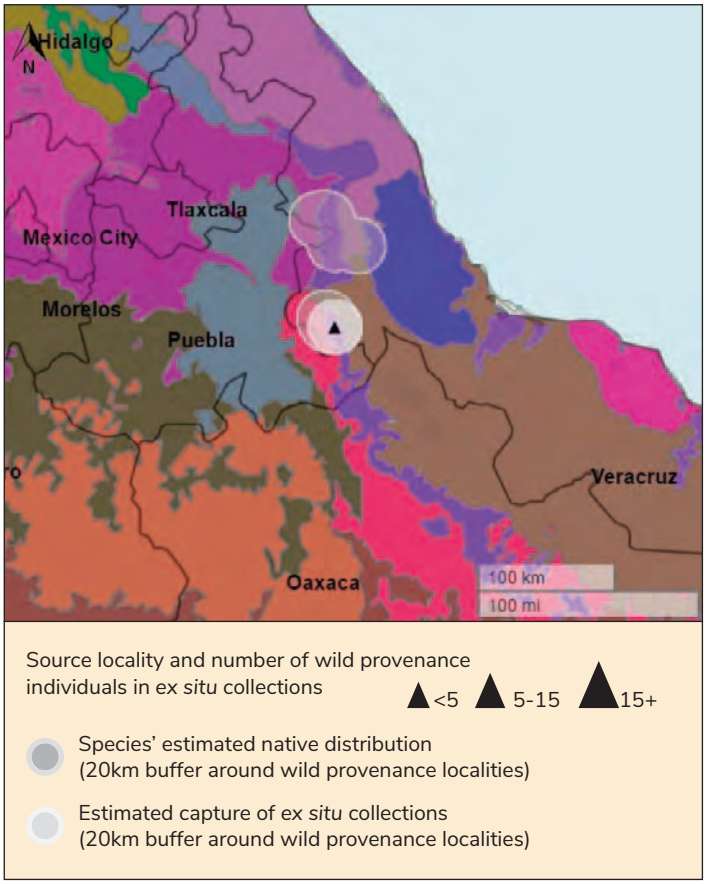

Figure 4. *Magnolia vovidesii in situ* occurrence points and ex *situ* collection source localities. Terrestrial Ecoregions of the World (Olson 2001) are coloured; the recorded distribution is included in the Trans-Mexican Volcanic Belt pine-oak forests, Oaxacan montane forests, Veracruz moist forests and Sierra Madre de Oaxaca pine-oak forests ecoregions.

Research: pests & pathogens
One institution reports carrying out research on pests and pathogens of *M. vovidesii*.

Research: Genetics
A study on the genetic diversity of *Magnolia* of section *Macrophylla* showed moderate genetic diversity and evidence of some inbreeding in *M. vovidesii*. Forest fragmentation is threatening pollen and seed dispersal between populations and improving connectivity of populations should be a priority (Chávez-Cortázar et *al*. 2021).

Research: Climate change
A study was conducted on the potential for assisted migration to higher elevations to mitigate climate change effects. Seedlings successfully grew at elevations around 600m above that of the current distribution. Intermediate levels of canopy cover at various elevations could be beneficial to the growth of this species (García-Hernández and Toledo-Aceves 2020). A study on the adaptability of *Magnolia* species in eastern Mexico showed some resilience to climatic variation (such as dry conditions) in *M. vovidesii* via adaptability in the hydraulic system (Rodríguez-Ramírez et *al* 2020).

Public awareness or education
One institution reports this activity for *M. vovidesii*.

Protect and/or manage habitat
Traditional management and use of the species is ongoing in Zongolica where the species is grown for decoration, firewood and medicinal purposes (Ixtacua-Martinez et *al*. 2018). One institution reports this activity for *M. vovidesii*.

Population reinforcement or introduction
One institution reports this activity for *M. vovidesii*.

Pollen and/or seed banking
One institution reports this activity for *M. vovidesii*.

Occurrence surveys or population monitoring
Two institutions report this activity for *M. vovidesii*.

Habitat restoration
One institution reports this activity for *M. vovidesii*.

Cryopreservation/micropropagation
This species is included in the cryopreservation program at The Huntington.

Conservation horticulture
The ex *situ* propagation of seed can be carried out in a greenhouse with the necessary pre-treatments, in this case, a pre-germination treatment is needed to improve the germination percentage significantly. Treatment includes manual removal of the sarcotesta. Viable seeds can be separated from inviable seeds via flotation by immersing the seeds in a 30% H2O2 solution. The germination time is approximately two months in the greenhouse, under up to 90% shade mesh and periodic irrigation. One institution reports this activity for *M. vovidesii*.

Collection and distribution of germplasm
Two institutions report this activity for *M. vovidesii. Ex situ* collections are reported from the Oaxacan montane forests ecoregion (Figure 4).

