Cactus and Succulent Plants Specialist Group Newsletter

July 2025

Content

CSSG News 2

Conservation Initiatives

Cactaceae management and rescue practices. Urgent and necessary improvements in the framework of the Sistema de Evaluación de Impacto Ambiental (SEIA) projects in Chile. 11

People and plants

I found out the plant I bought may have come from an illegal collection. What should I do? 14

Conservation and the Cactus and Succulent Society of America 14

Commented publications

Lessons learned from cactus demographic studies 19

The Cerrado through cacti, and the cacti in the Cerrado 21

The great diversity of cacti in Central Chile 23

New Research on Cacti and Succulents 27

Events and Opportunities 30

www.iucn-cssg.org

A Few Words from the Co-Chairs

Dear Members of the IUCN SSC Cactus and Succulent Plants Specialist Group,

We have had an exciting year with lots of advancements carried out for the conservation of cacti and other succulent plants. We grew our membership and brought in many CSSG Members to serve as focal points for the IUCN Red List reassessment of Cactaceae. We developed a new partnership with Huntington Botanical Garden to further our goals, and we partnered with colleagues from Chile to circumvent the illegal trade of cacti. Unfortunately, the illegal trade of cacti and other succulent plants remains to be a serious problem, but efforts made by CSSG and others, such as the new IUCN SSC Succulent Plant Illegal Trade Task Force, are working hard to combat it. This year, we expect to be a further push forward for the conservation of these amazing plants, especially through the help and collaboration of all of our membership and partners.

Best regards,

Bárbara Goettsch and Lucas C. Majure (Co-Chairs of the CSSG)

Pygmaeocereus familiaris near Atiquipa, Peru, September 2023. Photo: Lucas C. Majure.

CSSG News

New Members

We welcome our new Members! We continue to broaden our membership as part of our commitments for the quadrennium (2021-2025) with a particular emphasis on increasing women and young researcher (under 35 years) representation:

- Usama Ghazali, a Wildlife Ecology Manager at the Prince Mohammed bin Salman Royal Reserve joined the CSSG. His expertise lies in Asparagaceae, particularly the genus *Dracaena*.
- Moisés Grimberg, Manager at Parque Nacional Llanos de Challe, CONAF, Chile. He specializes in Cactaceae from Chile.
- Ana Pin joined the CSSG, contributing valuable expertise on the Cactaceae of Paraguay. She has also agreed to serve as the focal point for Paraguay for the Cactaceae reassessments.
- Ana Sandoval, Technical Manager at Banco Base de Semillas, Instituto de Investigaciones Agropecuarias INIA Intihuasi, Chile. She specializes in *ex situ* conservation of cacti.

Program Officer Departure and Search

Michiel (Mich) Pillet is moving on from his position as Program Officer, effective May 2025. Mich expresses his gratitude for the experience he's gained during his tenure, the opportunities for contributing to the conservation of cacti and other succulents, and the interactions he's had with CSSG Members and other conservation stakeholders. He is keen to continue research collaborations, and can be reached at mdpillet@gmail.com. We are grateful for Mich's dedication during his time as Program Officer.

If you or someone you know might be interested in taking this position, please get in touch.

Donations

We are grateful to B.Willow, our partner store located in Maryland, USA, the Central Arizona Cactus and Succulent Society, located in Phoenix, USA, and the Kautz Family Foundation for their kind donations and conservation support. Their donations help advance our mission and will be especially helpful for funding the reassessments of Cactaceae.

Partnership with The Huntington Library, Art Museum, and Botanical Gardens

On September 1st, 2023, The Huntington Library, Art Museum, and Botanical Gardens welcomed lectures by Co-Chair Bárbara Goettsch and Program Officer Michiel Pillet as part of the 40th Annual Succulent Plants Symposium. This was followed by several meetings with conservation stakeholders. We are excited to announce that these activities resulted in the establishment of a partnership with The Huntington (Fig. 1). Huntington staff and interns will be supporting the reassessment of Cactaceae for the IUCN Red List by preparing and reviewing assessments. We look forward to our collaboration with The Huntington.

Figure 1. CSSG Co-Chairs Dr. Lucas Majure and Dr. Bárbara Goettsch, and Program Officer Michiel Pillet, met with staff at The Huntington Library, Art Museum, and Botanical Gardens to seek collaborations.

Launch of the Integrated Conservation Action Plan for the Genus *Copiapoa*

We are very excited to announce that the Integrated Conservation Action Plan for the Genus Copiapoa has been launched. This Plan is the result of a series of seven workshop sessions that took place in August and September 2022. It was convened by Ministerio de Medio Ambiente de Chile (MMA), Chester Zoo, the IUCN Species Survival Commission (SSC) Conservation Planning Specialist Group (CPSG), and CSSG. 35 experts from over 20 institutions and five countries participated. The resulting Action Plan is being adapted as a national action plan (RECOGE) by MMA, and includes threat assessments as well as recommended conservation actions. Launch of the Plan was accompanied by an IUCN press release.

We are confident that the Action Plan will have a positive impact on the conservation of *Copiapoa*, and implementation has already started. In November 2023, an in-person workshop with 14 stakeholders of the *Copiapoa* Working Group took place in Chile to start the implementation of the Plan (Fig. 2). CSSG Co-Chair Bárbara Goettsch and CSSG Member Pablo Guerrero participated in this meeting. The event was featured by Chilean media. The *Copiapoa* Working Group will meet twice a year, starting in April 2024.

CSSG would like to express its gratitude to all the participants who contributed their time and expertise. We are grateful to Chester Zoo and the British Cactus and Succulent Society for their financial and technical support. We would like to thank MMA for endorsing and

supporting the Action Plan and for their technical input. We thank CPSG for all their hard work in preparing and facilitating the workshop. The workshop was also financially supported by the SSC Internal Grants.

Figure 2. CSSG Co-Chair Bárbara Goettsch met with collaborators in Chile in late 2023 to begin the implementation of the Integrated Conservation Action Plan for the Genus *Copiapoa*.

Updates on *Copiapoa* Conservation

Beyond updates on the progress of the Integrated Conservation Action Plan and Operation Atacama, several other noteworthy events related to *Copiapoa* (Fig. 3) should be mentioned. As we are busy preparing to reassess the rest of the cactus family, reassessments for the genus *Copiapoa* have been published on the IUCN Red List. As discussed in the press release, 82% of *Copiapoa* are now assessed under a threatened category, up from 55% in 2013. Major threats include illegal trade, facilitated by social media, road and housing development, and climate change.

A study published in the journal *Conservation Biology* (Villalobo-Lopez *et al.*, 2024) examines the drivers of extinction risk for the genus using machine learning models. They find that trade, poaching, habitat degradation, and their interactions are the most important factors threatening *Copiapoa*. The authors emphasize the urgent need for development and enforcement of strategies monitoring international trade. Four CSSG Members co-authored the study.

These alarming findings have attracted attention by the media. CSSG Co-Chair Dr. Bárbara Goettsch and Members Dr. Pablo Guerrero and Dr. Jared Margulies, in an interview with PBS, partially attribute the increase in poaching pressure to a lack of enforcement on social media and e-commerce platforms. They also call for educational intervention. Ladera Sur, a Chilean news outlet, interviews Dr. Goettsch and Dr. Guerrero about the threats faced by *Copiapoa*, emphasizing the cultural importance of these species.

Reference

Villalobo-Lopez, A., Peña, C.M., Varas-Myrik, A., Pillet, M., Jahnsen, P., Pliscoff, P., Goettsch, B. and Guerrero, P.C. 2024. Effects of trade and poaching pressure on extinction risk for cacti in the Atacama Desert. *Conservation Biology* 38: 1-13. https://doi.org/10.1111/cobi.14353.

Figure 3. *Copiapoa cinerea* ssp. *columna-alba* in its natural habitat. Photo: Bárbara Goettsch.

Cactaceae Reassessment Task Force

A Task Force to reassess the Cactaceae family for the IUCN Red List of Threatened Species is being set up. The objective of the Task Force is to catalyze the reassessment of the Cactaceae family with the help of focal points identified by region or country. The focal points will be in charge of leading and managing the process, as well as involving experts of their respective regions/countries and seeking funding. The focal points will receive support from the CSSG Chairs and the Program Officer. If you are interested in being part of the Task Force for your country or region, please do not hesitate to let us know.

In January 2024, an initial meeting took place with five regional focal points and two supporting institutions from Sonora, Guanajuato, Hidalgo, Queretaro, Cuba, Hispaniola, Peru and Chile to discuss the reassessment process. Following a taxonomic review using “Cactaceae at Caryophyllales.org”, several draft taxon lists for focal points have been prepared: Sonoran Desert (133 taxa), Guanajuato, Hidalgo and Queretaro (184 taxa), Peru (164 taxa), Chile (161 taxa), Hispaniola (36 taxa), Cuba (47 taxa), Tehuacán-Cuicatlán Valley (102 taxa), Paraguay (68 taxa), Ecuador (46 taxa) and Colombia (56 taxa). We also secured institutional support for the reassessment from The Huntington Library, Art Museum, and Botanical Gardens in San Marino, California, USA and Comisión Nacional para Conocimiento y Uso de la Biodiversidad (CONABIO) in Mexico.

We are pleased to share that the following focal points have agreed to be part of the Task Force (listed geographically from north to south):

- José Luis León de la Luz, independent researcher - will support the reassessment of cactus species of the Baja California Peninsula
- Jardín Botánico Regional de Cadereyta, Querétaro, Mexico - will support the reassessment of cactus species of Querétaro, Hidalgo, and Guanajuato, Mexico
- Duniel Barrios Valdés, Jardín Botánico de la Habana, La Habana, Cuba - will support the reassessment of Cuban cactus species
- Yuley Encarnación Piñeyro, Department of Biology and Florida Museum, University of Florida, and Jardín Botánico Nacional "Dr. Rafael M. Moscoso", Dominican Republic - will support the reassessment of Hispaniolan cacti
- Daniela Zappi, Instituto de Ciências Biológicas, Universidade de Brasília, Brasília, Brazil - will support the reassessment of Brazilian cacti
- Mónica Arakaki, Museo de Historia Natural, Universidad de San Marcos, Lima, Peru - will support the reassessment of Peruvian cactus species and those species shared with Chile
- Ana Pin - will support the reassessment of cacti from Paraguay
- Pablo Guerrero, Universidad de Concepción, Concepción, Chile - will be in charge of the reassessment of Chilean cacti

We still have to contact focal points for a number of regions, however, if you are interested in participating do not hesitate to contact us.

Operation Atacama: Cacti Had Their Day in Court

In 2023, we announced that the Centro de Rescate de Cactáceas (Cactaceae Rescue Centre) in the Atacama region was opened with the purpose of housing specimens of *Copiapoa* seized during Operation Atacama (Fig. 4) in Italy. More than 800 cacti are housed in this facility, managed by the Corporación Nacional Forestal (CONAF) with technical and scientific support from the Instituto Forestal (INFOR).

In April 2024, Operation Atacama continued with the bringing of legal action against two alleged poachers in Senigallia, Italy. The case was supported Conservation-Litigation.org, the CSSG and a team of pro bono lawyers from the firm DLA Piper, and the Associazione per la Biodiversità e la sua Conservazione (ABC), a cactus conservation group founded by CSSG Member Andrea Cattabriga. A press release announcing the case can be found here.

"Our network is currently developing cases just like this one across 6 countries. A Green Wave of cases argue this key point - if you harm nature, you can be held accountable for helping to remedy it", says Dr. Jacob Phelps, Co-Executive Director of Conservation-Litigation.org and faculty at Lancaster Environment Center.

Andrea Cattabriga: "This action helps to bring this story full-circle. The identified offenders have been caught and are being prosecuted, and the plants have been returned to Chile. Although the harm to these threatened species cannot be undone, our legal action will hopefully help to ensure their survival."

Figure 4. *Copiapoa cinerea* confiscated during Operation Atacama. Photo: Andrea Cattabriga.

In February of this year, a decision was made: not only were criminal sanctions imposed, but the defendants were also ordered to pay civil penalties to ABC. These penalties will be used to support conservation research and actions, as well as implement an awareness campaign. Of even broader impact is the precedent set by this case: conservation groups can take legal actions for activities harming their mission. As commented by Dr. Jacob Phelps: "This verdict shows that existing laws can hold offenders responsible for helping remedy the harms they cause. It puts the focus on conservation, rather than just punishment. This could prove a transformative response to the biodiversity crisis that will inspire similar legal actions globally." Dr. Bárbara Goettsch emphasizes that: "This case not only recognises the severity of environmental crime, but the role and power of the courts to create greater accountability." Outcome of the case received extensive media coverage, including by The Guardian, BBC, and La Nación. More information on the decision can be found here. A recording of a March 2025 webinar discussing the implications of the case can be found here.

As reported here, one of the poachers was also fined by a Chilean court, and banned from re-entering the country for ten years. Additional investigation is ongoing in Chile.

