Orchids:
2017 Global *Ex situ* Collections Assessment

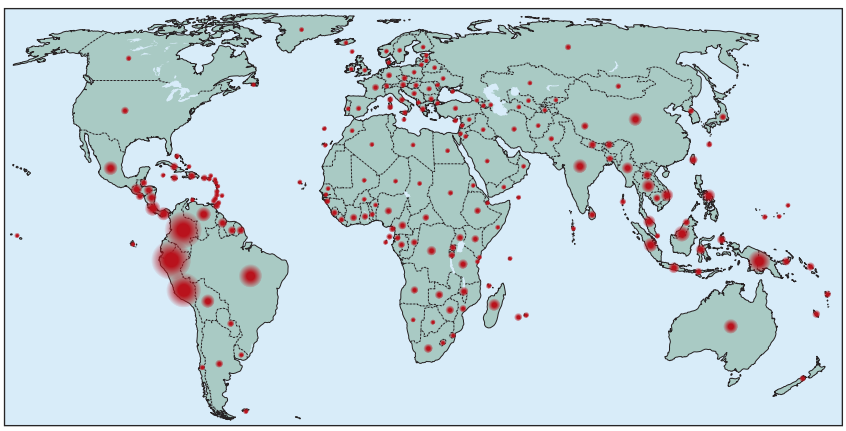
Botanic gardens collectively maintain one-third of Earth's plant diversity. Through their conservation, education, horticulture, and research activities, botanic gardens inspire millions of people each year about the importance of plants.

Ophrys apifera
(Bernard DuPon)

Angraecum conchoglossum
(Scott Zona)

With one in five species facing extinction due to threats such as habitat loss, climate change, and invasive species, botanic garden *ex situ* collections serve a central purpose in preventing the loss of species and essential genetic diversity.

To support the Global Strategy for Plant Conservation, botanic gardens create integrated conservation programs that utilize diverse partners and innovative techniques. As genetically diverse collections are developed, our collective global safety net against plant extinction is strengthened.



Country-level distribution of orchids around the world (map data courtesy of Michael Harrington via ArcGIS)




Left to right: **Renanthera monachica** *(Dalton Holland Baptista)*, **Platanthera ciliaris** *(Wikimedia Commons Jhapeman)*, **Anacamptis boryi** *(Hans Stieglitz)* ***and*** **Paphiopedilum exul** *(Wikimedia Commons Orchi)*.

Orchids

Orchids (Orchidaceae) make up one of the largest plant families on Earth, comprising over 25,000 species and around 8% of all flowering plants (Koopowitz, 2001). Orchids naturally occur on nearly all continents and ecosystems on Earth, with high diversity found in tropical and subtropical regions. Scientists and horticulturists have been fascinated for centuries by the complex flowers and life cycles, pollinator relationships, and uses of orchids including foods, flavorings, medicines, ornaments, and perfumes (Popova *et al*., 2016).

The diversity, stunning flowers, seductiveness, size, and ability to hybridize are all traits which make orchids extremely valuable to collectors, florists, and horticulturists around the world. Over-collection of wild plants is a major cause of species decline in the wild. Orchids are also very sensitive to environmental changes, and increasing habitat loss and climate change are leading contributors to the disappearance of orchids worldwide. As a result, exchange of all orchids between countries is regulated by the Convention on International Trade of Endangered Species (CITES).

Gardens Support Orchid Conservation

Remaining orchid habitat (and pollinators) are declining rapidly enough that *ex situ* conservation must serve as a safety net to ensure long-term species survival. One orchid species, *Oeceoclades seychellarum*, has been assessed by the IUCN as Extinct due to habitat degradation caused by human settlement and invasive plants. Although only 3% (890 of 27,800) of orchids have been assessed by the IUCN, 59% (529 taxa) are considered threatened and need *ex situ* protection to prevent extinction.

Orchid threat assessment status

Assessed by the IUCN as threatened[2]

Assessed by the IUCN as not threatened[2]

Not yet assessed by the IUCN[1]

[1]Angiosperm Phylogeny Website (http://www.mobot.org/MOBOT/research/APweb/)
[2]IUCN Red List of Threatened Species (http://www.iucnredlist.org/)

Due to their complicated biology *ex situ* conservation of orchids can be technically challenging. Research at botanic gardens and other conservation partners is producing protocols for long-term storage of seed, pollen, and associated fungi, as well as seed germination and *in vitro* propagation for a growing number of orchid species. This is revealing new opportunities for orchid *ex situ* conservation, and a variety of *ex situ* approaches are being utilized including the maintenance of living plants, stored seeds, cryopreserved tissues, and also the growth and study of fungal partners (IUCN Orchid Specialist Group, 2017).

