

Rediscovery and conservation of *Begonia larorum* (Begoniaceae): a Critically Endangered, insular, narrow endemic species of Brazil

GABRIEL SABINO^{*1} , VITOR KAMIMURA¹ , GABRIEL MARCUSO² , INGRID KOCH¹ 
GUSTAVO SHIMIZU¹  and FABIO PINHEIRO¹ 

Abstract *Begonia larorum* is a threatened plant species endemic to Alcatrazes Island, south-east Brazil, which had not been recorded since its discovery in the 1920s. Here we report its rediscovery after more than a century since the first and only collection. In February 2024, we found a single individual in the forest understorey and successfully propagated it ex situ. Later that year we located a population of 19 individuals in an open area of vegetation prone to fires and invasive grasses and we obtained the first colour photographs of the species. Given its restricted range and the threats to its survival, we recommend the species be assessed for inclusion on the global IUCN Red List in addition to maintaining its Critically Endangered status at national level on the Red List of Brazilian Flora. We also propose in situ and ex situ conservation actions.

Keywords *Begonia*, conservation status, endemism, island, IUCN, rediscovery

Field expeditions to remote islands provide unique opportunities to explore overlooked biodiversity (Ríos-Saldaña et al., 2018) and rediscover species not recorded for extended periods (Paglia et al., 2022; Arana et al., 2024). Islands frequently harbour endemic species (Sabino et al., 2023, 2024), many of which are rare and threatened with extinction, requiring urgent conservation efforts (Ríos-Saldaña et al., 2018). Some genera, such as *Begonia*, encompass widely distributed as well as narrowly endemic species (Chan et al., 2019); conservation is critical especially for those with restricted ranges that are vulnerable to habitat loss and climate change (Thomas et al., 2024).

Begonia (Begoniaceae) is the eighth-largest genus of flowering plants, with a pantropical distribution and 2,144 species (Moonlight et al., 2024). Globally and locally, the conservation status of 745 species of *Begonia* has been evaluated, of which 365 (nearly 50%) are threatened at some level (BGCI, 2020). Brazil is home to

229 species, of which 186 are endemic to the Atlantic Forest (Jacques, 2024), a critical biodiversity hotspot under continuing threat from anthropogenic activities (Lima et al., 2024). Many *Begonia* species are endemic to small areas in specific geographical locations (e.g. Moonlight et al., 2023), with small and highly vulnerable populations (Chan et al., 2019). This is the case for *Begonia larorum*, which is endemic to Alcatrazes Island on the south-east coast of Brazil (Fig. 1).

Alcatrazes Island, the largest island in the archipelago of the same name, is located 35 km from the mainland. Since 2016, it has been part of the protected areas Refúgio de Vida Silvestre de Alcatrazes and Estação Ecológica Tupinambás (ICMBio, 2017). Both reserves are classified by the IUCN as Ia Strict Nature Reserves, the most restrictive category (Dudley, 2008; IUCN, 2012). The island's unique geomorphology, characterized by cliffs and isolated granitic outcrops, creates a variety of microhabitats including rocky outcrop vegetation and forest patches influenced by the coastal Atlantic Forest (Sabino et al., 2025). On rock formations, where the soil is thin or absent, the forest gives way to shrubby or herbaceous vegetation (ICMBio, 2017). Alcatrazes Island is an inselberg in the Atlantic Ocean, which further isolates it and limits gene flow between island and mainland populations (Pinheiro et al., 2021), leading to the presence of several endemic plants, such as *Anthurium alcatrazense* (Araceae), *Tillandsia alcatrazensis* and *Tillandsia uiraretama* (Bromeliaceae).

Historical botanical collections from the island are sparse. Albert Löfgren was the first collector in 1895, followed by Hermann Luederwaldt in the 1920s. *Begonia simulans* Irmsch. (Irmscher, 1953) was described from a specimen collected by Luederwaldt in 1920 (Luederwaldt & Fonseca s.n., SP8787). It was later verified as a homonym of *Begonia simulans* Merr. & L.M. Perry (described in 1943), requiring a new name, which was published as *Begonia larorum* (Smith & Wasshausen, 1983).

We conducted extensive surveys during 14 field expeditions from March 2022 to September 2024. *Begonia larorum* was located twice, in February and September 2024, in areas that were difficult to access (Plate 1). In February, we found a single, sterile individual from which we successfully propagated tip cuttings rooted in water, ex situ. This resulted in five clones, two of which reached

*Corresponding author, gpsabino@gmail.com

¹Department of Plant Biology, Institute of Biology, Universidade Estadual de Campinas, Campinas, Brazil

²Instituto de Pesquisas, Jardim Botânico do Rio de Janeiro, Rio de Janeiro, Brazil

Received 4 October 2024. Revision requested 11 March 2025.