Dr. Phelps states: "This is a unique example of what IUCN SSC groups can do to more assertively help protect and

remedy the species we are responsible for protecting. It should inspire other scientists and conservationists to consider when they need to also take legal action." Andrea Cattabriga comments: "We're giving plants a right, a right to not be destroyed, because they are living beings."

IUCN Regional Conservation Forum

Co-Chair Bárbara Goettsch met with representatives from other Specialist Groups at the IUCN Regional Conservation Forum in Mexico in April 2024 (Fig. 5). They discussed which regional conservation topics need prioritization, including illegal trade.

Figure 5. CSSG Co-Chair Bárbara Goettsch with Mexico-based CSSG Members and representatives from other Specialist Groups at the IUCN Regional Conservation Forum.

Illicit International Trade of Mexican Succulent Plants: a Panel in the IPCC to Discuss and Propose Actions to Achieve KMBF Target 5

By Emiliano Sánchez Martínez[1], Beatriz Maruri Aguilar[1] (bmaruri@concyteq.edu.mx), María Magdalena Hernández Martínez[1] and Gabriela Rocha Álvarez[2]

[1]Cadereyta Regional Botanic Garden, Queretaro, Mexico
[2]Chicago Botanic Garden, Chicago, IL, USA

The International Plant Conservation Conference (IPCC), organized by the Global Partnership for Plant Conservation, discussed the new goals of the Global Strategy for Plant Conservation (GSPC) and its complementary actions. This effort contributes to the achievement of the goals and targets of the Kunming-Montreal Global Biodiversity Framework. The conference took place at the Missouri Botanical Garden during March 2025, and the Cadereyta Regional Botanic Garden hosted a panel addressing issues related to the plant trade (Fig. 6) - a critical aspect of target 5 of the Kunming-Montreal Biodiversity Framework.

Mexican Cactaceae served as the primary source of data and inspiration for the ideas of this panel, which brought together specialists from Mexico and the United States. The poaching of Cactaceae is a cyclical process in Mexico, reinforced by the discovery of new species highly sought after by international collectors. Additionally, there is a continuous demand for iconic plant species whose populations are declining. For years, these occurrences have been adequately documented, alongside the recognition that illegal plant trade networks and distribution channels have grown increasingly sophisticated, utilizing advanced tools and technology, and with individuals operating both in the field and online. The evolution of the illegal trade of cacti has outpaced the Mexican environmental regulatory updates and alignment to international agreements. CITES has facilitated the traceability of exported cacti species and has recognized seed trade as the primary activity.

The panel concluded that tackling this problem requires a comprehensive international, layered strategy (Fig. 7), including widespread education at all societal levels - ranging from foreign plant collectors to local poachers. It also requires enhancing horticultural practices to restore populations of threatened species while fulfilling the legal demand for succulent plants. Additionally, legal frameworks must be established to ensure the quick and proper management of aspects such as the repatriation of batches of Cactaceae seized in other countries.

The Cadereyta Regional Botanic Garden has been documenting the devastating effects of the illegal plant trade and running the campaign "Leave them in their land" ("Déjalos en su tierra," in Spanish), which raises awareness of the illegal poaching of plants and discourages their illicit trade. The Chicago Botanic Garden is actively advocating the repatriation of a batch of confiscated *Ariocarpus fissuratus* at the O'Hare International Airport. Experiences from both institutions were shared as part of the panel.

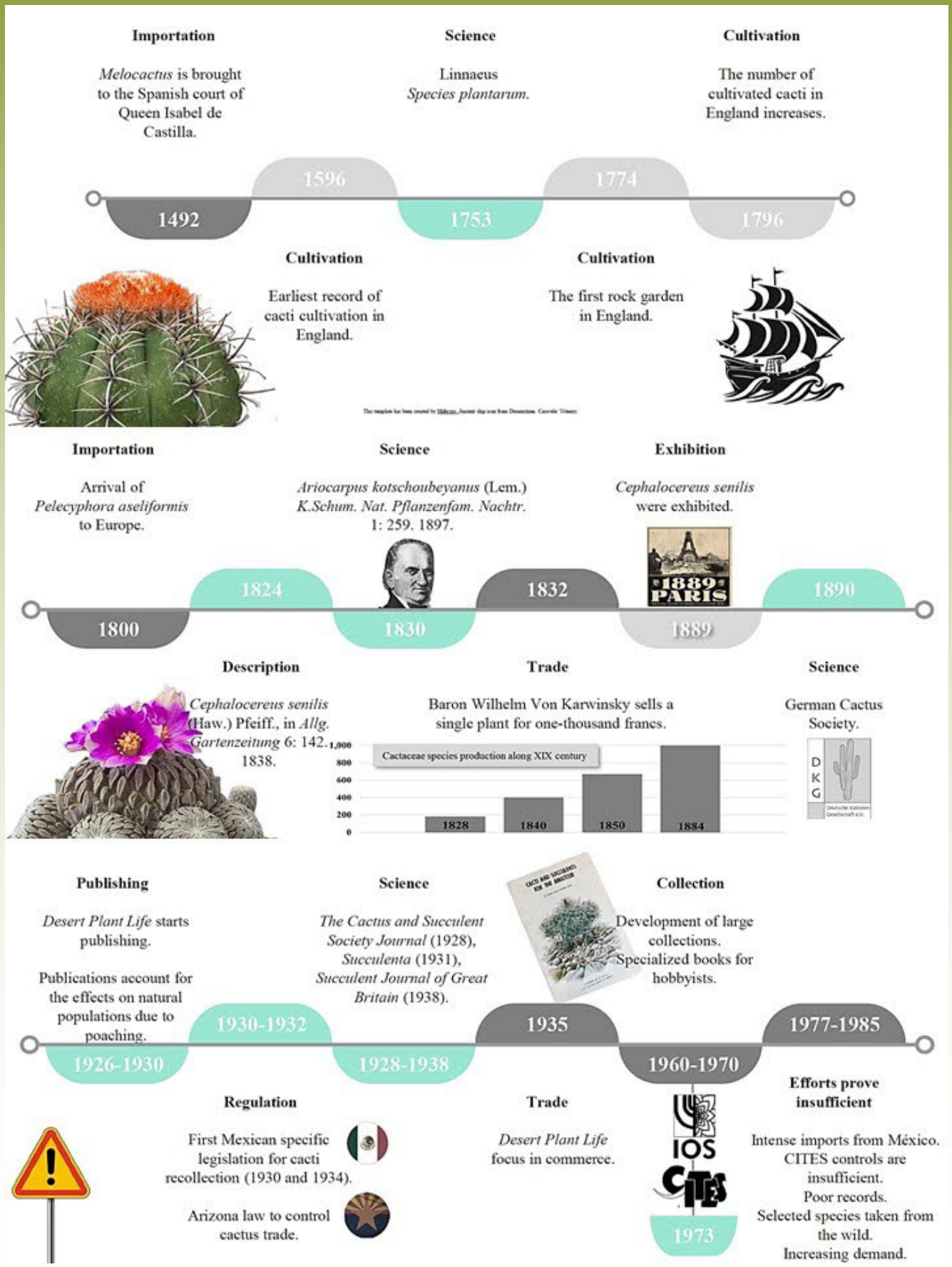


Figure 6. Brief overview of the history of cactus and succulent trade. According to McMahan, L. 1987. A Brief History of the Cactus and Succulent Trade. *In*: Fuller, D. and Fitzgerald, S. (Eds.) *Conservation and Commerce of Cacti and Other Succulents*. World Wildlife Fund - TRAFFIC (U.S.A.), Washington D.C.

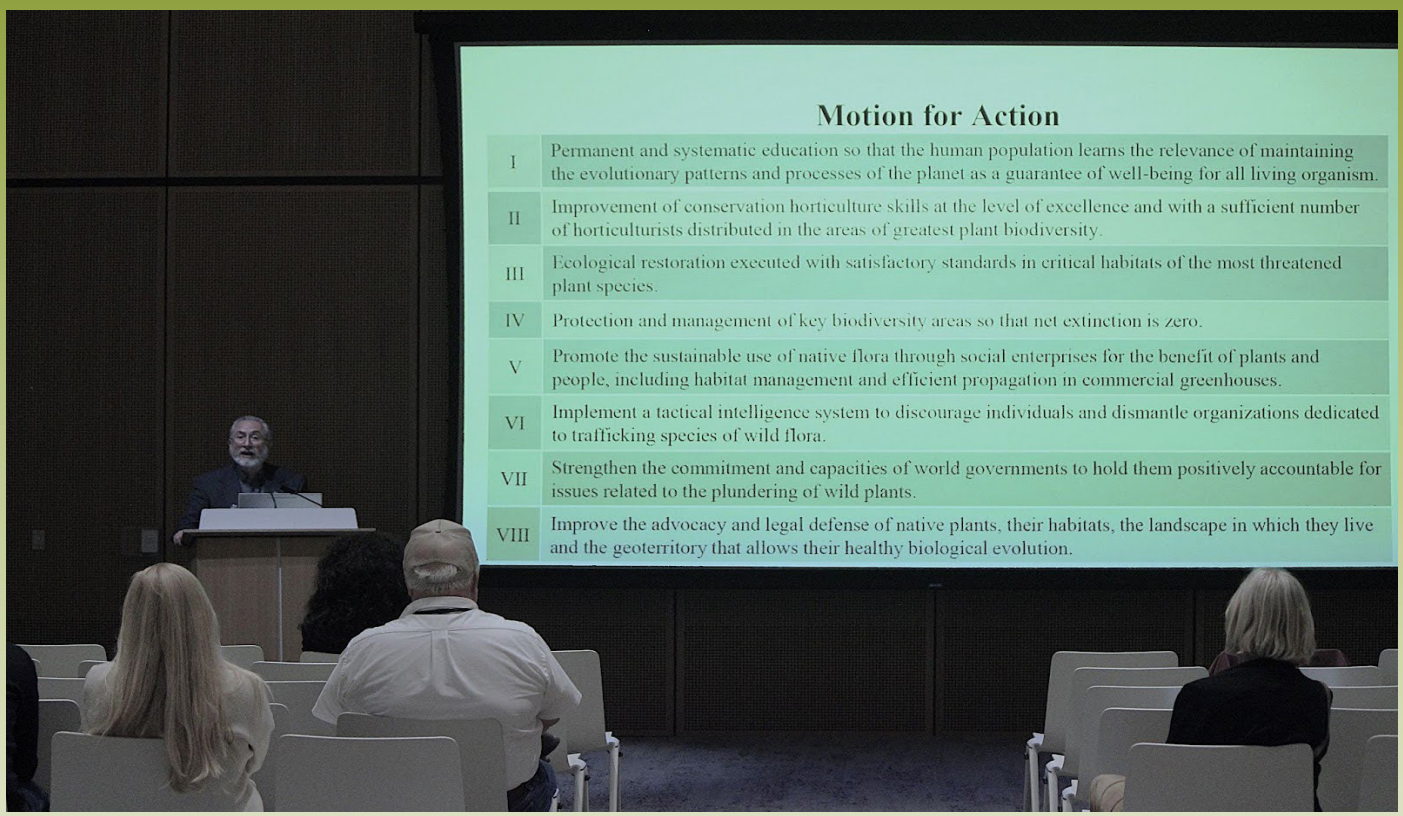


Figure 7. "Motion for action": a comprehensive international layered strategy, proposed at the panel by Emiliano Sánchez Martínez.

New Book on the Illegal Trade of Cacti and Succulents

By Jared Margulies (jdmargulies@ua.edu)

Department of Geography, University of Alabama, Tuscaloosa, AL, USA

The Cactus Hunters: Desire and Extinction in the Illicit Succulent Trade by Jared Margulies was published in late 2023 by University of Minnesota Press. The book will be of interest to Members of the CSSG wanting to learn more about how both legal and illegal trade affect cactus and succulent conservation, and the role of both conservationists and plant collectors in shaping succulent species futures. The book is comprised of eight chapters drawing on fieldwork conducted across seven countries on four continents. Margulies explores what underpins collector desires for cactus and succulent plants as 'plant-people', and how this desire can variously steer species towards trajectories of abundance and proliferation, or endangerment and even extinction. The first chapters develop a theoretical argument about the need to better understand the role of desire in environmental change and within collector and conservation communities drawing on stories from fieldwork in the US, UK, Mexico, Brazil, and Czechia. The second half of the book traces out the surprising and unusual case of *Dudleya farinosa* and *Dudleya pachyphytum* poaching from the US and Mexico which emerged while Margulies' research was already underway. Ultimately, questions about this new trade lead the author to South Korea to understand the truly global nature of illegal wildlife trade in cactus and succulent plants. The book has been well received in both popular and academic outlets including the journals *Oryx*, *Conservation and Society*, the *American Association of Geographers Review of Books*, *Landscape Architecture Magazine*, and the *Cactus and Succulent Journal* of the Cactus and Succulent Society of America. The book is available online and through many booksellers.

Reference

Margulies, J. D. 2023. *The Cactus Hunters: Desire and Extinction in the Illicit Succulent Trade*. University of Minnesota Press, Minneapolis, 392 pp.