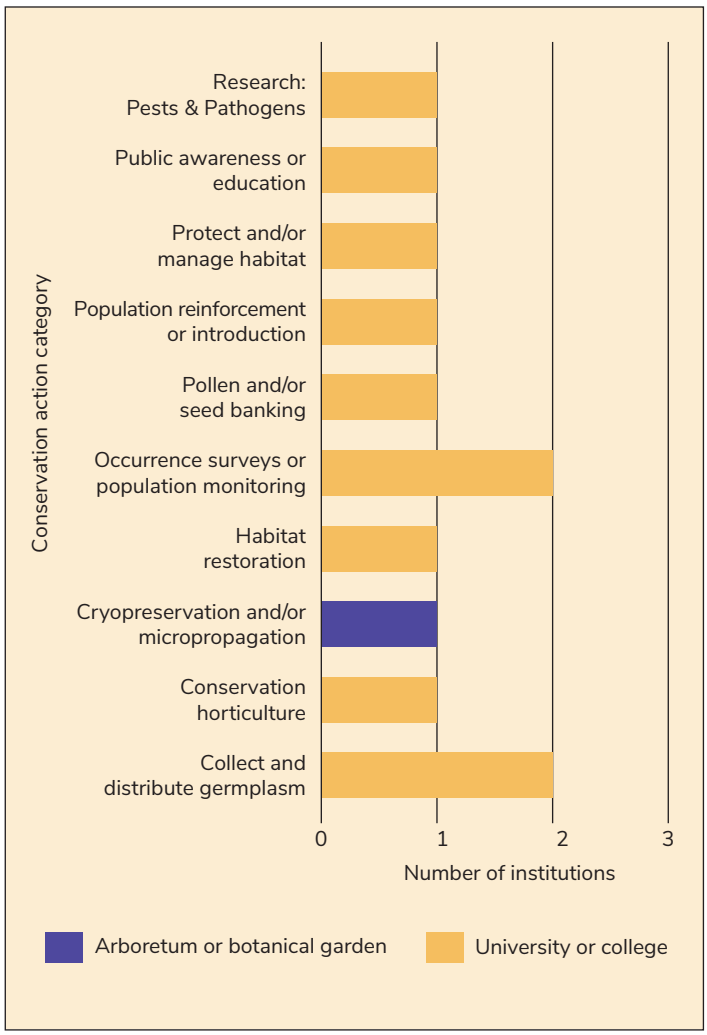

Figure 5. Number of institutions reporting conservation activities for *Magnolia vovidesii* grouped by organization type. Four of 56 institutions reported activities focused on *M. vovidesii* (see Appendix F for a list of all responding institutions).

Conservation actions needed

There is evidence that *M. vovidesii* may be more threatened than previous assessments indicate. It is recommended that *M. vovidesii* be included in national legislation for protection of threatened species under NOM-059-SEMARNAT-2010 standard in the category in danger of extinction (P). Integrated habitat conservation as well as ex *situ* conservation in suitable gardens and near situ habitats are suggested (Galván-Hernández et *al*. 2020). An integrated management program for cloud forest where this species grows is required. Seed selection of genotypes with high genetic variation should be a priority for ex *situ* culture. Seedling re-introduction from those individuals which have been propagated ex *situ* into potential distribution areas, maintaining a distance of 1-2 meter to reduce the spatial aggregation should be carried out. Further seed banking and habitat restoration are also recommended.

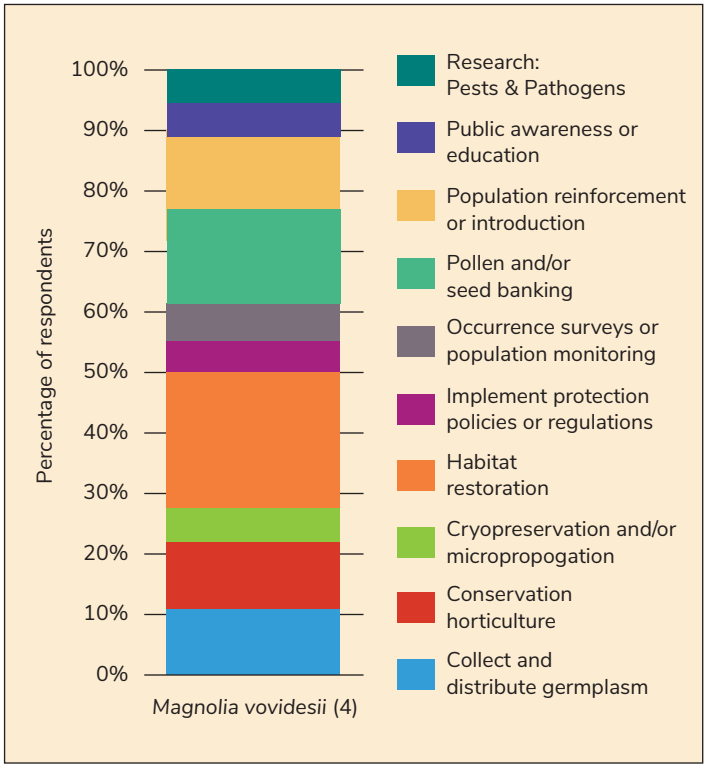

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. vovidesii* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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Dulce Maria Galván-Hernández