Accepted 14 March 2025. First published online 16 October 2025.



FIG. 1 Location of Alcatrazes Island, state of São Paulo, south-east Brazil.

maturity after 7.5 months in a climate-controlled greenhouse at the University of Campinas, São Paulo, Brazil. Conditions in the greenhouse were controlled to maintain a favourable temperature (not above 25 °C) and water supply (watering once daily in mild weather and three times daily in hot conditions).

In September 2024, we discovered a new population of 19 individuals, including 17 reproductive plants, in the south of Alcatrazes Island. We georeferenced and photographed the plants in situ, and provided herbarium vouchers (Sabino et al., 1000, UEC 214737; acronyms according to Thiers, 2025).

Despite its ecological significance and relative inaccessibility, Alcatrazes Island has a history of anthropogenic disturbance dating back to the early 1900s when areas of native vegetation were cleared for subsistence farming (e.g. sugarcane, banana, cassava) and the construction of three houses for lighthouse keepers (ICMBio, 2017). Subsequently, vegetation was cleared to allow harvesting of seabird guano for fertilizer, which continued until the 1990s (F.P. Campos, pers. comm., 2024). In the 1970s, the Brazilian Navy began restricting access to the island and conducting military exercises, resulting in successive fires. In 2004, a large fire caused by an artillery exercise destroyed 20 ha of native vegetation in the north-east of the island (ICMBio, 2017). Invasive species such as *Melinis minutiflora* (Poaceae) and *Pteridium esculentum* (Dennstaedtiaceae) spread into the damaged areas (ICMBio, 2017). Both species have a competitive advantage over other species in open

areas and accumulate large amounts of dry biomass, raising the risk of future fires (Jatoba et al., 2016; Zenni et al., 2019) and posing a serious threat to species with a restricted distribution, such as *Begonia larorum*. After years of campaigning by environmentalists, in 2013 the military exercises were relocated to Sapata Island, a small islet c. 4 km north-east of Alcatrazes Island.

With only 17 reproductive individuals of *Begonia larorum* known to exist, there are concerns about the species' genetic diversity and long-term viability. However, the steep, inaccessible terrain raises the possibility that more individuals may exist in unreachable areas. *Begonia larorum* is monoecious (Plate 1) but further details about its reproduction are unknown. Most *Begonia* species are monoecious, and inbreeding depression (Ågren & Schemske, 1993) and self-incompatibility (Wyatt & Sazima, 2011) have been reported for other species in the genus. These reproductive traits may constrain plant colonization and reproduction on islands, as populations are small and prone to extreme demographic variation (Crawford et al., 2011). Many island plants are hermaphroditic and self-compatible, which may confer higher reproductive success in isolated environments (Crawford et al., 2011). An earlier conservation assessment for the Red List of Brazilian Flora, based on the only collection prior to ours, categorized *B. larorum* as Critically Endangered, citing its restricted distribution with an estimated area of occupancy of only 4 km² and the additional threat posed by invasive species (Sfair & Messina, 2012).



PLATE 1 Collection site and habitat of *Begonia larorum* in Alcatrazes Island, Brazil. (a) Aerial view of Alcatrazes Island, with white dots indicating the collection sites of *B. larorum*, (b) typical habitat of *B. larorum*, (c) *B. larorum* in situ. Photos: L. Candisani (a); G.P. Sabino (b,c).

We recommend maintaining the status of *B. larorum* as Critically Endangered on the Red List of Brazilian Flora and updating its global status accordingly. In this context, we will submit a recommendation to the IUCN for the species to be assessed for inclusion on the IUCN Red List of Threatened Species. For in situ conservation, it is crucial

that military exercises continue to be excluded from the island, and that invasive species are actively managed to prevent further incursions into *B. larorum* habitat. Additionally, ex situ conservation should involve cultivating and preserving specimens in botanical gardens, greenhouses and collections at independent sites. Our study provides key insights into the ex situ conservation of this unique species through the successful cloning by cuttings. It also contributes to in situ conservation by locating a previously unknown population, describing its habitat, and producing a digital herbarium voucher and the first colour photographs.

Our rediscovery of *B. larorum* underscores the critical need for conservation efforts targeting this and similar endemic species in vulnerable habitats like Alcatrazes Island. Our work highlights the importance of botanical surveys and effective management strategies to protect isolated populations from threats such as habitat degradation and invasive species (Gallagher et al., 2023). The findings will contribute to future conservation strategies but further research is essential to assess the genetic diversity of the newly discovered *B. larorum* population and to monitor its ecological interactions and life strategy over time. In particular, studies of its reproductive and pollination ecology will be crucial for understanding the viability of this small population.