Central Arizona Cactus and Succulent Society: Review of 2024 Annual Show

By Don Begley and Chris Ginkel (contact.us@centralarizonacactus.org)

Central Arizona Cactus and Succulent Society, Phoenix, AZ, USA

In planning our Annual Show for May 2024, we knew we needed to address three key objectives:

1. demonstrate CACSS commitment to conservation,
2. develop something new to draw guests into the Show, and
3. continue to strengthen our relationship with the Desert Botanical Garden.

First, the CACSS looked inward to identify how we could support conservation. A group of renowned CACSS members modified the Show Rules to tighten controls by eliminating the entry of field-harvested plants and those that are illegal to own such as in the genus *Lophophora*. An individual inspection of all plants was conducted for all plants entered for exhibition to identify nonconforming plants. Desert Botanical Garden experts from Research and Conservation were enlisted to perform a final inspection of all plants before the Show judging. With over 450 plants on exhibition, this was a major task. Any plant identified as questionable was evaluated by at least two experts before being pulled from the Show. Four plants were pulled before the Show.

The Education Committee of the May 2024 Show addressed the need to draw guests to the Show when high temperatures reduced attendance at the Desert Botanical Garden. The development of a science-based educational program in partnership with DBG Research/Conservation members featured exhibitions in an adjoining gallery and six 30-minute informal chats conducted over the three days. The exhibits featured details of growing plants from seeds and tissue culture, heat impact on plants, efforts to conserve world plant populations in situ, discouragement of poaching and destruction of habitats, and restoration of these habitats.

CACSS continues to provide education to our members and through our Outreach Program to the public to facilitate a better understanding of what individuals can do to help protect the plants we love and enjoy.

Announcing the IUCN SSC Succulent Plant Illegal Trade Task Force

By Carly Cowell (carly.cowell@bgci.org)

Botanic Gardens Conservation International

The IUCN SSC Succulent Plant Illegal Trade Task Force was established in response to the alarming rise in illegal trade of wild-harvested succulent plants. Succulents, particularly from regions like South Africa, Namibia, and Madagascar, have become highly sought-after due to their unique appearances, making them desirable for ornamental purposes. Unfortunately, this demand has led to overharvesting, threatening several species with extinction. It brings together botanists, conservationists, law enforcement agencies, and policymakers to combat the illegal trade and ensure sustainable practices.

The objectives of the Task Force are to:

1. Monitor and research the scale and impact of illegal trade on succulent populations;
2. Collaborate with governments and international organizations to strengthen policies and enforcement of wildlife trade laws, particularly through instruments like CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora);
3. Raise awareness among consumers about the impacts of buying wild-harvested succulents and promote legal, sustainable alternatives;
4. Engage local communities to find alternatives to illegal harvesting by promoting conservation efforts and sustainable livelihoods;
5. Build capacity for conservation actions by providing training and resources to law enforcement and border control agencies.

By curbing illegal trade, the Task Force aims to reduce pressure on wild populations and safeguard endangered species from extinction.

BGCI Campaign to Tackle the Illegal Trade in Plants

By Carly Cowell (carly.cowell@bgci.org)

Botanic Gardens Conservation International

Combating the illegal trade of plants requires a multi-pronged effort from a wide range of strategic partners. Thus, Botanic Gardens Conservation International (BGCI) has launched a new initiative that draws on the extensive international reach of botanic gardens worldwide and their networks, partners and visitor outreach capacity. This vision has been unanimously endorsed by BGCI's International Advisory Council with strong recognition of both the need for this new collaboration and the unique potential for botanic gardens to lead this important work. Designing a global campaign for a complicated challenge such as reducing the illegal trade in plants requires a rigorous and thoughtful process. The interrelated nature of illegal trade that cuts across borders requires a collective, coordinated, and global effort. To succeed at this scale, BGCI has created a partnership with the Commission on Education and Communication of the International Union for the Conservation of Nature (IUCN CEC) and several botanic gardens and institutes from around the world. This process will take time. We could act quickly and risk little impact, or design carefully and collectively to ensure that we create more than just a "campaign" and, instead, launch a societal "movement" that works to reduce worldwide illegal trade in plants. This initiative aims to raise awareness, strengthen international cooperation, and ensure sustainable management of plant resources. To learn more about our work and the campaign please visit the BGCI website.

Editorial note: a webinar on tackling the illegal trade in plants by Dr. Cowell can be found here.

International Collaborations: CSSG Members Collaborated in a Collecting Expedition to Northern Peru

By Raul Puente (rpuente@dbg.org)

Department of Research, Conservation and Collections, Desert Botanical Garden, Phoenix, AZ, USA

In August 2024, several CSSG Members met in Lima, Peru for a joint expedition to study cacti in the northern portion of the country (Fig. 8). The team included: Lucas Majure (University of Florida and Co-chair of the CSSG), Raul Puente (Desert Botanical Garden and Red List Authority Coordinator), Andrew Salywon and Noemi Hernandez (Desert Botanical Garden), Monica Arakaki (Universidad Mayor de San Marcos) and her students Piero Arana and Leonardo Caballero. The goal of this joint expedition was to document cactus populations, collect herbarium vouchers and tissue samples for molecular studies along remote localities in the Cordillera de los Andes.

During the expedition, we drove more than 3000 kilometers from the city of Lima, following the coast and into the mountains and were able to collect specimens of *Armatocereus*, *Austrocylindropuntia*, *Borzicactus*, *Browningia*, *Haageocereus*, *Espostoa*, *Matucana*, *Mila*, *Melocactus*, *Neoraimondia*, *Trichocereus*, *Opuntia* and *Weberbauerocereus*. Collected herbarium vouchers will be deposited in the Museo de Historia Natural de Lima, with duplicates shared to University of Florida and Desert Botanical Garden herbaria. Seeing the species growing in their natural habitat provided us with a great opportunity to gather information on environmental conditions, population density, and uses of many species. This was also an opportunity to see first-hand conservation challenges that threaten both the plants and the habitats of this biodiverse country.

At the end of the trip, the team gave three talks at the Museum of Natural History to students and members of the Sociedad Peruana de Cactus y Suculentas (SPECS). Lucas Majure presented on “Cactaceae of the Caribbean”, Raul Puente on “Cactus Restoration in Central Arizona” and Andrew Salywon on “Agave Domestication in the Southwest USA”.

The team also visited the Cactaceae collection in the botanical garden located at Parque Las Leyendas in Lima with Guillermo Pino and several members of SPECS as guides. The cactus collection is extraordinary in number of species as well as of mature specimens and has a complete collection of species from Peru. While visiting the collection, the team was also informed of some of the challenges to maintain the plants: budget, need of plant labels, database, phytosanitary problems and staff. One of the more pressing concerns is the need to make herbarium vouchers of many of the wild collected plants, which is something that the Museo de Historia Natural is already planning to do with the help of students. Members of Desert Botanical Garden discussed some ideas of how to help the collection in the near future, with making plant labels and providing database software.

Figure 8. Processing of herbarium samples. Shown left to right are Red List Authority Coordinator Raúl Puente-Martínez, CSSG Members Andrew Salywon and Mónica Arakaki, and Co-Chair Lucas Majure.

This is one example of collaborative work that can be carried out among CSSG member institutions that will result in documentation of cactus populations in areas that are poorly studied. The resulting voucher collections will help to enrich collections in the respective herbaria and fill gaps in the knowledge of the cactus of Peru. We hope that this contribution will encourage future collaboration among other CSSG institutions.

Curbing the Illegal Plant Trade on eBay

Online trade of wild-collected plants increases the likelihood of extinction for many species of cacti and succulents. Several conservation groups push to strengthen the development and enforcement of policies combating such trade on e-commerce platforms.

In September 2024, TRAFFIC, in collaboration with eBay, Royal Botanic Gardens, Kew, and supported by the United Kingdom through the Illegal Wildlife Trade Challenge Fund, organized a training session for over fifty eBay monitors to increase awareness on the illegal trade in plants and to provide guidance on how to enforce eBay’s existing Prohibited and Restricted Items policies.

Presentations on the illegal trade of cacti, South African and Madagascar succulents, and Indonesian plants were followed by discussions of CITES and recommendations for strengthening and enforcing existing eBay policies. Spearheaded by TRAFFIC Project Manager Dominique Prinsloo, CSSG Program Officer Michiel Pillet participated by presenting examples of illegal trade of cacti on online

platforms. More information on these efforts can be found in an article by The Irish News.

Caryophyllales.org Used for Cactaceae Reassessment

As mentioned above, we are utilizing a new checklist for the family Cactaceae as a basis for the IUCN Red List reassessments of Cactaceae. This new and improved list (Korotokova *et al.*, 2021), which is housed on Caryophyllales.org is based on the work of numerous specialists across the family Cactaceae. Taxonomy across Cactaceae is notoriously difficult for a myriad of reasons, ranging from biology to historical and traditional interpretations of species. Thus, there is a broad range of species accepted for the family depending on the list proposed. The new, accepted list contains over 1850 recognized species. These in many cases are the result of the splitting of previously accepted taxa but also a result of new species recently described. The new list effectively avoids species recognition bias based on the opinions of just one or two people and places the responsibility of the names accepted for the family on the shoulders of many different researchers who are actively involved in systematic studies across the distribution of the family. We are excited to implement this new list for upcoming reassessments of the family.

Reference

Korotkova, N., Aquino, D., Arias, S., Eggli, U., Franck, A., Gómez-Hinostrosa, C., Guerrero, P.C., Hernández, H.M., Kohlbecker, A., Köhler, M. *et al*. 2021. Cactaceae at Caryophyllales.org – a dynamic online taxonomic backbone for the family. *Willdenowia* 51: 251-271. https://doi.org/10.3372/wi.51.51208.

Annual Report

As part of an overhaul of the CSSG website, we have added the 2022 and 2023 Annual Reports.

Acknowledgements

On behalf of the CSSG, we would like to thank the generosity of our host institution: the Desert Botanical Garden in Phoenix, Arizona, USA. Its support is invaluable to us and thanks to them we have the assistance of our Program Officer. Also, we are grateful to Chester Zoo for their support for the Integrated Conservation Action Plan for the Genus *Copiapoa*. We would like to thank The Huntington Library, Art Museum, and Botanical Gardens, Jardín Botánico Regional de Cadereyta, and Comisión Nacional para Conocimiento y Uso de la Biodiversidad (CONABIO) for their support with the reassessments of Cactaceae.

We express our gratitude to the CSSG Members and others who contributed with articles for the Newsletter.

Scientific Outreach Articles

Conservation Initiatives

Cactaceae management and rescue practices. Urgent and necessary improvements in the framework of the Sistema de Evaluación de Impacto Ambiental (SEIA) projects in Chile.

Ana C. Sandoval[1] and Leonora Rojas Salinas[2]

[1]Banco Base de Semillas. Instituto de Investigaciones Agropecuarias INIA Intihuasi. Email: ana.sandoval@inia.cl.
[2]Departamento de Conservación de Especies. Ministerio del Medio Ambiente. Gobierno de Chile.

Chile's energy policy is driving the transformation of the electricity matrix towards renewable sources (Ministerio de Energía, 2020). Solar plants, wind turbines and electric highways are becoming more frequent. These are not only transforming the landscape, but are also exerting a strong pressure on biodiversity. One of the four pillars of this policy states that energy development must be compatible with care for the environment, and this is a great challenge today. In 1994, Chile began regulating development projects in relation to their impact on the environment through the Ley de Bases del Medio Ambiente (Law 19.300). This includes not only energy projects, but also other industrial sectors, obliging companies to avoid, mitigate or compensate impacts on the environment, and this of course includes energy infrastructure.

This has led to the rescue and relocation of cacti being commonly offered as a compensation measure. However, the success of these measures is not always achieved and the criteria applied are variable. For these reasons, and in order to improve these practices, a joint collaboration was carried out with the Ministerio del Medio Ambiente through a consultancy. The main objective was to develop a proposal of recommendations to improve the *ex situ* management of plant material, addressing different flora species, including cacti. To learn about the work carried out by the companies, more than 400 projects with an approved Resolución de Calificación Ambiental were reviewed in search of those that have developed plans to rescue affected cacti. Workshops were held with environmental consultants and surveys were conducted to learn about the challenges they face in executing these plans. Experts in the area were interviewed and literature was reviewed to seek recommendations to improve current practices. This opportunity would not only improve current implemented practices for cacti in the framework of development projects, it would also allow aligning them with *ex situ* conservation approaches to ensure they contribute more faithfully to biodiversity conservation objectives at all levels and attributes.

Thus, an integrated management proposal focused on the protection of affected populations was elaborated, addressing, through a strategy (Fig. 1), several simultaneous lines of work. Each line increases the probabilities of success of the future population that will be installed using the materials coming from the affected population. In the coming months, this proposal will result in the publication of Guidelines that will be available to all.