Magnolia yoroconte Dandy

Section: *Magnolia* **Synonyms:** None **Common names:** Candelillo, Cucharo, Redondo, Yaro, and Yoroconte
IUCN Red List Category and Criteria: Vulnerable A2c

Co-author: J. Antonio Vázquez García, Universidad de Guadalajara

Suggested citation: Linsky, J., & Vázquez García, J.A. (2022). *Magnolia yoroconte* Dandy. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia yoroconte is still poorly understood morphologically and ecologically. The species has previously been thought to grow in Mexico through Belize, Guatemala and into Honduras (Vázquez García 1994), however current knowledge is that *M. yoroconte* has only been confirmed in Honduras and a single plant found in Southern Guatemala (A. Vazquez-García, pers. comm, 2021; Mejia et *al*. 2021). Plants identified as *M. yoroconte* in Belize, further locations in Guatemala and Mexico are likely to be other species. There are plantations of putative *M. yoroconte* in Honduras, where it is called "redondo", "cucharo", "yaro", and "yoroconte" but the lack of vouchers, descriptions and photographs prevent confirming its identification in any other areas, but at its type locality and nearby in Tarros, Santa Barbara Department. The species is used for construction in Honduras. *M. yoroconte* is assessed as Vulnerable on the IUCN Red List, however the assessment requires updating with current range, population size and threat information.

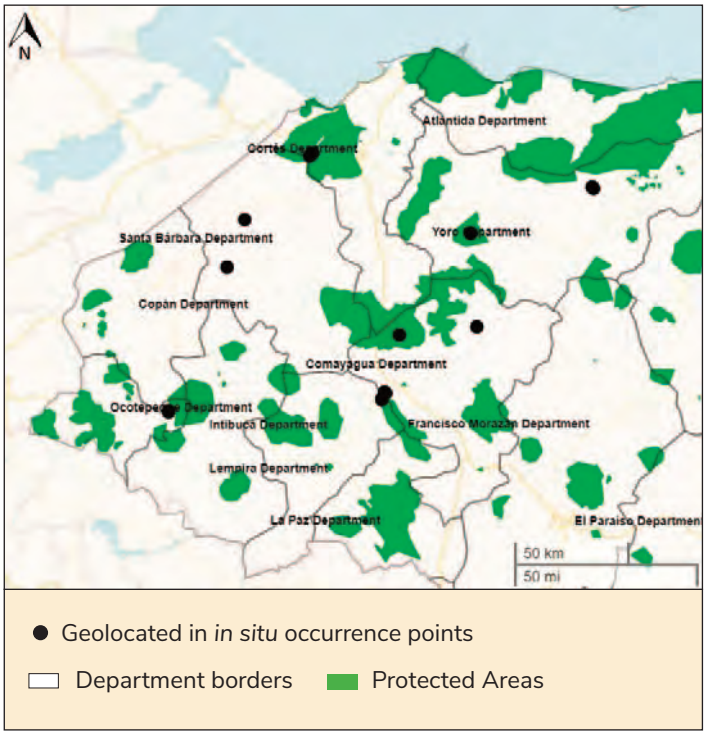

Figure 1. Potential *in situ* occurrence points for *Magnolia yoroconte* in Honduras (GBIF 2021; Lisa Wheeler (BGCI) 2014). Protected areas (green) are from Protected Planet (UNEP-WCMC 2021).


Wilson Morales

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia yoroconte*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators)..

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	-
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	5
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	5
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	40
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
					Average vulnerability score		17

Threats to Wild populations

The habitat of *M. yoroconte* is threatened by selective logging, general deforestation and fire. Climate change is also indicated as a threat to this species.

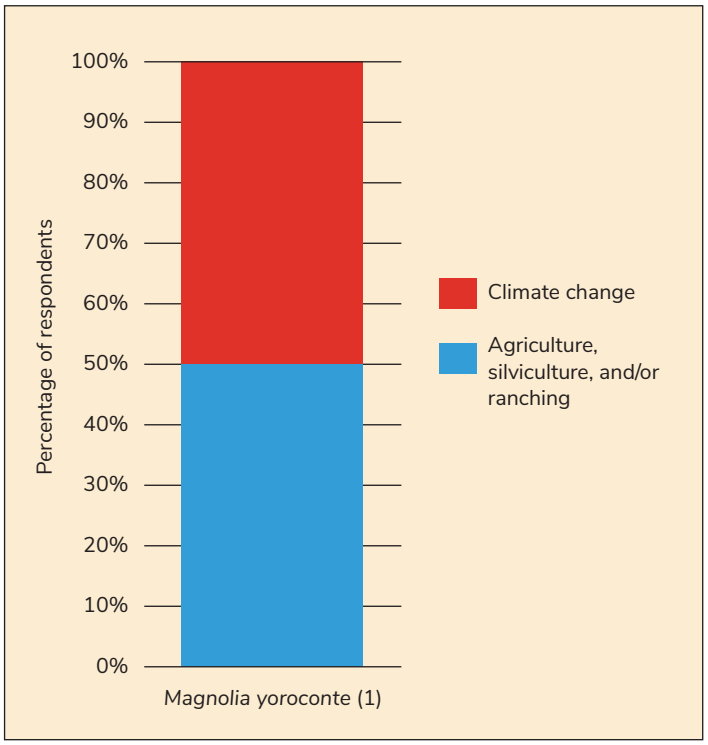

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. yoroconte* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Conservation Activities:

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of ex *situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

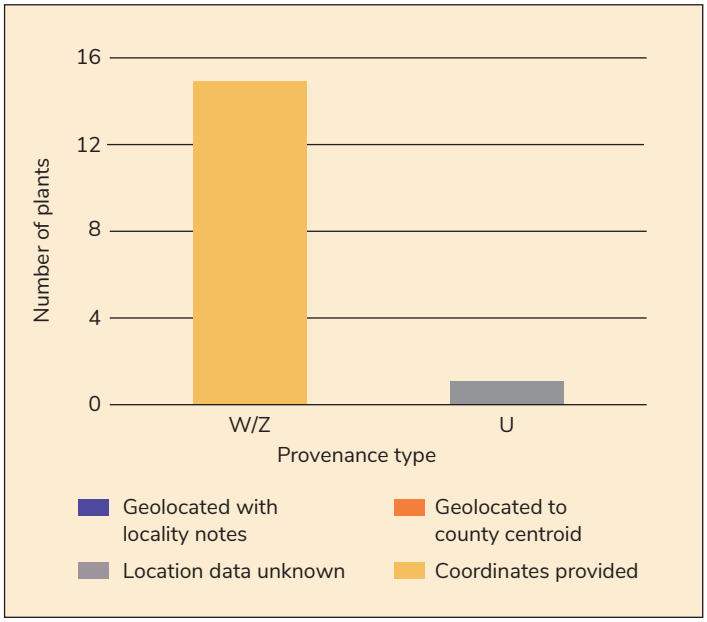

Figure 3. Number and origin of *Magnolia yoroconte* plants in ex *situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

Results of ex *situ* survey

Number of ex *situ* collections reporting this species:	2
Number of plants in ex *situ* collections:	16
Average number of plants per institution:	8
Percent of ex *situ* plants of wild origin:	94%
Percent of wild origin plants with known locality:	100%

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in ex *situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The ex *situ* buffer area represents the native range "captured" in ex *situ* collections, or "combined area ex *situ*" (CAE20, CAE50, CAE100). Geographic coverage of ex *situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

Estimated ex *situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	929 / 11,774 **(8%)**	4,879 / 37,835 **(13%)**	18,927 / 57,969 **(33%)**	**18%**
Ecological coverage	3 / 5 **(60%)**	5 / 5 **(100%)**	5 / 5 **(100%)**	**87%**

Protect and/or manage habitat
Based on reported *in situ* occurrences the species is potentially found in National Park Azul Meambar, Pico Pijol and Montecillos Biological Reserve.

Conservation horticulture
Pre-germinative treatment of scarification and growth on wet sand at cool temperatures is suggested (Salazar *et al.* 2000).

Collect and distribute germplasm
Ex situ collections are reported from the Central American Atlantic moist forests ecoregion (Figure 4).

No other conservation activities were reported from the questionnaire.

Conservation actions needed

Research on species delimitation and biology are needed to confirm the identity of this species. Population monitoring is required to assess species trends and phenology. Field study is needed to confirm the species range and updated status. No other conservation activities were reported from the questionnaire.