Author contributions Study design: GPS, VAK, GMM, FP; data collection: GPS, VAK, GMM; plate design: GPS; writing: all authors.

Acknowledgements We thank the staff from ICMBio-Alcatrazes; and Matheus Soares for identifying the Diptera. Financial support for this study was provided by the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP; grant no. 2022/02667-1), CBioClima (Processo FAPESP 2021/10639-5) and CAPES—Finance Code 001. Additional funds were provided by grants from FAEPEX (FUNCAMP) to FP, fellowships to GPS (FAPESP; grant no. 2023/02443-9), VAK (FAPESP; grant no. 2022/09041-0) and FP (CNPq, productivity grant no. 302849/2021-1). IK thanks CNPq (productivity grant no. 315048/2021-2); GMM thanks FAPERJ (research grant no. E-26/205.680/2022).

Conflicts of interest None.

Ethical standards Plants were collected under the permit Sistema de Autorização e Informação em Biodiversidade (SISBIO) number 85929. This research abided by the *Oryx* guidelines on ethical standards.

Data availability Voucher specimens are deposited at Herbarium Universidade Estadual de Campinas.



PLATE 2 *Begonia larorum*: (a) male inflorescence, (b) female inflorescence, (c) male flowers with *Allograpta exotica* (Diptera) consuming pollen, (d) branch with male inflorescence and immature green fruits, (e) infructescence, (f) sterile branch, adaxial side, (g) sterile branch, abaxial side. Photos: G.P. Sabino and G.M. Marcusso, from herbarium voucher Sabino et al., 1000, UEC 214737.

References

- ÅGREN, J. & SCHEMSKE, D.W. (1993) Outcrossing rate and inbreeding depression in two annual monoecious herbs, *Begonia hirsuta* and *B. semiovata*. *Evolution*, 47, 125–135.
- ARANA, M., NATALE, E. & OGGERO, A. (2024) Lost and found: the rediscovery of the lost fern species *Asplenium achalense* (Aspleniaceae) and assessment of its conservation status. *Oryx*, 58, 607–610.
- BGCI (BOTANIC GARDENS CONSERVATION INTERNATIONAL) (2020) *PlantSearch Database*. Botanic Gardens Conservation International, London, UK. tools.bgci.org/threat_search.php [accessed 11 September 2025].
- CHAN, Y.M., CHUA, L.S.L., LEE, S.L. & LEE, C.T. (2019) Understanding rarity in a narrow endemic *Begonia* through biological comparison with a common species. *Journal of Tropical Forest Science*, 31, 422–432.
- CRAWFORD, D.J., ANDERSON, G.J. & BERNARDELLO, G. (2011) The reproductive biology of island plants. In *The Biology of Island Floras* (eds D. Bramwell & J. Caujapé-Castells), pp. 11–36. Cambridge University Press, Cambridge, UK.
- DUDLEY, N. (ed.) (2008) *Guidelines for Applying Protected Area Management Categories*. IUCN, Gland, Switzerland.
- GALLAGHER, R.V., ALLEN, S.P., GOVAERTS, R., RIVERS, M.C., ALLEN, A.P., KEITH, D.A. et al. (2023) Global shortfalls in threat assessments for endemic flora by country. *Plants, People, Planet*, 5, 885–898.
- ICMBio (2017) *Plano de Manejo da Estação Ecológica Tupinambás e Refúgio de Vida Silvestre do Arquipélago de Alcatrazes*. Vol. 1. Instituto Chico Mendes de Conservação da Biodiversidade, Brasília, Brazil.
- IRMSCHER, E. (1953) Systematische Studien über Begoniaceen des tropischen Südamerikas, besonders Brasiliens. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie*, 76, 1–102.
- IUCN (2012) *Red List Categories and Criteria*. Version 3.1, 2nd edition. IUCN, Gland, Switzerland. [iucnredlist.org/resources/categories-and-criteria](https://www.iucnredlist.org/resources/categories-and-criteria) [accessed 11 September 2025].
- JACQUES, E.L. (2024) *Begoniaceae. Flora e Funga do Brasil*. Jardim Botânico do Rio de Janeiro, Rio de Janeiro, Brazil. floradobrasil.jbrj.gov.br/consulta/ficha.html?idDadosListaBrasil=5562 [accessed 10 September 2024].
- JATOBA, L.J., VARELA, R.M., MOLINILLO, J.M.G., DIN, Z.U., GUALTIERI, S.C.J., RODRIGUES-FILHO, E. & MACIAS, F.A. (2016) Allelopathy of bracken fern (*Pteridium arachnoideum*): new evidence from green fronds, litter, and soil. *PLOS One*, 11, e0161670.
- LIMA, R.A.F., DAUBY, G., GASPER, A.L., FERNANDEZ, E.P., VIBRANS, A.C., OLIVEIRA, A.A. et al. (2024) Comprehensive conservation assessments reveal high extinction risks across Atlantic Forest trees. *Science*, 383, 219–225.