The Guidelines begin with the scope that these recommendations have, which is its capacity to generally cover all Chilean cacti, it lists the number of species and their extinction risk. The information is provided by genus, considering the species included in the most recent taxonomic revision (Korotkova *et al.*, 2021; Walter and Guerrero, 2022). This list is composed of 134 species belonging to 22 genera, we provide examples for a few of them later in the text.

It continues with a brief section on the general considerations that should be taken into account when proposing measures, with special emphasis on what is recommended by the standards on Compensaciones por Pérdidas de Biodiversidad (BBOP, 2012; SEA, 2014, 2015, 2022). These point out that before the proposal and application of any reparation and compensation measures involving any species, and especially in the case of cacti, the principle of hierarchy of measures must be applied. In other words, it is essential to exhaust all instances to avoid significant adverse effects on flora, either through project design, application of mitigation measures, or other measures to reduce the negative effects on populations to the minimum possible. Then, and only when these instances have been exhausted, and there are no other possible alternatives for the protection of the population in question, then measures for the *ex situ* management of plant material can be proposed. This is due to the fact that the protection of nature will always prove to be the most economical and lasting measure over time. Recreating a new population in an effective and successful manner represents an enormous challenge in terms of research, investment and time.

These considerations highlight the need for good sampling techniques, due to the difficulty of detection of some of the species, and taxonomic identification, in the majority of the cases. Therefore, the need for expert advice and the incorporation of molecular tools, especially for the more complex species, is recommended.

The recommendations are formulated as a strategy that attempts to address the various tasks involved from different angles and are summarized in ten steps to achieve it. Each step is described in detail, exemplifying techniques and species in which its application is

possible. In addition, an estimate of the time required to implement them is provided. A brief description of each of the proposed steps follows:

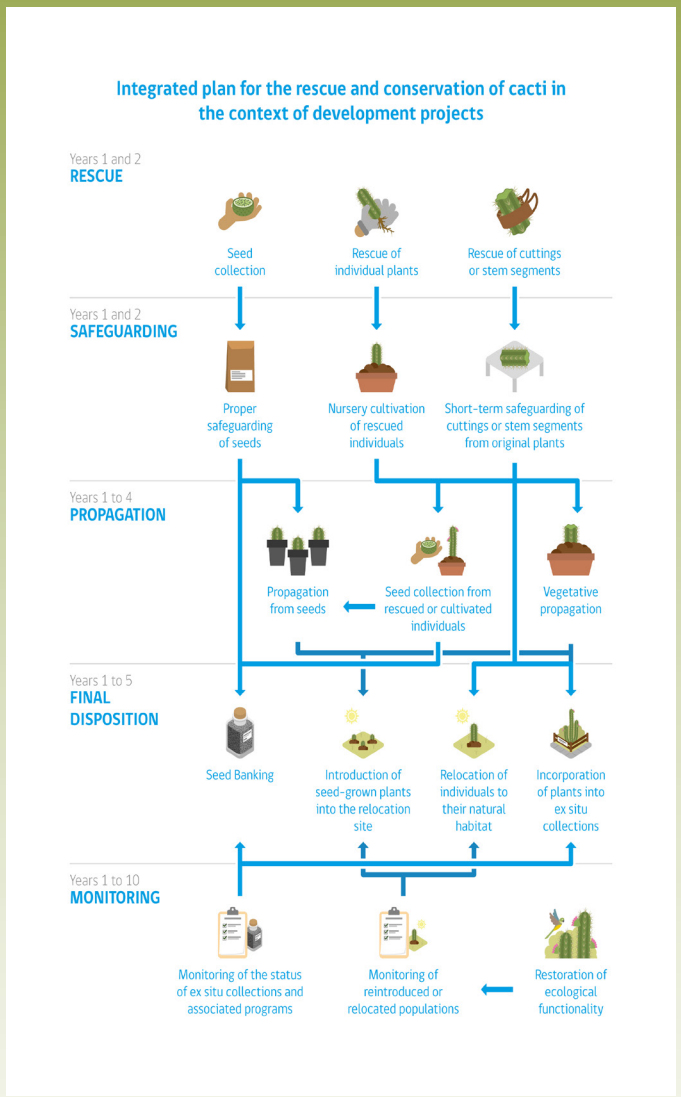


Figure 1. Outline of the strategy that addresses the different complementary measures for *ex situ* management of Chilean cacti, which guarantee the conservation of germplasm *ex situ* and aim at successful measures for the relocation of populations and the increase in the number of individuals. Graphic by Cristian Vargas.

Step 1. Location of the populations
This point emphasizes the importance of efforts to detect and adequately quantify the individuals that will be affected, so it would not only be necessary to georeference and mark the specimens, but also this work is an opportunity to gather information about the species' preferences, in every sense, associations with other plant species, the distance between plants and their arrangement, type of soil and its characteristics (physical-chemical), presence and abundance of stones, among others.

Step 2. Seed rescue
In this step, recommendations are given regarding the need to obtain seeds of the best possible quality, both from the individuals that will be directly affected, as well as from the rest of the affected population. Examples of species, fruit types, considerations regarding plant maturity and sampling strategies are detailed, aimed at capturing genetic diversity. In relation to the use of these seeds, it is recommended for them to be used for both propagation and long-term conservation, as a backup to reduce genetic erosion of the affected populations.

Step 3. Rescue of individuals
In relation to the rescue of individuals, different recommendations are given related to the growth habit and size of the specimens, but with emphasis on the care of both the body of the cactus and its roots. Also, on the need to maintain its orientation, avoid damage by excessive radiation, shade and humidity. And about the extreme care required by the reserve roots, or the presence of fragile and delicate necks, which in some cases make a successful transplant practically impossible.

Step 4. Salvage of vegetative material
When dealing with larger cacti, whether columnar cacti or cushion cacti, recommendations are given on how to obtain pieces of the original plant to propagate it, when its size does not allow the rescue of complete individuals. In these cases, measures are emphasized to avoid rotting of the material due to deficient cuts, bruises or damage during transport.

Step 5. Nursery care protocol for rescued individuals
At this point, recommendations are given in relation to the nursery care protocol of both complete individuals and rescued segments. This step is intended to ensure the care of the plants, as well as their strengthening to improve their chances of survival in their final destination.

Step 6. Propagation of plants from seeds
During nursery care, it would be ideal not only to work with vegetative material, but it is also recommended to start propagation from seed to multiply and introduce younger individuals into the new population.

Step 7. Relocation
This will be the ultimate goal pursued by the strategy, the recreation of a "new population" that can maintain the genetic integrity of the initial affected population, maintaining and even allowing a gain in terms of net biodiversity. This population will be formed from different sources. First by those individuals and segments of individuals rescued directly. Later by those specimens that went through the nursery stage, and later and in several pulses, by young individuals obtained from seeds. This would then occur at various times during the life of the project, allowing for greater heterogeneity in the system. Considerations are highlighted with respect to the characteristics of the chosen site, in relation to the preferences of the species as well as the particularities required in terms of microsites. The use of tools that can facilitate site selection, such as potential niche models,

need to be considered, especially in the scenario of climate change.

Step 8. Monitoring
Monitoring at all stages is essential, but especially so during relocation. The focus should be placed not only on the survival of individuals, but mainly on the recovery of the functionality of the new population, so vigor, flowering, fruiting, dispersal and recruitment should be incorporated. To this end, it is essential to have a long-term view to ensure the viability of the new population over time.

Step 9. Incorporating materials into *ex situ* collections
In this step, it is recommended that efforts not only focus on the relocation strategy, but also to invest efforts in *ex situ* alternatives, involving the deposit of both seeds and specimens in collections of institutions dedicated to *ex situ* conservation, such as seed banks, botanical gardens or local collections. In this way, long-term backup material can be safeguarded.

Step 10. Information and traceability
This last recommendation is essential in each of the steps described above. Maintaining correct identification, marking and traceability of the materials at each step, as well as keeping a correct record of the information of each task, will allow continuous improvement of the practices, by increasing the experience in the management of the different species and their monitoring.

We hope that this document can be a contribution to the improvement of the practices carried out in the Chilean flora within the framework of the SEIA, incorporating a comprehensive view with a focus on biodiversity conservation.

References

Business and Biodiversity Offsets Programme (BBOP). 2012. *Biodiversity Offset Design Handbook-Updated*. BBOP, Washington D.C. 101 pp. Available from: http://bbop.forest-trends.org/guidelines/Updated_ODH.pdf.

Korotkova, N., Aquino, D., Arias, S. *et al*. 2021. Cactaceae at Caryophyllales. org–a dynamic online species-level taxonomic backbone for the family. *Willdenowia* 51: 251-270.

Ministerio de Energía. 2022. *Transición Energética de Chile, Política Energética Nacional. Actualización 2022.* Gobierno de Chile, Santiago, Chile, 91 pp.

Servicio de Evaluación Ambiental (SEA). 2022. *Criterio de Evaluación en el SEIA: Objetos de protección*. 9 pp.

Servicio de Evaluación Ambiental (SEA). 2014. *Guía Para La Compensación De Biodiversidad En El SEIA.* Gobierno de Chile, Santiago, Chile, 64 pp.

Servicio de Evaluación Ambiental (SEA). 2015. *Guía para la Descripción de los Componentes Suelo, Flora y Fauna de Ecosistemas Terrestres en el SEIA.* 96 pp.

Walter, H.E. and Guerrero, P.C. 2022. Towards a unified taxonomic catalogue for the Chilean cacti: assembling molecular systematics and classical taxonomy. *Phytotaxa* 550: 79-98.

People and Plants

I found out the plant I bought may have come from an illegal collection. What should I do?

Tania Hernández[1,2] and Bárbara Goettsch[2]

[1]Department of Research, Conservation and Collections, Desert Botanical Garden, Phoenix, AZ, USA. Email: thernandez@dbg.org.
[2]IUCN SSC Cactus and Succulent Plants Specialist Group.

We had the privilege of hearing Kal Kaminer speak about the pressing issue of illegal plant trade. His presentation vividly illustrated the dramatic impact this trade has on natural plant populations. It was eye-opening to see how traders can devastate ecosystems for profit, easily exporting these plants to nearly any location and selling them online with minimal oversight.

By the end of the talk, someone in the audience asked an interesting question: What should I do if I find out that a plant I purchased was probably collected illegally from its natural habitat? Several ideas came to mind, and there was some discussion around it, but in my opinion, there wasn't a clear answer to this important question. I was unsure as well. I called my friend, Bárbara Goettsch, co-chair of the IUCN (International Union for Conservation of Nature) Cactus and Succulent Plants Specialist Group, and here is a synthesis of what we discussed.

Many plant enthusiasts and collectors may unintentionally purchase plants that were illegally collected from their natural habitats. Once this discovery is made, it can raise ethical dilemmas about what to do next. Here's some ideas that might serve as guidelines. First, it's important to acknowledge that collecting plants from the wild without permission is unethical and often illegal and harmful to ecosystems. The depletion of natural populations, especially of rare and endangered species, poses a significant threat to biodiversity.

However, if you find yourself in possession of a plant that was illegally collected, or you used to be on the "dark side" as Mr. Kaminer, and collected them or purchased them in larger amounts but now are absolutely repentant, there are a few responsible steps you can take.

1. **Avoid Collecting from the Wild**
   The first rule is prevention. Always ensure that any plant you buy comes from legal, ethical and sustainable sources.
2. **Consider Donating the Plant**
   If you regret your purchase, one option is to donate the plant to a botanical garden or conservation institution. These organizations have the resources and expertise to care for such plants, and in this way, the plant can be used for scientific research or educational purposes.
3. **Work with Experts**
   If you are an experienced collector, horticulturist or nursery professional with a valuable collection, consider collaborating with botanical gardens or conservationists. By registering your collection, and making it available for scientific research, you can continue to care for it while contributing to scientific efforts to conserve, understand and protect these species. Additionally, you can collaborate with the selected botanical garden to transfer knowledge and techniques related to the specific plants in your collection before eventually donating them.
4. **Give Back**
   If you have gained knowledge, developed technology or profited from illegally collected plants, it's essential to act ethically. Consider collaborating with the communities and countries from which these plants originate to share the benefits. This can involve capacity building efforts, transferring technology or supporting *in situ* conservation projects. Working with local communities ensures they receive a share of the benefits and contributes to the sustainable use and protection of the species. Ethical actions like these can help mitigate the harm caused by illegal collection and promote conservation.

How about returning the plant to the wild? While it may seem like a good idea to return the plant to its natural habitat, experts generally advise against this. The plant may have been exposed to pathogens or pests while in captivity which could harm wild populations. It is also difficult to determine exactly where the plant was collected from, making its reintroduction risky and potentially disruptive.

In summary, while buying a plant that was illegally collected is a serious matter, there are ways to act responsibly after the fact. Collaborating with conservation institutions, ensuring that collections are used for research, and supporting local conservation efforts are all steps that can help mitigate the harm caused by illegal and/or unethical plant collection.

Conservation and the Cactus and Succulent Society of America

Irwin Lightstone[1], Ann Hopkinson[2], and Rod Haenni[3]

[1]Vice President, Director and Co-Chair of the Conservation Committee of the Cactus and Succulent Society of America (CSSA). Email: vicepresident@cactusandsucculentsociety.org.
[2]Director and member of the Conservation Committee of the CSSA.
[3]President, Director and member of the Conservation

Committee of the CSSA.