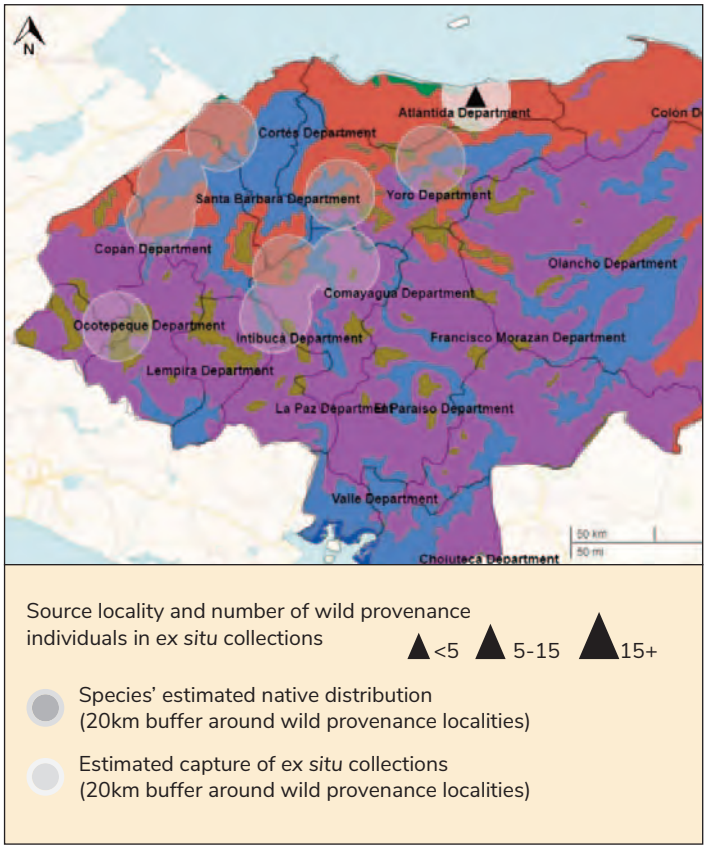

Figure 4. *Magnolia yoroconte in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the World (Olson 2001) are coloured; the recorded distribution is included in the Central American Atlantic moist forests, Central American dry forests, Central American pine-oak forests and Central American montane forests ecoregions.

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Magnolia zenii W.C.Cheng

Section: *Yulania* **Synonyms:** *Magnolia elliptilimba* Y.W.Law & Z.Y.Gao, *Yulania zenii* (W.C.Cheng) D.L.Fu
Common names: Baohua Yulan **IUCN Red List Category and Criteria:** Critically Endangered D

Co-author: Xiangying Wen, Botanic Gardens Conservation International, China

Suggested citation: Linsky, J., & Wen, X.Y. (2022). *Magnolia amoena* W.C.Cheng. In Linsky, J., Crowley, D., Beckman Bruns, E. & Coffey, E.E.D. *Global Conservation Gap Analysis of Magnolia*. Atlanta, GA: Atlanta Botanical Garden.

Distribution and Ecology

Magnolia zenii is endemic to Jiangsu in China. It is known from the type locality on the north slopes of Mount Baohua within a national forest park at an altitude of 220 m asl. There are just 18 individuals existing in the wild (China Expert Workshop 2014). It is assessed as Critically Endangered due to its extremely small population size and is a national key protected species.

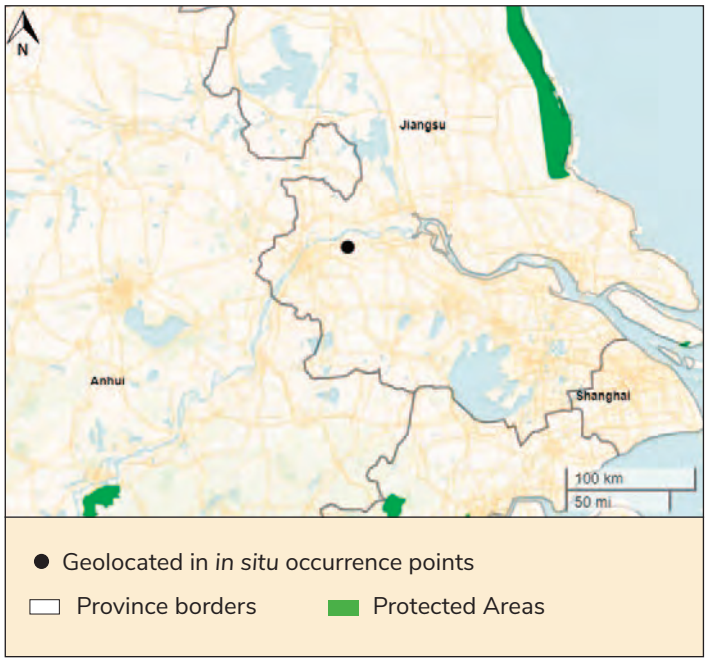

Figure 1. Documented *in situ* occurrence points for *Magnolia zenii* (China Expert Workshop 2014). Protected areas are from Protected Planet (UNEP-WCMC 2021).

Threats to Wild populations

This species has an extremely small population. Germination rate of seeds is very low and the population is impacted by visitors of the protected area. Germination of seeds is impacted by the dense forest canopy and the high humidity in the forest. So, there are few seedlings found in its wild habitat (Chu 2021). Inbreeding, development, climate change and agriculture, silviculture and/or ranching are all identified as threats to this species.