Extinct	1
Critically Endangered	163
Endangered	249
Vulnerable	116

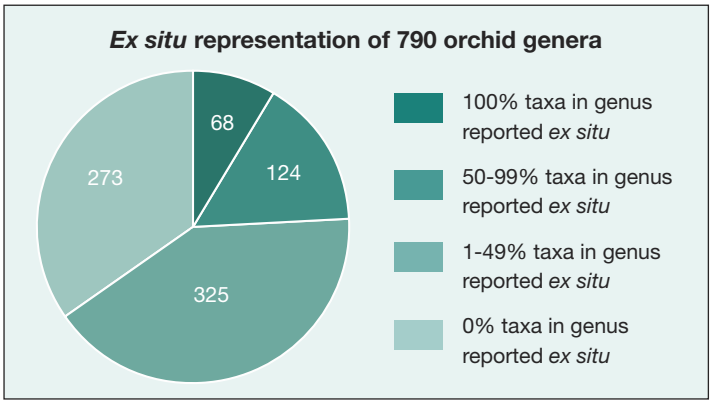
Total orchid taxa per IUCN Red List Threat Rank[1]

[1]IUCN Red List of Threatened Species (http://www.iucnredlist.org/)

Cyrtopodium punctatum *(Valerie Pence)*

Orchids in Collections

Using a list of 30,477 orchid species from the *World Checklist of Orchids* (Govaerts, *et al*., 2016) and BGCI's PlantSearch database, 436 plant and 33 seed *ex situ* sites were identified that currently report any orchid species. Of the nearly 800 genera included in the checklist, 517 (65%) orchid genera were reported among these collections. A majority of the most species-diverse orchid collections are found in the United States and Europe, outside tropical regions where natural orchid diversity is highest. This reflects possible gaps in regional collections capacity and PlantSearch data.

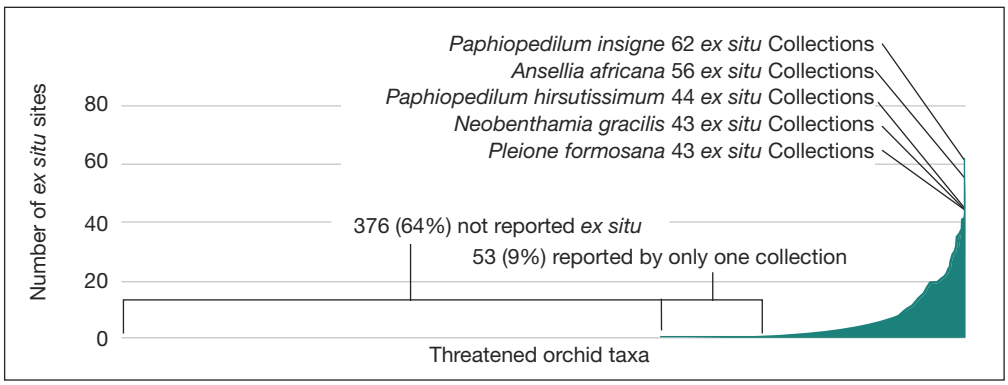


Institution	Country	Number of orchid species
Atlanta Botanical Garden	United States	1600+
Royal Botanic Gardens, Kew	United Kingdom	1300+
Smithsonian Gardens - Orchid Collection	United States	1050+
Marie Selby Botanical Gardens	United States	1000+
Gothenburg Botanical Garden	Sweden	900+
Jardin Botanique de Montréal	Canada	890+
Botanischer Garten der Philipps-Universität Marburg	Germany	880+
Hortus botanicus Leiden	Netherlands	870+
Glasgow Botanic Gardens	United Kingdom	750+
Huntington Botanical Gardens	United States	740+
Main Botanical Garden, Russian Academy of Sciences	Russia	610+
United States Botanic Garden	United States	600+
Wheeler Orchid Collection and Species Bank	United States	590+
Denver Botanic Gardens	United States	540+
Singapore Botanic Gardens	Singapore	500+
Botanic Garden Meise	Belgium	470+
Longwood Gardens	United States	470+
Jardin Botanique de la Ville de Lyon	France	450+
San Diego Zoo Botanical Gardens	United States	440+
Jardin des Plantes de Paris et Arboretum de Chevreloup	France	410+
University of California Botanical Garden at Berkeley	United States	390+