Introduction

Founded in 1929, the Cactus and Succulent Society of America (CSSA) (https://www.cactusandsucculentsociety.org) is an international community dedicated to advancing the appreciation, knowledge, research, and conservation of cacti and succulent plants. In the early years, the heroes of the cactus and succulent world were the explorers and popularizers, like John Lavranos, who discovered new plants, dug them from nature and then brought them into the hobby. Much has changed in the intervening 95 years. Estimated to be approximately 2 billion in 1927, the human population has now swelled to nearly 9 billion people. As cacti and succulents have grown increasingly popular in the plant trade, the threats arrayed against them have grown and multiplied. To counter these increasing threats, the CSSA more actively supports conservation education and projects.

Three major factors threaten the plants we love:
1. Climate change;
2. Habitat destruction due to competing land uses such as agriculture, mining, and development;
3. Extraction of plants from their habitat for commercial sale.

Unsurprisingly, cacti and other succulents have become some of the most threatened groups of plants. Nearly a decade ago, the IUCN noted that 31% of all cacti are threatened with extinction (Goettsch *et al.*, 2015). Given the increasing impact of climate change, the continued habitat destruction due to competing land uses, and the burgeoning international trade in plants collected from the wild, we expect that ongoing and future assessment will show a greater number of cacti threatened. Other succulent plant groups are under similar threats (Figs. 1-2). Many South African Asphodelaceae and Aizoaceae are becoming endangered. For example, all *Conophytum* species are now threatened. Some *Conophytum* have been wiped out completely at their only known localities, e.g. *C. bachelorum*, *C. mirabile*, *C. youngii*, *C. regale*, *C. chrisocruxum*, and *C. chrisolum*. Plant poaching has been exploding. Figure 3 shows the exponential growth of succulent plant seizure by authorities in the Western Cape of South Africa.

Conservation becomes a primary focus of the CSSA

Though it was always a part of its agenda, the CSSA recognized the urgency of conservation and elevated it to become one of its primary objectives beginning in 2020, with the formation of the Conservation Committee. The Conservation Initiative, Goals, and Actions summarizes this change in direction and states that CSSA will:
1. Promote habitat preservation and restoration through conservation efforts

Figure 1. One of many boxes of plants confiscated in South Africa and transferred to a South African National Biodiversity Institute institution (Photo: Irwin Lightstone).

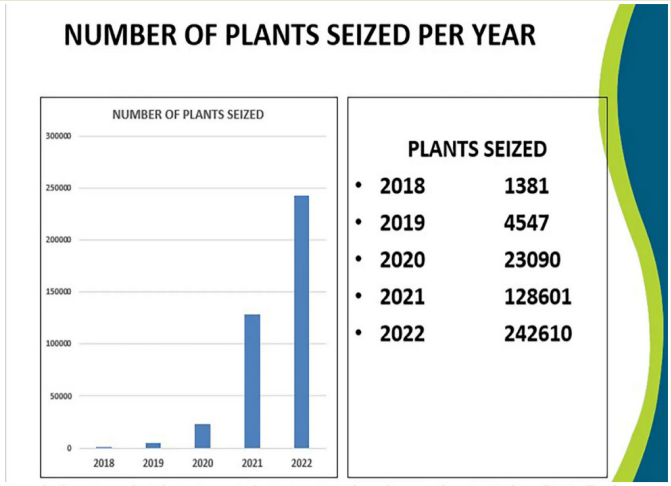
2. Establish guidelines and best practices for ethical seed collection and distribution
3. Encourage and expand seed distribution networks
4. Strengthen alliances with like-minded organizations focused on biodiversity and plant conservation
5. Facilitate knowledge exchange and resource sharing among researchers, horticulturists, and conservationists
6. Foster educational programs to raise awareness of the importance of plant conservation
7. Encourage citizen science initiatives to involve the public in conservation efforts
8. Monitor and evaluate the effectiveness of conservation projects to ensure ongoing improvement

Figure 2. After confiscated plants are received, inventoried, and planted, it is heartbreaking that many don't survive being stripped from habitat without their full root system. It may take several years before they die (Photo: Irwin Lightstone).

Beginning in 2022, the CSSA began funding smaller, active conservation projects, which are listed below:
1. January 2022 - Purchased drone for South African Police Service to assist enforcement of anti-poaching

laws.

2. February 2022 - Funded repopulation of *Lithops coleorum* colony by *Lithops* Research and Conservation Foundation (Earlé, 2023).
3. October 2023 - Funded the hiring of intern(s) by the Alamocito Foundation to resurvey the Arizona populations of *Ibervillea macdougalii*.
4. June 2023 - Grant to Wilthon Anthony Laurel Yepez to catalog and collect cacti seed in the Arequipa region of Peru and to propagate these plants in his greenhouse authorized by the Peruvian government (Laurel Yepez, 2023). Characteristics of the plants and seeds, including habit, height, altitude, and location will be reported in the study.
5. August 2023 - Underwrote the grant submitted by Sue Milton-Dean, PhD, on behalf of the Wolwekraal Conservation and Research Organization (Prince Albert, South Africa) to purchase nature cameras to prevent poaching in a critical *Lithops* habitat.
6. January 2024 - Funded the upgrade of the tunnels at the Karoo Desert Botanical Gardens in Worcester, South Africa to protect plants confiscated from poachers.
7. March 2024 - Funded the upgrade of the hoop house at the National Botanical Garden of Namibia, including materials and the cost of labor for the installation of fencing, roofing, benches, and an irrigation system. The expense of hiring a part-time intern to care for the plants was also included.



A graph of recent succulent plant seizures, in the Western Cape alone, shows an almost vertical trendline in illegal poaching. (Graph: Paul Gildenhuys CapeNature)

Figure 3. Trend in succulent plant seizures in the Western Cape province, South Africa. Reprinted with permission from the Fall 2024 issue of the *Cactus and Succulent Journal*.

The initial conservation projects funded by the CSSA may be modest in scope, but they are worthwhile and the first steps in building a meaningful program. Given the plant sales and the building of collections associated with the hobby, the CSSA determined that it should concentrate on reducing the commercial harvesting of plants from nature and assisting in the *ex situ* conservation of those plants. As the CSSA builds its expertise, it anticipates addressing other important problems such as global warming.

Education and the dissemination of knowledge are essential parts of the CSSA's mission. Utilizing all of its platforms, the CSSA seeks to reach its members as well as other members of the plant community with its message of conservation. One example is that the CSSA hosts webinars accessible to both members and the public free of charge with as many as 500 attendees, with additional viewers on our live Facebook stream. The entire summer issue of the *Cactus and Succulent Journal* was devoted to articles about conservation; it has published numerous single articles concerning conservation. At our biennial convention in Colorado Springs, Colorado, in July 2023, members of the Conservation Committee met with CSSA members for a free-flowing conservation discussion.

To combat the sale of plants recently collected from nature, the CSSA distributed informational charts illustrating differences between nursery grown and natural habitat grown plants. These charts, titled *Creating an Ethical Cactus and Succulent Collection*, were created by Stefan Campbell, Alex Gonzalez, and Sarah C. Bird. This informative chart was added to the CSSA website, distributed to affiliate societies, mailed to all CSSA members with the Summer 2022 Journal, and highlighted at the 2023 CSSA Convention. The CSSA also underwrote the cost of printing several foreign language versions of the chart for distribution in South America. The Spring 2024 *Cactus and Succulent Journal* issue followed up with publishing an article titled *Conscientious Consumers Support Ethical, Responsible and Sustainable Use of Succulent Plants* authored by Tasneem Variawa and the staff of the South African National Biodiversity Institute (SANBI) (Variawa, 2024). Together, these guides help plant lovers avoid unscrupulous sellers of field collected plants.

In the fall of 2023, the CSSA enacted its conservation policy statement to guide our operations and provide a guide for our affiliate organizations. CITES and the IOS Code of Conduct are incorporated by reference. Commercial selling practices are highlighted with an endorsement of vendors that produce sale plants from seed, cuttings, or other artificial means. CSSA is committed to working to modernize laws regarding the sale of seeds, artificially propagated plants, and hybrids across international borders. Additionally, the CSSA restated its prohibition against field-collected plants at its competitive shows or sales. This conservation policy can be read in full on the Cactus and Succulent Society of America website (https://cactusandsucculentsociety.org/programs/conservation/). Affiliate societies are urged to adopt CSSA Conservation Policies in developing their own missions and show and sale policies.

In January 2024, the CSSA strengthened its policy against the commercial collection of plants in the wild by implementing a suspension policy. Selling or using plants collected from their habitat during the past two years results

in a two-year suspension from most CSSA activities. The suspension applies even when wild collected plants were sold or used in commercial transactions outside of CSSA-sanctioned events.

As one of its objectives, the Conservation Initiative, Goals, and Actions seeks to strengthen alliances with like-minded organizations focused on biodiversity and plant conservation. Bringing all the stakeholders together is essential for any comprehensive conservation efforts. The CSSA has been in discussions with other national cactus and succulent societies, growers, botanical gardens, and conservation groups.

The Cactus and Succulent Society of America is engaging in the difficult task of changing the direction of the hobby to protecting the plants remaining in habitat by encouraging members and the general public to engage in conservation-minded, sustainable growing. There remain some in our community who are more concerned with acquiring mature specimens than the negative impact of extracting those plants from their habitat. By education, rewarding the artificial propagation of these plants, and emphasizing the care that allows our young plants to grow and mature into beautiful specimens, the CSSA seeks to effect change in the values and ethics in this hobby and protect the plants we love. With an emphasis in growing plants from seed, CSSA President, Rod Haenni, gives voice to these values in the following essay.

An essay from Rod Haenni, CSSA President

I first became interested in succulents while I was working in Arizona as a minerals exploration geologist. This was in 1978, when roadside dealers sold cacti from Texas for very little and most of the plants were meant to be used for home landscaping in the Phoenix metro area. The state of Arizona did not allow the collection of cacti in the wild without a permit but Texas did and still does allow private landowners to remove any cacti from their own land without any restrictions.

Few enthusiasts grew from seed in those days; indeed Mesa Garden, destined to become the premier succulent seed-supplying nursery in the world, was just getting started, so even finding a variety of seeds to grow was difficult. Now, seeds of even the rarest cacti and other succulents are widely available and many, many enthusiasts have experienced the joy of growing their plants to blooming size and beyond from their own or commercially produced seed. Seed is widely available from commercial vendors and for members of the Cactus and Succulent Society of America via the Seed Depot. Amateur growers trade seed with one another on social media sites and production of interesting hybrids and cultivars is at an all-time high.

Tissue culture of rare succulents is also exploding, but this is largely the domain of commercial labs that mass produce new cultivars for both wholesale and retail sale. The requirements for setting up a hobbyist tissue culture lab are daunting; the expense of the necessary equipment, the sterile environment required, and the sometimes arduous reestablishment of the plants transferred from the flask to a greenhouse environment to grow new roots into pots. Shipping plants in flasks is commonplace in some plant groups, such as orchids which are shipped all over the world, but it is not as common with succulents.

Poaching of specimen and rare plants from the wild is driven by demand in Asia, Europe, and the United States for “trophies” and is an ongoing scourge that the CSSA, the IUCN, CITES, U.S. Fish and Wildlife, SANBI and many other organizations are working diligently to curtail. Show tables in many countries no longer allow the display of field-collected plants, legally collected or not, acting to prevent the perception that glorifying the presentation of specimens collected from the wild is ever appropriate. The CSSA does not allow the sale or exhibiting of wild collected plants and encourages our affiliates to do the same.

Major goals of the CSSA include the regulation-free exchange of nursery-grown seed and tissue-cultured plants around the world; the monetary support of well-conceived *in situ* conservation and research programs wherever succulent plants are at risk; and the prosecution of poaching. We recognize that the easy availability of rare seed and propagules plays a strong role in reducing the monetary rewards of illegal plant smuggling.

People’s perceptions are changing the succulent hobby. More and more folks are turning away from collecting and acquiring trophy plants from nature to cultivating and growing beautiful plants sustainably. The CSSA will continue to educate, and provide information to allow our members and the general public to appreciate succulent plants in their natural habitats while ethically propagating desirable succulents for their personal collections.

Conclusion

The CSSA is in the process of transformation. Active conservation efforts are replacing the more passive conservation positions previously expressed by the CSSA. A number of concrete steps have been taken. The CSSA actively uses its publications and media to educate its members about the need to eliminate wild plant collections within the plant trade. In support of this goal, the CSSA has published articles and charts to help its members determine whether a plant offered for sale was collected from natural habitat. To dampen the desire for collected specimen plants, the CSSA is trying to shift the culture and emphasize the joy and skill of caring for and raising plants sustainably. The new suspension policy will prohibit those in the trade that actively engage

in collecting plants from associating with the CSSA.