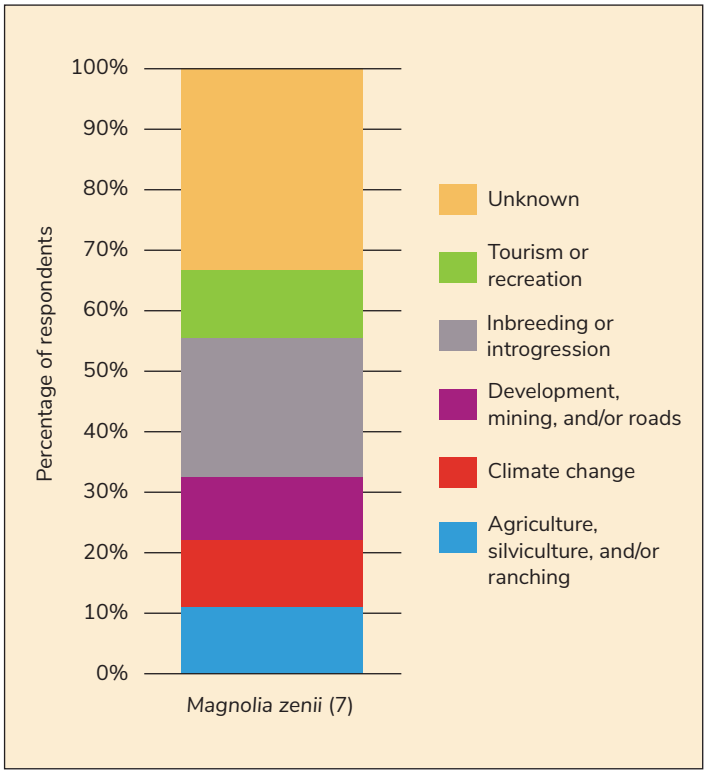

Figure 2. Responses from the *Magnolia* conservation action questionnaire for *M. zenii* for 'Select what you see as the most significant threats to wild populations of each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

Vulnerability of Wild populations

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Magnolia zenii*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	40
Range/endemism	Extremely small range or 1 location	EOO < 100 km2 or AOO < 10 km2 or 2-4 locations	EOO < 5,000 km2 or AOO < 500 km2 or 5-9 locations	EOO < 20,000 km2 or AOO < 2,000 km2 or 10+ locations	EOO > 20,000 km2 or AOO > 2,000 km2	Unknown	40
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	-
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	0
Regeneration/ recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	40
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	-
					Average vulnerability score		30

Conservation Activities

In 2019 and 2020, *Magnolia* taxon and accession level data were gathered from PlantSearch as well as a survey of *ex situ* collections. A total of 522 institutions from 65 countries submitted data for *Magnolia* species. Current and needed conservation activities for *Magnolia* species were also gathered through literature review, expert consultation and a conservation actions questionnaire. A total of 90 respondents from 77 institutions in 25 countries responded to the *Magnolia* Conservation Actions Questionnaire including 64 respondents from 56 institutions providing information on 145 threatened species and additional species of concern.

Results of *ex situ* survey

Number of *ex situ* collections reporting this species:	75
Number of plants in *ex situ* collections:	132
Average number of plants per institution:	2
Percent of *ex situ* plants of wild origin:	14%
Percent of wild origin plants with known locality:	53%

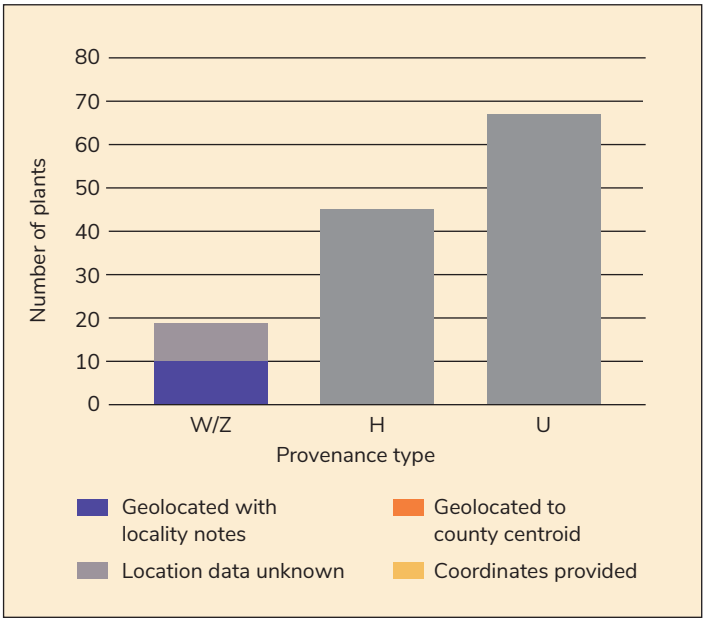

Figure 3. Number and origin of *Magnolia zenii* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

Estimated *ex situ* representation

	20km buffer	50km buffer	100km buffer	Average of all three buffer sizes
Geographic coverage	1,285 / 1,319 **(97%)**	7,923 / 8,005 **(99%)**	31,100 / 31,265 **(99%)**	**99%**
Ecological coverage	1 / 1 **(100%)**	1 / 1 **(100%)**	1 / 1 **(100%)**	**100%**

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Twenty, 50 and 100 kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in *ex situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or "combined area *in situ*" (CAI20, CAI50, CAI100 respectively). The *ex situ* buffer area represents the native range "captured" in *ex situ* collections, or "combined area *ex situ*" (CAE20, CAE50, CAE100). Geographic coverage of *ex situ* collections was estimated by dividing CAE by CAI and is presented here in km² and percentage of area covered. Ecological coverage was estimated by dividing the number of Terrestrial Ecoregions of the World present in the CAE by the number of ecoregions in the CAI. The average percentage of coverage of all three buffer sizes is also presented for the species.