- MOONLIGHT, P.W., BALDASZTI, L., CARDOSO, D., ELLIOTT, A., SÄRKINEN, T. & KNAPP, S. (2024) Twenty years of big plant genera. *Proceedings of the Royal Society B*, 291, 20240702.
- MOONLIGHT, P.W., JARA-MUÑOZ, O.A., PURVIS, D.A., DELVES, J., ALLEN, J.P. & REYNEL, C. (2023) The genus *Begonia* (Begoniaceae) in Peru. *European Journal of Taxonomy*, 881, 1–334.
- PAGLIA, I., LUBER, J., DE FREITAS MANSANO, V. & FREITAS, L. (2022) A narrowly endemic species of Begoniaceae: rediscovery, distribution and conservation of *Begonia jocelinoi*. *Oryx*, 56, 935–938.
- PINHEIRO, F., VEIGA, G.S., CHAVES, C.J.N., CACOSI, T.C. & DA SILVA, C.P. (2021) Reproductive barriers and genetic differentiation between continental and island populations of *Epidendrum fulgens* (Orchidaceae). *Plant Systematics and Evolution*, 307, 36.
- RIOS-SALDAÑA, C.A., DELIBES-MATEOS, M. & FERREIRA, C.C. (2018) Are fieldwork studies being relegated to second place in conservation science? *Global Ecology and Conservation*, 14, e00389.
- SABINO, G.P., LEODEGARIO, M.M., MARCUSO, G.M., SHIMIZU, G.H., KOCH, I., TAVARES, D.U. & PINHEIRO, F. (2023) *Tillandsia alcatrazensis* (Bromeliaceae), a new endemic species from Alcatrazes Island in southeastern Brazil. *Phytotaxa*, 607, 213–221.
- SABINO, G.P., LEODEGARIO, M.M., MARCUSO, G.M., DAVID, N.M.G., KOCH, I., TAVARES, D.U. & PINHEIRO, F. (2024) *Tillandsia uiraretama* (Bromeliaceae), another new species from Alcatrazes Island, southeastern Brazil. *Phytotaxa*, 676, 85–94.
- SABINO, G.P., PINHEIRO, F., CABRAL, J.S., KOCH, I., MARCUSO, G.M., TAVARES, M.M. et al. (2025) Islanded islands: dual isolation drive distinctive and threatened floras of Neotropical maritime inselbergs. *Journal of Vegetation Science*, 36, e70037.
- SFAIR, J.C. & MESSINA, T. (2012) *Begonia larorum* (Begoniaceae). Red List of Brazilian Flora, National Center for Flora Conservation/Research Institute of the Rio de Janeiro Botanical Garden. cncflora.jbrj.gov.br/portal/pt-br/profile/Begonia%20larorum [accessed 17 September 2024].
- SMITH, L.B. & WASSHAUSEN, D.C. (1983) Notes on Begoniaceae—I. *Phytologia*, 52, 441–451.
- THIERS, B.M. (2025) *Index Herbariorum. A Worldwide Index of Herbaria and Associated Staff Where Plant and Fungal Specimens are Permanently Housed*. New York Botanical Garden, New York, USA. sweetgum.nybg.org/science/ih [accessed 11 September 2025].
- THOMAS, D.C., ARDI, W.H., CHONG, Y.H., THOMAS, P. & HUGHES, M. (2024) Conservation status assessments of species-rich tropical taxa in the face of data availability limitations: insights from Sulawesi *Begonia*. *Scientific Reports*, 14, 14007.
- WYATT, G.E. & SAZIMA, M. (2011) Pollination and reproductive biology of thirteen species of *Begonia* in the Serra do Mar State Park, São Paulo, Brazil. *Journal of Pollination Ecology*, 6, 95–107.
- ZENNI, R.D., SAMPAIO, A.B., LIMA, Y.P., PESSOA-FILHO, M., LINS, T.C.L., PIVELLO, V.R. & DAEHLER, C. (2019) Invasive *Melinis minutiflora* outperforms native species, but the magnitude of the effect is context-dependent. *Biological Invasions*, 21, 657–667.