Beyond education, the CSSA has recently funded varied conservation projects. They range from providing equipment to help detect and prevent poaching, to funding the reestablishment of endangered species in natural habitats, to funding facilities for the preservation of poached plants, to funding plant surveys. As the CSSA achieves more experience in this area, it expects it will fund projects with greater impact.

Perhaps most important are the CSSA's aspirations and goals. The CSSA seeks to become a viable and contributing partner with like-minded conservation groups. Additionally, the CSSA seeks to leverage the expertise of its membership in areas as diverse as the care and cultivation of rare species to provide genetic diversity in *ex situ* conservation projects. Though important now, CSSA's conservation efforts will only grow in significance in the future.

References

Goettsch, B., Hilton-Taylor, C., Cruz-Piñón, G., Duffy, J.P., Frances, A., Hernández, H.M., Inger, R., Pollock, C., Schipper, J., Superina, M. *et al.* 2015. High proportion of cactus species threatened with extinction. *Nature Plants* 1: 15142.

Earlé, R.A. 2023. The *Lithops coleorum* Colony Restoration Project. *Cactus and Succulent Journal* 95: 194-197.

Laurel Yepez, W.A. 2023. Arequipa between the Sea and the Andes: Desert Species of Peru and their Conservation. *Cactus and Succulent Journal* 95: 274-283.

Variawa, T. 2024. Conscientious Consumers Support Ethical, Responsible and Sustainable Use of Succulent Plants. *Cactus and Succulent Journal* 96: 52-53.

Commented Publications

Lessons learned from cactus demographic studies

Graciela Jiménez Guzmán[1] and Ernesto Vega[2]

[1]Posgrado en Ciencias Biológicas, Universidad Nacional Autónoma de México, México City, Mexico. Email: gjimenez@iies.unam.mx.
[2]Instituto de Investigaciones en Ecosistemas y Sustentabilidad, Universidad Nacional Autónoma de México, Morelia Michoacán, Mexico. Email: evega@iies.unam.mx.

Cacti play a crucial role in the culture, local economy, and the ecosystems in which they develop. This plant group is native to the Americas, with Mexico, Argentina, Bolivia, Peru, and Brazil having the greatest number of species and endemisms. The family Cactaceae encompasses over 1,800 species, which are classified into five distinct subfamilies. Among these subfamilies, three are single-genus, and two, Cactoideae and Opuntioideae, are categorized into various tribes. Despite the extensive diversity of species in this family, nearly 30% are categorized as at risk by the IUCN Red List. As a result, it is essential to evaluate these populations for conservation status and to formulate management strategies (Amaral *et al.*, 2022; Goettsch *et al.*, 2019; Korotkova *et al.*, 2021).

Cactus population evaluations are conducted through demographic models, which organize populations based on attributes like size. Currently, there are two common types of demographic models used to analyze these populations: matrix population models (MPM) and integral projection models (IPM). The main difference between these two approaches is that MPMs classify organisms into discrete categories, while IPMs enable the use of both discrete categories and continuous values (Doak *et al.*, 2021).

In a recent study aimed at identifying trends and knowledge gaps regarding cactus demography, we conducted a systematic review. The paper is titled “What do we know about the demographic modeling of cacti? A systematic review of current knowledge” and is available through open access. The review consisted of an exhaustive search of all demographic research on cacti published in journals and gray literature, in both English and Spanish. From this, it was possible to describe the characteristics of the demographic literature, identify the most common attributes for modeling, and provide an overview of populations and their conservation status (Jiménez-Guzmán *et al.*, 2024).

Regarding the literature

We identified a total of 83 publications that included at least one demographic model of cacti. These publications have studied 65 species belonging to five tribes: Cacteae (n = 39), Cereeae (n = 4), Cylindropuntieae (n = 2), Echinocereeae (n = 16), and Opuntieae (n = 4). This result implies an increase of nearly 500% in demographic studies compared to the last population review of cacti conducted 20 years ago (Godínez-Álvarez *et al.*, 2003). However, the studies still demonstrate a pattern of evaluating populations over short periods and with few site replications.

Regarding the geographical location of the studies

An additional finding to note is that demographic studies have been carried out exclusively in Mexico, the USA, and Brazil (Fig. 1). This could be attributed to these countries being at the forefront of GDP rankings, which allows them to invest more in such research. However, the limited research in South America is significant, as this region contains two of the three nuclei of cactus endemism and species richness; as a result, we do not have enough information about the species in this region to understand their population dynamics.

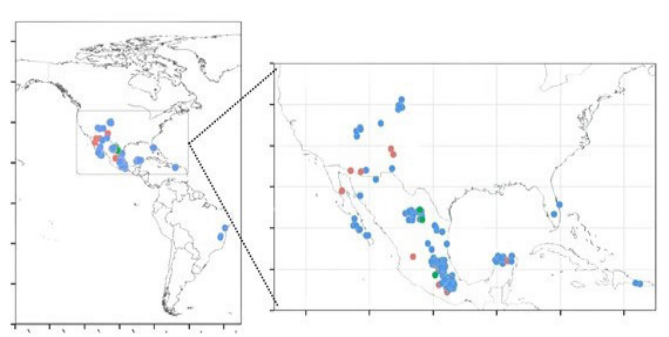


Figure 1. Locations of demographics studies of cacti populations in North and South America (n = 138). Blue: matrix population models. Red: integral projection models. Green: Life table models. Modified from Jimenez-Guzmán *et al.* (2024).

We identified at least two biases: a geographic bias, where there is insufficient representation of South American species, and a taxonomic bias. Regarding taxonomy, we identified genera from the Cacteae and Echinocereeae tribes that have more publications than expected. For example, the genus *Lophophora* has received more attention in publications than expected, likely because it is of interest to researchers for its traditional medicinal and religious uses, owed to its psychoactive components.

Regarding demographic models

Concerning the types of models applied, we observed that MPMs are used more often, but IPMs have begun to see increased use over the past decade. This is attributed to MPMs being described earlier than IPMs. Additionally, growth rates (λ) near unity are observed in the majority of populations. This is a typical pattern for species with long lifespans.

Concerning life history patterns, we identified that populations of the Cacteae and Opuntieae tribes exhibit greater spread within the demographic triangle.

Concerning which demographic process (survival, growth or fecundity) has a bigger influence on growth rate, we identified that survival is the most important one in Cacteae and Opuntieae tribes, while fecundity is the least important; the relative importance of growth is highly variable. A similar pattern was found for the other tribes, only with a much lower variation of growth importance. This could suggest a preliminary pattern of how taxonomy may impact the vital rates of populations. However, we need to be careful with this result owing to the biases mentioned before.

Regarding areas of interest

During our analysis of the key topics of interest to demographers, we identified 53 non-exclusive objectives, subsequently grouped into four main categories: interactions, life history, numerical simulation, and conservation (Fig. 2a). Regarding interactions, climatic effects and the protection provided by the sheltered nurse-plant system are the most represented. In the life history category, the calculation of vital rates and prospective analyses of sensitivities and elasticities are the most frequently reported, along with the analysis of germination rates, seed viability, and recruitment of new individuals. It is worth emphasizing that there is a scarcity of research on the vegetative reproduction of these plants. With respect to numerical simulations, it is common to examine changes in demographic processes, particularly in relation to bottlenecks within this family, such as fecundity and the establishment of new individuals. Lastly, in the conservation category, we considered multidisciplinary studies, which are notably scarce. Among the limited studies available, the impact of illegal seed trade and individual extraction has been examined, along with the suggestion of potential changes to risk categories under Mexican law.

Similarly, of the 65 species that have been studied, just over half fall under the Least Concern (LC) category of the IUCN Red List, with only a very small percentage classified as Critically Endangered (CR) (Fig. 2b). We also identified four species - *Coryphantha werdermannii*, *Mammillaria heyderi* subsp. *gaumeri*, *Harrisia fragrans*, and *H. portoricensis* - that have not been evaluated by the Red List, possibly due to their name changes.

Finally, we extend a cordial invitation to cactus demographers to design their research for the medium and long term, as well as to increase the number of population sites, in order to achieve more accurate patterns and a better understanding of variability in vital rates. We also find it important that the research be shared in the global databases COMPADRE (Salguero-Gómez *et al.*, 2015) and PADRINO (Levin *et al.*, 2022) to enhance accessibility to the models, which could

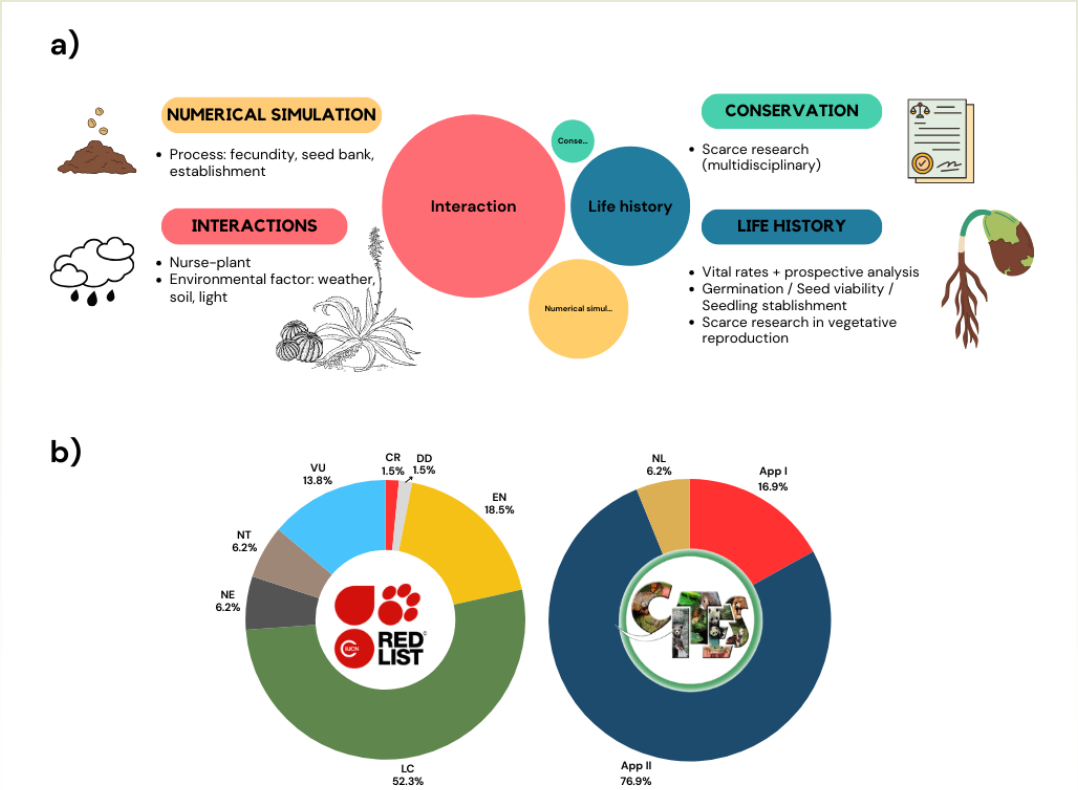


Figure 2. Main areas of interest (a) and risk categories (b) of CITES and IUCN of demographics studies of cacti populations (n = 63). App I: Appendix I. App II: Appendix II. CR: Critically Endangered; DD: Data Deficient; EN: Endangered; LC: Least Concern; NE: Not Evaluated, NT: Near Threatened. VU: Vulnerable. Modified from Jimenez-Guzmán *et al.* (2024).

be employed in other types of research such as meta-analyses or comparative demography.

Acknowledgements

We thank Posgrado en Ciencias Biológicas, UNAM and the funding by CONAHCYT through the postgraduate grant (817856) to GJG.

References

Amaral, D.T., Bonatelli, I.A.S., Romeiro-Brito, M., Moraes, E.M. and Franco, F.F. 2022. Spatial patterns of evolutionary diversity in Cactaceae show low ecological representation within protected areas. *Biological Conservation* 273: 109677.

Doak, D.F., Waddle, E., Langendorf, R.E., Louthan, A. M., Isabelle Chardon, N., Dibner, R.R., Keinath, D.A., Lombardi, E., Steenbock, C., Shriver, R.K. *et al.* 2021. A critical comparison of integral projection and matrix projection models for demographic analysis. *Ecological Monographs* 91: e01447.

Godínez-Álvarez, H., Valverde, T. and Ortega-Baes, P. 2003. Demographic Trends in the Cactaceae. *Botanical Review* 69: 173-201.

Goettsch, B., Durán, A.P. and Gaston, K.J. 2019. Global gap analysis of cactus species and priority sites for their conservation. *Conservation Biology* 33: 369-376.

Jiménez-Guzmán, G., Arroyo-Cosultchi, G., Martorell, C., Martínez-Ramos, M. and Vega-Peña, E.V. 2024. What do we know about the demographic modeling of cacti? A systematic review of current knowledge. *Journal of Arid Environments* 224: 105226.