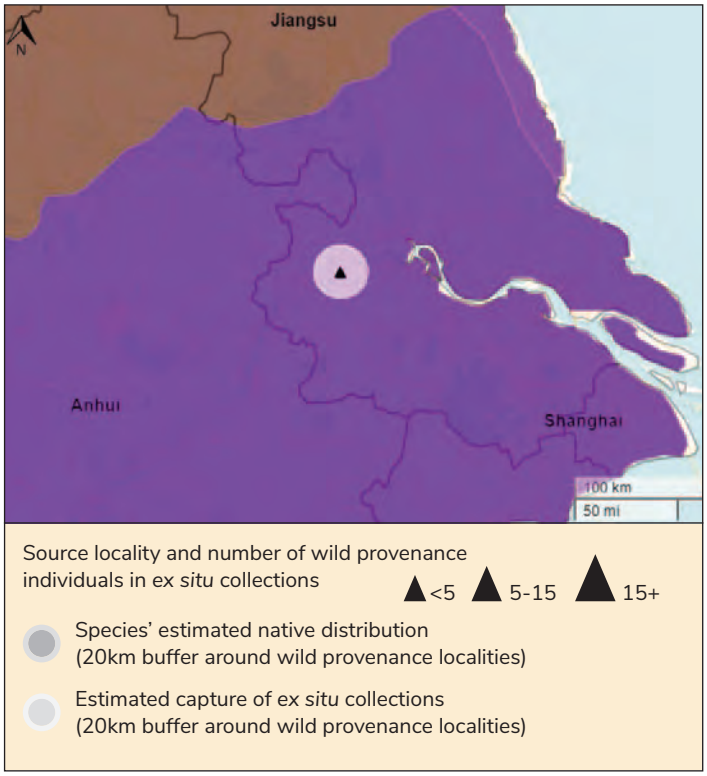

Figure 4. *Magnolia zenii in situ* occurrence points and *ex situ* collection source localities. Terrestrial Ecoregions of the world (Olson 2001) are coloured; the recorded distribution is included in the Changjiang Plain evergreen forests ecoregion.

Research: Genetics
Gifu Academy of Forest Science and Culture reports carrying out genetic research on *M. zenii*.

Research: Climate change
One institution reports this activity for *M. zenii*.

Public awareness/education:
Three institutions reported this activity in the questionnaire including Gardens of the Big Bend at University of Florida and Shenzhen Fairy Lake Botanical Garden.

Population reinforcement or introduction
M. zenii has been included in reintroduction projects and is a National key protected species in China (Ren H. 2020).

Protect and/or manage habitat
In 2020 and 2021, reinforcement of the slope habitat as well as guardrails have been installed surrounding the individuals (Chu 2021). Studies on population patterns and ecology showed that the species was subdominant in its communities (Jiang et *al*. 2010). Shenzhen Fairy Lake Botanical Garden reports this activity.

Population reinforcement or introduction
One institution reports this activity for *M. zenii*.

Pollen and/or seed banking
Both Shenzhen Fairy Lake Botanical Garden and University of British Columbia Botanical Garden report this activity for. *M. zenii*.

Occurrence surveys or population monitoring
Shenzhen Fairy Lake Botanical Garden reports this activity.

Implementation of protection policies or regulations
Shenzhen Fairy Lake Botanical Garden reports this activity for *M. zenii*.

Habitat restoration

Shenzhen Fairy Lake Botanical Garden reports this activity for *M. zenii*.

Conservation Horticulture

Gardens of the Big Bend at University of Florida, Shenzhen Fairy Lake Botanical Garden and the University of British Columbia Botanical Garden all report conservation horticulture as an activity carried out by their institutions.

Collect and distribute germplasm

Jiangsu Institute of Botany, Nanjing Forestry University, Nanjing Normal University, South China Botanical Garden, and Research Institute of Subtropical Forestry, Chinese Academy of Forestry have all carried out *ex situ* conservation at a small scale. Shanghai Botanical Garden also holds *M. zenii ex situ* collections (Chu 2021). Shenzhen Fairy Lake Botanical Garden and Zhejiang A&F University report this activity for *M. zenii*. *Ex situ* collections are reported from the endemic location of this species in the Changjiang Plain evergreen forests ecoregion (Figure 4).