Top 20 most species-diverse orchid collections recorded in PlantSearch
**based on Govaerts,* et al. *(2016) orchid checklist and BGCI's PlantSearch database*


Hexalectris spicata
(Wikimedia Commons Orchi)

Top priorities for *ex situ* conservation action include focusing efforts on globally threatened species. A majority (64%) of the 604 globally threatened orchid species assessed by the IUCN and NatureServe have not been reported by *ex situ* collections (BGCI, 2017). Of the threatened orchids maintained in collections, one fifth (122 species) are reported by five or fewer collections. Ensuring that every threatened species is protected in *ex situ* collections is a first step to creating a global safety net against extinction.Species in one or a few collections should be acquired, duplicated and backed up at other sites.



Ex situ *collection status of 604 globally threatened orchids*
**Data sources: IUCN Red List, NatureServe, and BGCI's PlantSearch database*


Phalaenopsis violacea
(Wikimedia Commons Orchi)

Angraecum eburneum
(Scott Zona)

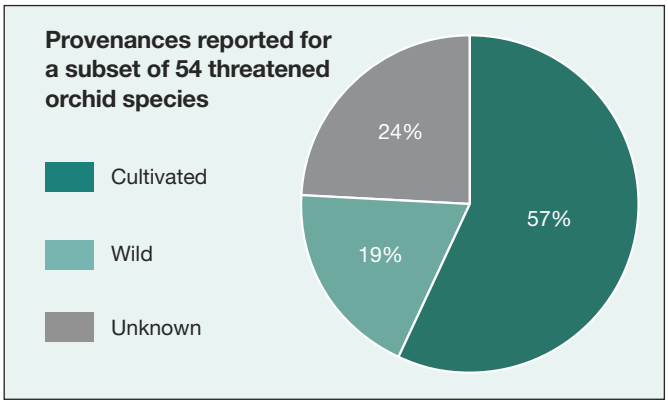
Orchid Accessions Survey

In 2017, a subset of 54 globally threatened orchid species was used for a survey of accessions data maintained at gardens. Out of 202 institutions in 70 countries reporting the target species to BGCI's PlantSearch database, 37 responded to the survey and sent lists of accessions. Over twenty fields of data were requested for each accession, focusing on provenance (origin) of the target species.

Overall, accession number, source, provenance type (wild, cultivated, or unknown origin), and number of individuals were reported for more than 80% of accession records submitted. Latitude and longitude, on the other hand, were reported for less than 1% of records. The majority (57%) of accession provenances reported for the target species were of cultivated (garden or horticultural) origin (see right). Notably, several orchid accessions reported by gardens were acquired as a plant rescue or border confiscation.

As recently discovered with *Brighamia insignis* collections, however, the non-wild origin accessions can be extremely valuable for preserving genetic diversity (Fant *et al*., 2016). It is possible that further investigation of accessions history and provenance could reveal known origins. When locality is known, it is also feasible to retro-classify spatial data for accessions of wild origin. Adequate data collection during wild-collecting efforts, and curation and preservation of accession data for existing *ex situ* collections make *ex situ* collections readily available and valuable for conservation and research applications.

“ Collection and curation of provenance data make *ex situ* collections readily available and valuable for conservation and research. ”