Korotkova, N., Aquino, D., Arias, S., Eggli, U., Franck, A., Gómez-Hinostrosa, C., Guerrero, P.C., Hernández, H.M., Kohlbecker, A., Köhler, M. *et al.* 2021. Cactaceae at Caryophyllales.org- A dynamic online species-level taxonomic backbone for the family. *Willdenowia* 51: 251-270.

Levin, S., Compagnoni, A., Childs, D., Evers, S., Potter, T., Salguero-Gomez, R. and Knight, T. 2022. *Rpadrino: Interact with the "PADRINO" IPM Database (R package version 0.0.4)*. Available from: https://CRAN.R-project.org/package=Rpadrino.

Salguero-Gómez, R., Jones, O. R., Archer, C. R., Buckley, Y.M., Che-Castaldo, J., Caswell, H., Hodgson, D., Scheuerlein, A., Conde, D.A., Brinks, E. *et al.* 2015. The compadre Plant Matrix Database: An open online repository for plant demography. *Journal of Ecology* 103: 202-218.

The Cerrado through cacti, and the cacti in the Cerrado

Matias Köhler[1]

[1]Departamento de Biologia, Centro de Ciências Humanas e Biológicas, Universidade Federal de São Carlos, Sorocaba, São Paulo, Brazil. Email: matias.k@ufrgs.br.

For specialists, some of this content may seem redundant. However, when engaging with a general audience, we realize the importance of being able to communicate and decipher knowledge - often hermetic - in a way that is accessible to a broader audience. Although it is common to associate cacti with deserts, this perception can lead to misconceptions, such as imagining that cacti are native to African or Australian deserts - especially among young students. In fact, cacti are primarily endemic to the Americas and are not exclusive to deserts. This commentary explores the presence of cacti in another frequently misunderstood environment: the Cerrado.

"Cerrado" is a polysemic term,as it can have different meanings depending on the context. Generally, for Brazilians, it represents a biome, as this is how Brazil's official geography and environmental agencies legally define it. However, in the scientific community, we understand that biome has a different concept, and the area defined as Cerrado is not properly described as a single biome but rather as a region composed of various biomes. The Cerrado covers a large area approximately in the center of South America - its largest portion falls within Brazil - and features significant variations in topography, soil, and vegetation. About eleven distinct types of vegetation are recognized within the Cerrado, including savannas, wet or dry grasslands, forests, and rocky or stony fields, for example.

Etymologically, the term 'Cerrado' might be related to the Spanish equivalent meaning of 'closed', putatively associated with its most typical vegetational aspect (Cerrado *s.str.*): a savanna with twisted trees and shrubs, and a dense ground layer of grasses and other herbs. This type of vegetation, under the climatic conditions of the region, represents one of the key characteristics of the Cerrado - a region that co-evolves with seasonal fires. As such, many traits of the local flora are linked to possible adaptive responses to this frequent disturbance. Thick, rough bark, underground storage structures, and leathery leaves are some of these traits. Given the fire-prone environment, the Cerrado has traditionally been considered unconquerable to cacti, as succulents would likely boil to death under such fire-swept conditions. However, recent studies have pointed to the Cerrado as a potentially important ancestral area for the origin, dispersal, and diversification of certain South American cacti. But which Cerrado? And where can these cacti be found within the Cerrado?

This was the central question guiding a recent perspective published in the *Journal of Biogeography* (Köhler *et al.*, 2024). A review of cactus occurrences across regions defined as Cerrado revealed that the majority of records (about 80-90%) belong to plants living on rocky outcrops (rupicolous) (Fig. 1). In other words, the cacti of the Cerrado are not actually in the Cerrado (Fig. 2). When they are not rupicolous, species that are not phylogenetically related may exhibit traits possibly linked to adaptive responses to fire (subterranean structures or specialized globose morphology). Despite some endemism in the region (~20%), most of the species recorded in areas designated as Cerrado have their core distribution in adjacent areas, such as the Chaco and the Caatinga. Additionally, notable differences in the number of records arise when considering different definitions of the Cerrado.

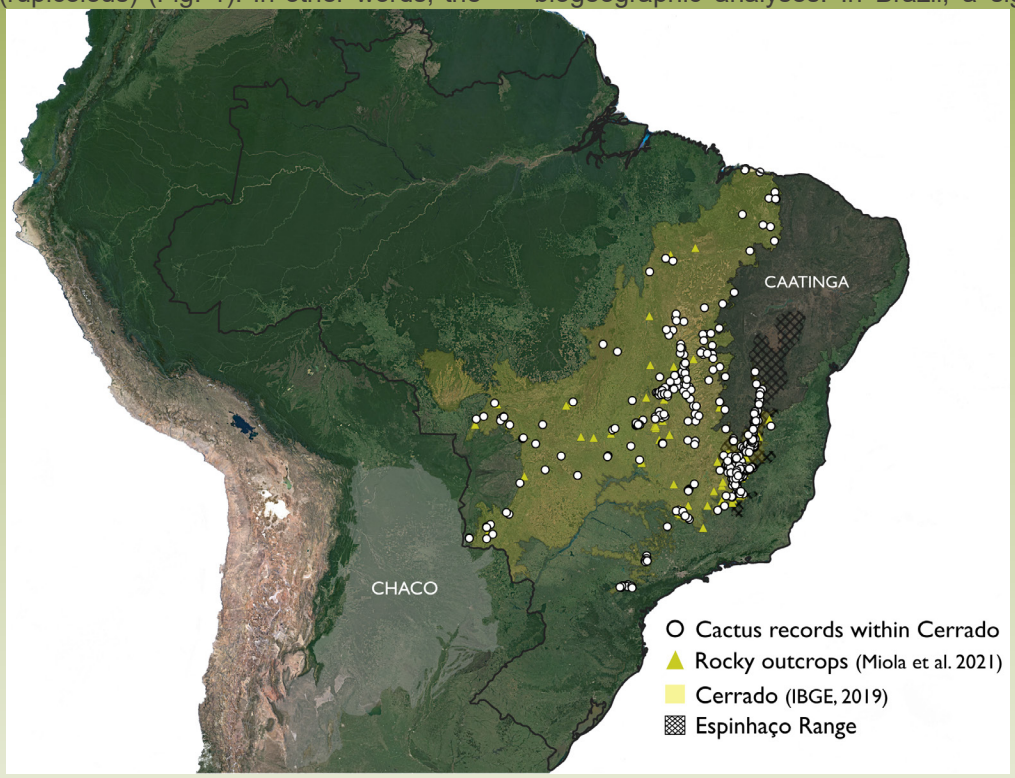


Figure 1. Occurrence records of cacti within a region delimited as Cerrado, highlighting significant rocky outcrops, the Espinhaço Range, and two adjacent areas of relevance (Chaco and Caatinga).

These observations carry potential implications. Rocky outcrops are one habitat for cacti, but they are certainly not the only one. In fire-prone environments, rocky outcrops can function as shelter and represent potential refuges from this disturbance. The rocky environments (crystalline, sedimentary, or limestone) that are sparsely scattered throughout the Cerrado act as small island-like patches, marking the evolutionary history of cacti in South America. Thus, the Cerrado can simultaneously function as a biogeographic corridor for migration but also as a barrier, due to its fire-prone habitats that limit the dispersal and occupation of fire-sensitive lineages.

It is important to emphasize that defining what constitutes the Cerrado, what it encompasses, and which areas belong to this domain/biome/ecoregion is crucial when addressing this topic. Such definitions, by assigning a species to one operational area or another, can entirely determine the results and meanings of, for example, biogeographic analyses. In Brazil, a significant portion of cactus species diversity is associated with the rocky outcrops (*campos rupestres*) of the Espinhaço Range, which is sometimes considered part of the Cerrado. However, recent studies have highlighted that the *campos rupestres* can be quite distinct and may be treated as a separate biome. In this sense, cacti may serve as important elements for distinguishing between these discussed biomes and ecoregions.

Finally, some questions remain open. If there is a preconceived idea that fire-prone environments are unconquerable by cacti, this may need to be reconsidered. The development of specialized morphological structures or life forms that allow survival through fire episodes suggests that cacti may indeed show tolerance or even adaptation to this disturbance. Studies in other ecosystems characterized by seasonal fires in both South and North America support this perspective. Therefore, further research could explore different questions related to the tolerance and adaptation of cacti to fire, as well as the relationships between niche shifts, edaphic specialization, and the colonization, biogeography, and evolutionary history of this fascinating biological group. Additional information and references regarding the elements discussed in this commentary can be found in the peer-reviewed publication.

Acknowledgments

I would like to thank Lucas C. Majure, Bárbara Goettsch and Michiel Pillet for the invitation to write this commented publication, and Monique Romeiro-Brito and Milena Telhe for sharing authorship, discussions, and ideas in the originally published work.

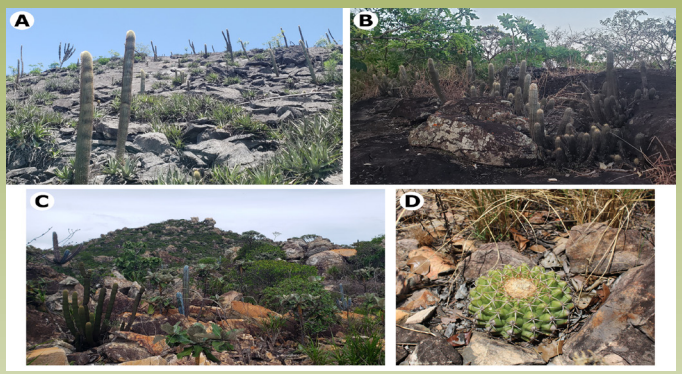


Figure 2. Some cacti found on Cerrado outcrops. A. Limestone with *Coleocephalocereus neoestevesii*, *Cereus pierrebraunianus*, and *Pilosocereus diersianus*. B. Crystalline outcrop with *P. cristalinensis*. C. Part of the Espinhaço Range, with *Micranthocereus albicephalus* and *Pilosocereus pachycladus sensu lato*. D. Globose-depressed *Disco-cactus fariae-peresii* in gravel environment. All photos from the author, except D, reproduced with permission of Fabricio O. Pereira.

Reference

Köhler, M., Romeiro-Brito, M. and Telhe, M. 2024. The Cerrado through cacti. *Journal of Biogeography* 51: 1827-1841.

The great diversity of cacti in Central Chile

Heidy M. Villalobos-Barrantes[1,2,3,*]

[1]Escuela de Química, Universidad de Costa Rica, San José, Costa Rica.
[2]Centro de investigación en Biología Celular y Molecular, Universidad de Costa Rica, San José, Costa Rica.
[3]Biomas, Facultad de Ciencias Naturales y Oceanográficas, Universidad de Concepción, Concepción, Chile.
[*]Email: hemaviba@gmail.com.

One of the most widely distributed biomes on the planet is that of arid and semi-arid zones, which covers approximately 40% of the Earth's surface, being the habitat of a third of the human population and whose activities contribute significantly to the global economy (Goettsch *et al.*, 2015). In addition, this area contains a higher biodiversity than previously estimated and a high rate of endemism (Goettsch *et al.*, 2018). In fact, seven of the 25 biodiversity hotspots and 30% of the global centers of plant diversity are found in arid areas (Arroyo *et al.*, 2008). However, there are few studies that integrate evolutionary and ecological mechanisms to explain patterns of diversification of plant species adapted to arid zones (Guerrero *et al.*, 2013; Böhnert *et al.*, 2022), but they are very necessary to understand the mechanisms that generated the current patterns of biodiversity in areas considered historically extreme for plants, having a direct benefit in the study of the species that inhabit them.

For example, in the study by Hernández-Hernández *et al.* (2014), which was a pioneer on this topic, in arid and semi-arid environments of North and South America, several hypotheses were evaluated on what could be the mechanisms that promoted the diversification of cacti. The first hypothesis states that the diversification of these plants occurred synchronously, on the earth's surface, as a response to the expansion of arid environments. The second hypothesis states that this occurred at different chronological times, in other words the opposite of the first hypothesis. The third hypothesis states that this diversification occurred as an adaptation to edaphic microhabitats (soil type for example) and later as monocarpic evolution and pollination by bats. On the other hand, the origin of the Crassulaceae Acid Metabolism syndrome (CAM) in succulents (which allows them to grow in sites with low water availability) is a response to adaptation to aridity and carbon dioxide levels (Vásquez-Cruz *et al.*, 2024).

This is related to the study by Arakaki *et al.* (2011) where it was concluded that the main cactus radiations were contemporaneous with the radiations of the core Ruschioideae in South Africa and agaves in North America, suggesting that there is an association with the global expansion of arid and semi-arid environments. Therefore, diversification occurred in response to a global colonization of arid environments due to environmental conditions, temperature and CO_2 levels, which favored this expansion.

Cactaceae are a key component of the arid flora of the New World, due to their ability to survive in extreme conditions of temperature and water scarcity, being a significant group at the ecosystem, agronomic, ornamental and cultural levels. In addition, they are perceived as one of the most charismatic groups of plants and are one of the five taxonomic groups in danger according to Red List data of the International Union for Conservation of Nature (IUCN) (Goettsch *et al.*, 2015, 2018).