Yang Keming


Philippe de Spoelberch

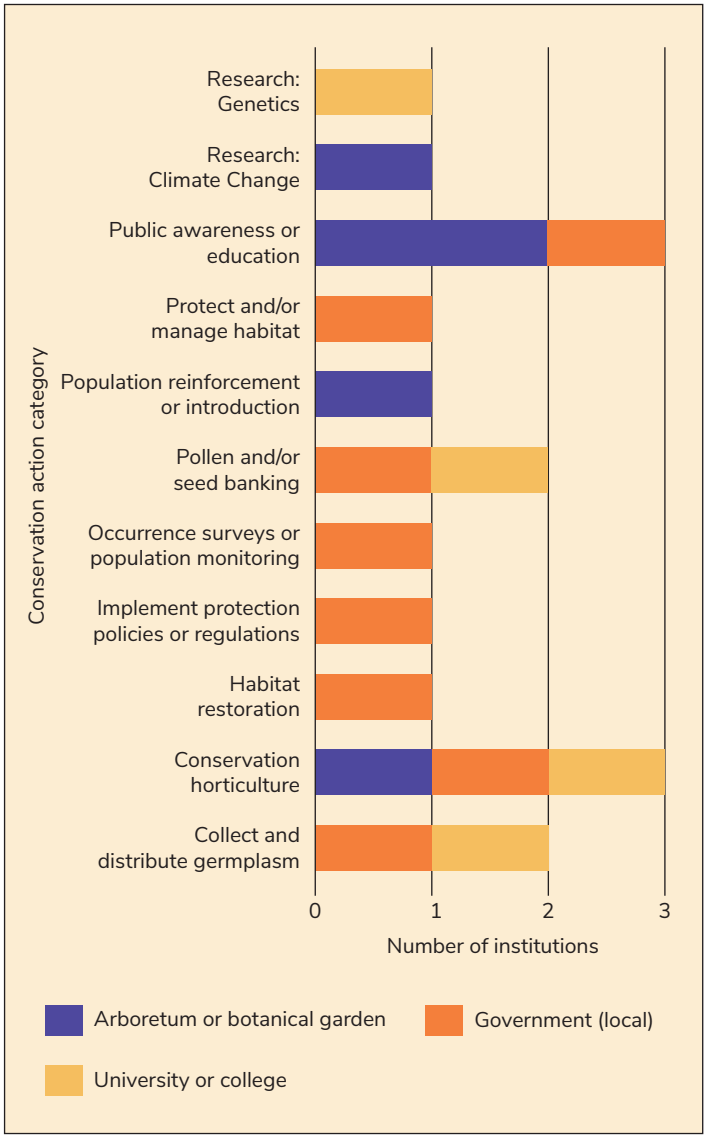

Figure 5. Number of institutions reporting conservation activities for *Magnolia zenii* grouped by organization type. Six of 56 institutions reported activities focused on *M. zenii* (see Appendix F for a list of all responding institutions).

Conservation Actions Needed

Shanghai Botanical Garden, Nanjing Forestry University, Jiangsu Wildlife Conservation Station, and the Baohuashan National Forest Park Management Committee have been participating in the joint project to conserve this species *in situ* (Chu 2021). On-going propagation, *in situ* conservation, *ex situ* conservation, reintroduction, public awareness raising and conservation technique training are supported by a Global Trees Campaign project.

While many activities are recommended for this species, collection and distribution of germplasm, public awareness and population monitoring are most recommended.

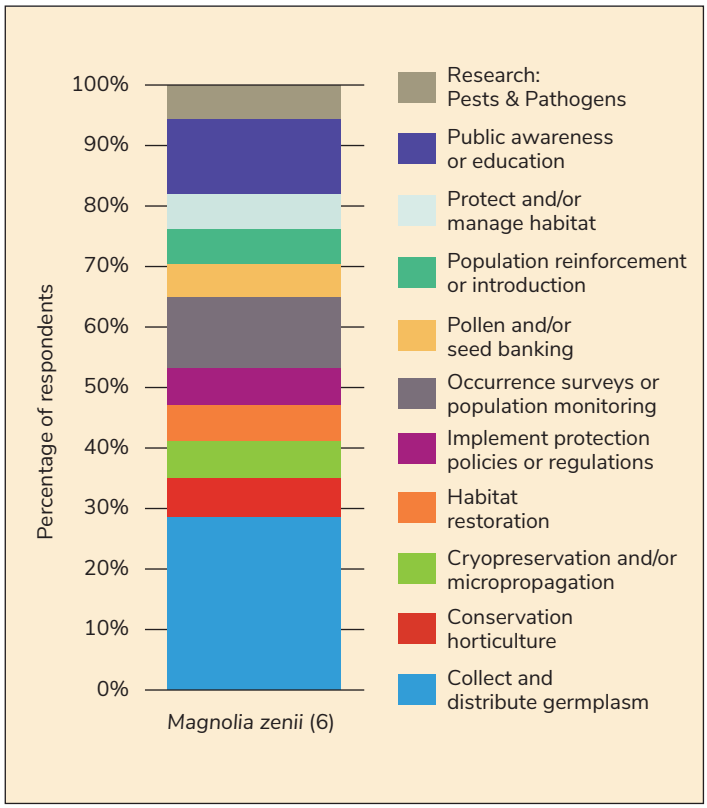

Figure 6. Responses from the *Magnolia* conservation action questionnaire for *M. zenii* for 'Select what you see as the most urgent conservation activities for each species'. The number of respondents participating in each question is listed in parentheses after the species' name.

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