Roles of Botanic Garden Orchid Collections

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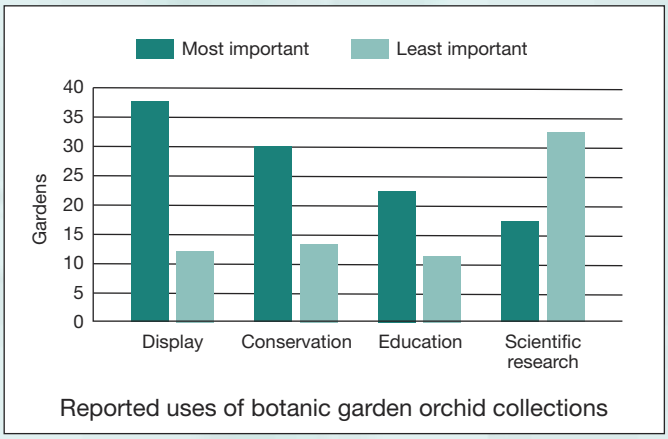
Botanic Gardens Conservation International (BGCI) has defined botanic gardens as "*institutions holding documented collections of living plants for the purposes of scientific research, conservation, display, and education.*" In 2017, the Gothenburg Botanical Garden sought to characterize the most important factors for acquisition and prioritization for botanic garden orchid collections, and estimate if those factors have changed over the past five years. A questionnaire was sent to 1833 gardens in the BGCI network, yielding almost 100 answers from orchid collections around the world.

Out of four main criteria offered, 38% of gardens reported "Display" as the most important factor for their orchid collections (see figure). Notably, the "Conservation" and "Scientific Research" criteria have increased in importance over the last five years for 35% and 22% of gardens, respectively. Gardens did not, however, report more or less research projects using living collections.

Recommendations of this study include increased and intentional use of orchid collections to support scientific research, conservation, display, and education. Strategic self-assessment, data sharing, and communication will support collections development, exchange, and use. Demonstrating the value and beauty of plants and biodiversity to the public is also a unique and critical role of botanic gardens.



Reported uses of botanic garden orchid collections

Bulbophyllum flabellum-veneris
(Wikimedia Commons orchidgalore)

Masdevallia ova-avis
(Wikimedia Commons Orchi)

Acknowledgements

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Atlanta Botanical Garden
Australian National Botanic Gardens
Birmingham Botanical Gardens
Botanic Garden of Smith College
Botanic Gardens of South Australia
Botanical Garden of the University of Osnabrück
Botanischer Garten der J.W. Goethe-Universitat
Denver Botanic Gardens
Dunedin Botanic Garden
EEB Biodiversity Education & Research Greenhouse
Frederik Meijer Gardens & Sculpture Park
Gents Universiteitsmuseum
Hortus Botanicus Leiden
Huntington Botanical Gardens
Jardin Botanique de la Ville de Caen
Les Jardins Suspendus
Linnaean Gardens of Uppsala
Longwood Gardens
Main Botanical Garden, RAS
Marie Selby Botanical Gardens
Millennium Seed Bank
Montréal Botanical Garden
Mt. Cuba Center
Multiplant International Medicinal Conservation
National Botanic Gardens, Glasnevin
Pukekura Park
Real Jardín Botánico Juan Carlos I
Royal Botanical Gardens, Hamilton
San Diego Zoo Botanical Garden
Smithsonian Gardens
Sukkulenten-Sammlung Zurich
Turku University Botanical Garden
United States Botanic Garden
University of California Botanical Garden at Berkeley
Utrecht Botanic Gardens
VanDusen Botanical Garden
Xishuangbanna Tropical Botanical Garden, CAS

Phragmipedium besseae
(Wikimedia Commons Averater)

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272 orchid genera not yet reported by *ex situ* collections to BGCI's PlantSearch database

If any of these genera exist in a living collection, public or private, please contact BGCI at info@bgci.org and contribute a plant list to PlantSearch at **www.bgci.org/plant_search.php**

Acanthophippium
Achlydosa
Adamantinia
Adrorhizon
Aenhenrya
Aglossorrhyncha
Alatiliparis
Ambrella
Amoana
Anacamptiplatanthera
Anacamptorchis
Anamantoglossum
Androcorys
Aracamunia
Archivea
Arethusa
Arnottia
Arthrochilus
Artorima
Auxopus
Baskervilla
Beclardia
Beloglottis
Bensteinia
Bhutanthera
Brachionidium
Brassocattleya
Bulleyia
Calassodia
Caluera
Calymmanthera
Campanulorchis
Cardiochilos
Catyclia
Centroglossa
Centrostigma
Cephalopactis
Cephalorchis
Chamaeanthus
Chamaegastrodia
Chamelophyton
Chauliodon
Cleisostomopsis
Codonorchis
Coenoemersa
Coilochilus
Cooktownia
Cottonia
Cotylolabium
Crossoliparis
Cryptarrhena
Cryptopylos
Cyanaeorchis
Cyanthera
Cybebus
Cypholoron
Cyrtidiorchis
Cyrtosia
Dactylanthera
Dactylocamptis
Dactylostalix
Daiotyla
Danhatchia
Danxiaorchis
Deceptor
Degranvillea
Devogelia
Diceratostele
Dickasonia
Didymoplexiella
Didymoplexiopsis
Didymoplexis
Diglyphosa
Dilochiopsis
Dinklageella
Diplocentrum
Discyphus
Distylodon
Dracomonticola
Draconanthes
Duckeella
Dunstervillea
Echinorhyncha
Echinosepala
Eclecticus
Eloyella
Eriaxis
Ericksonella
Erythrodes
Erythrorchis
Euryblema
Eurycentrum
Evotella
Frondaria
Fuertesiella
Funkiella
Galeoglossum
Galeottiella
Geesinkorchis
Guanchezia
Gymnanacamptis
Gymnotraunsteinera
Gymplatanthera
Hagsatera
Halleorchis
Hancockia
Hapalorchis
Helonoma
Hemipilia
Herpysma
Hintonella
Hoehneella
Hofmeisterella
Horvatia
Hsenhsua
Huttonaea
Hylophila
Imerinaea
Ixyophora
Jejewoodia
Kalimantanorchis
Kionophyton
Kreodanthus
Kuhlhasseltia
Laeliocattleya
Lankesterella
Lemurorchis
Lepidogyne
Lockia
Loefgrenianthus
Lueckelia
Lycamerlycaste
Lyroglossa
Megalorchis
Megastylis
Microepidendrum
Microthelys
Miltonidium
Mobilabium
Monophyllorchis
Myrmecolaelia
Myrosmodes
Nemaconia
Neobolusia
Neotinacamptis
Neotinarhiza
Nephrangis
Nothostele
Notyliopsis
Oberonioides
Octarrhena
Odisha
Odontochilus
Odontorrhynchus
Oestlundia
Oligophyton
Oliveriana
Ophioglossella
Orchidactylorhiza
Orchigymnadenia
Orchimantoglossum
Orchinea
Orchipedum
Orchiplatanthera
Orestias
Orleanesia
Pachites
Pachyplectron
Pachystoma
Palmorchis
Papillilabium
Papuaea
Paradisanthus
Penkimia
Phragmorchis
Physogyne
Pilophyllum
Platylepis
Pleurothallopsis
Poaephyllum
Pogoniopsis
Polyotidium
Porolabium
Porphyrostachys
Potosia
Praecoxanthus
Pseudadenia
Pseuderia
Pseudinium
Pseudocentrum
Pseudorhiza
Psytonia
Pterichis
Pterostemma
Pygmaeorchis
Quechua
Quekettia
Rauhiella
Rhizanthella
Rhomboda
Risleya
Roeperocharis
Saccolabiopsis
Saccolabium
Sanderella
Sansonia
Santotomasia
Sarcostoma
Saundersia
Sauroglossum
Schiedeella
Schistotylus
Schizochilus
Schlimia
Schuitemania
Schunkea
Sedirisia
Seegeriella
Seidenfadeniella
Selenipedium
Serapicamptis
Serapirhiza
Sertifera
Silvorchis
Singchia
Sirhookera
Sirindhornia
Skeptrostachys
Smithsonia
Solenocentrum
Sotoa
Sphyrarhynchus
Spongiola
Stalkya
Stenoptera
Stephanothelys
Stereosandra
Stigmatodactylus
Suarezia
Summerhayesia
Sutrina
Svenkoeltzia
Taeniorrhiza
Tamayorkis
Taprobanea
Teagueia
Thaia
Theana
Thelyschista
Thulinia
Thuniopsis
Tomzanonia
Townsonia
Trevoria
Triceratorhynchus
Tsaiorchis
Tylostigma
Uleiorchis
Uncifera
Vargasiella
Vasqueziella
Veyretella
Veyretia
Vietorchis
Waireia
Warreella
Warreopsis
Wullschlaegelia
Xerorchis
Yoania
Ypsilopus
Yunorchi

Acanthephippium mantinianum
(Wikimedia Commons Orchi)

Epidendrum ilense
(Andre P. Drapeau P)

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