The tribe Notocacteae, within subfamily Cactoideae, is one of the oldest lineages in South America, estimated to have diverged between 16 - 12 Ma (Arakaki *et al.*, 2011; Hernández-Hernández *et al.*, 2014). It is a very diverse tribe, with small to medium-sized species, with no or few branches, globose forms, geophytes or small columnar forms, and colorful, diurnal flowers. Because of this great variety of forms, its taxonomic classification is not entirely resolved (Guerrero *et al.*, 2019c).

Within this tribe is the genus *Eriosyce sensu lato*

(Cactaceae), which has had an extensive taxonomic treatment since the naturalist Rudolfo A. Philippi described it in 1872. Subsequently, Kattermann (1994) in his monograph "*Eriosyce* (Cactaceae): the genus revised and amplified" makes a thorough revision of the genus. This genus is monophyletic and includes the following subgenera: I. *Eriosyce sensu stricto* (distributed in Argentina and Peru), II. *Campanulatae* (endemic to Chile), III. *Pyrrhocactus* (endemic to Argentina), IV. *Horridocactus* (endemic to Chile), V. *Chileosyce* (endemic to Chile), VI. *Neoporteria* (endemic to Chile), and VII. still unnamed (endemic to Chile) (Guerrero *et al.*, 2011a, 2011b; Guerrero *et al.*, 2019a, 2019b). With about 70 species, it presents a wide geographic distribution, as well as great morphological heterogeneity at the level of stems and roots. Its habitat includes hills, slopes on land near the coast and inland, at elevations ranging from sea level to 2800 m and between latitudes 13°-37°S, its center of diversity being between 26°-30°S and 0-1500 m in elevation. Chile, with its particular geography due to the set of orographic, paleoclimatic and geomorphological processes, has a flora with high levels of biodiversity and endemism. But studying the processes implicit in the origin of biodiversity can be a relatively laborious task in groups with similar and often convergent morphologies such as the genus *Eriosyce*. This genus could present a greater specific diversity since much of its species richness could be hidden in morphological complexes of species, but there are few studies that integrate ecological and diversification mechanisms in arid zones, as well as on the evolution of morphological and niche characters that explain the diversity observed in these plants. In this study we propose that there are two processes that can explain the pattern of diversification in the genus *Eriosyce*, these are: i) niche evolution and ii) morphological evolution, acting independently or together.

To test these hypotheses, the distribution of genetic diversity was evaluated with microsatellite markers and, on the other hand, plastid and nuclear markers were used for the phylogenetic reconstruction of the genus *Eriosyce*. The study (Villalobos-Barrantes *et al.*, 2023) focused on:

1. species delimitation using molecular data from the globose cactus "*E. curvispina*" with which Bayesian phylogenetic inferences were made on 87 individuals of *Eriosyce*, including nine populations of *E. curvispina*, and analyzing three plastid non-coding introns, one plastid and one nuclear gene (Fig. 1).
2. the relationship between morphological traits and environmental variables, using phylogenetic comparative methods, to evaluate the evolution of length, volume, root type and stem type of cacti of the genus *Eriosyce*, and whether temperature and precipitation affect their evolution.
3. diversification was evaluated in terms of climatic and morphological niche.

The main results obtained are: i) the development of 12 pairs of nuclear microsatellites to evaluate the genetic structure at the population level, ii) identification of four groups that originated in independent cladogenetic events that occurred at different temporal depths (Fig. 2), iii) determination that temperature has an impact on the length and volume of cacti, while precipitation has

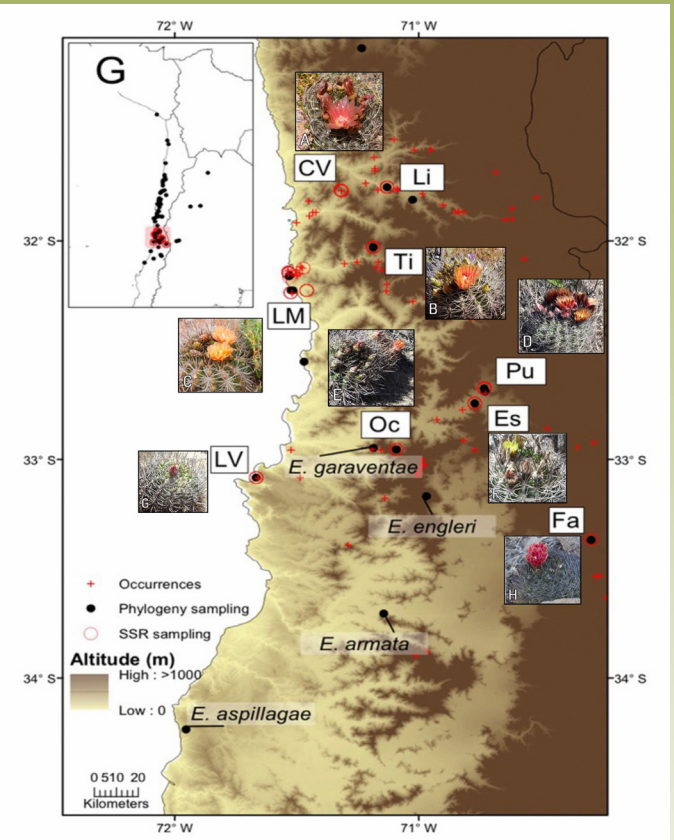


Figure 1. Morphological diversity of *Eriosyce curvispina* from nine sampled populations for phylogenetic and population evolutionary inference. A) Valle de Chopa (CV); B) Tilama (Ti); C) Los Molles (LM); D) Putaendo (Pu); E) Ocoa (Oc); F) Escorial (Es); G) Laguna Verde (LV); H) Farellones (Fa). Photos: A from M. Rosas; B and C from P.C. Guerrero; D, E and F from H.M.Villalobos-Barrantes; G from B. Verga-ra and H from J. Keymer.

an impact on the shape and type of stem, and iv) that these traits have evolved giving an adaptive advantage to these plants to colonize new places, survive over time and diversify. These results also have an impact at the conservation level, since with the delimitation and description of new species it is possible to accurately assess the risk of extinction and design efficient conservation actions, avoiding overlooking highly threatened species in an increasingly anthropized but very diverse landscape such as that of Central Chile.

Acknowledgments

This work was carried out at the Biomas Lab, Facultad de Ciencias Naturales y Oceanográficas, Universidad de Concepción, under the supervision of Dr. Pablo C. Guerrero, the co-supervision of Dr. Jorge Avaria and the collaboration of the co-authors: Beatriz M. Meriño, Helmut

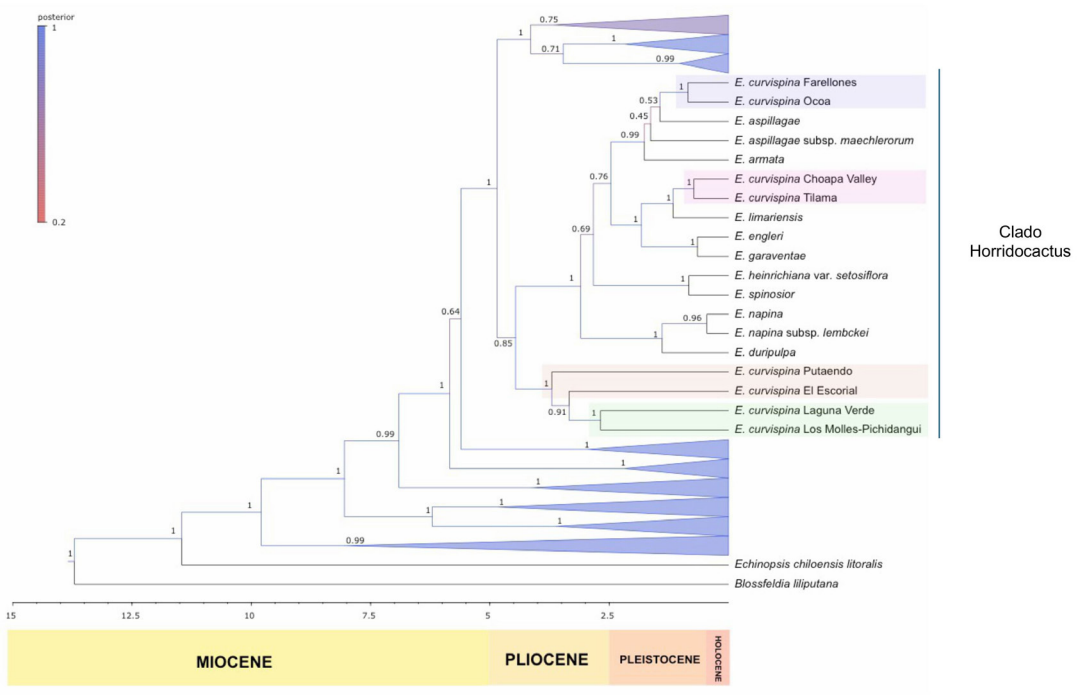


Figure 2. Time-calibrated phylogeny of *Eriosyce* with internal clades collapsed except for the *Horridocactus* clade to facilitate visualization of the phylogenetic position of putative members of *E. curvispina*. Numbers above nodes are *a posteriori* probabilities.

E. Walter and Arón Cádiz-Véliz.

This study and thesis work was carried out thanks to the projects funded by FONDECYT 1160583 and 121144, the project ANID PIA/BASAL FB210006, the research grant awarded by IAPT in 2019 (www.iaptglobal.org/awarded-grants, accessed: 19 November 2023), as well as with the support of the Programa de Becas del Sistema de Postgrado and the Beca de Estipendio during 2015 and 2016 of the Programa de Doctorado en Sistemática y Biodiversidad, both from the Universidad de Concepción.

References

Arakaki, M., Christin, P.-A., Nyffeler, R., Lendel A., Eggli U., Ogburn R.M., Spriggs, E., Moore M.J. and Edwards, E.J. 2011. Contemporaneous and recent radiations of the world's major succulent plant lineages. *Proceedings of the National Academy of Sciences* 108: 8379-8384.

Arroyo, M.T.K., Marquet, P., Marticorena, C., Somoneti, J., Cavieres, L., Sequeo, F., Rozzi, R. and Massardo, F. 2008. El hostpot chileno, prioridad mundial para la conservación. Pp. 90-93. *In:* Ugalde, R.J. & Stutzin, M. (eds). *Biodiversidad de Chile: Patriminio y Desafíos*, CONAMA, eight book editors, Santiago, Chile.

Böhnert, T., Luebert, F., Merklinger, F. F., Harpke, D., Stoll, A., Schneider, J. V. and Weigend, M. 2022. Plant migration under long-lasting hyperaridity–phylogenomics unravels recent biogeographic history in one of the oldest deserts on Earth. *New Phytologist* 234: 1863-1875.

Goettsch, B., Hilton-Taylor, C., Cruz-Piñón, G., Duffy, J.P., Frances, A., Hernández, H.M., Inger, R., Pollock, C., Schipper, J., Superina, M. *et al.* 2015. High proportion of cactus species threatened with extinction. *Nature Plants* 1: 15142.

Goettsch, B., Durán, A.P. and Gaston, K.J. 2019. Global gap analysis of cactus species and priority sites for their conservation. *Conservation Biology* 33: 369-376.

Guerrero, P.C., Durán, A.P. and Walter, H.E. 2011a. Latitudinal and altitudinal patterns of the endemic cacti from the Atacama Desert to Mediterranean Chile. *Journal of Environments* 75: 991-997.

Guerrero, P.C., Arroyo, M.T.K. and Bustamante, R.O. 2011b. Phylogenetics and predictive distribution modeling provide insights into the geographic divergence of *Eriosyce* subgen. *Neoporteria* (Cactaceae). *Plant Systematics and Evolution* 297: 113-128.

Guerrero, P.C., Rosas, M., Arroyo, M.T., and Wiens, J.J. 2013. Evolutionary lag times and recent origin of the biota of an ancient desert (Atacama-Sechura). *Proceedings of the National Academy of Sciences* 110: 11469-11474.

Guerrero, P.C., Majure, L.C., Cornejo-Romero, A. and Hernández-Hernández, T. 2019a. Phylogenetic relationships and evolutionary trends in the cactus family. *Journal of Heredity* 10: 4-21.

Guerrero, P.C., Walter. H.E., Arroyo, M.T.K., Peña, C.M. Tamburrino, I. De Benidictis, M. and Larridon, I. 2019b. Molecular phylogeny of the large South American genus *Eriosyce* (Notocacteae, Cactaceae): Generic delimitation and proposed changes in infrageneric and species ranks. *Taxon* 68: 557-5573.

Hernández-Hernández, T., Brown, J.W., Schlumpberger, B. O., Eguiarte, L.E. and Magallón, S. 2014. Beyond aridification: multiple explanations for the elevated diversification of cacti in the New World Succulent Biome. *New Phytologist* 202: 1382-1397.

Vásquez-Cruz, M., Loera, I., Del Angel, M., Nakamura, M., Hultine, K.R. and Hernández-Hernández, T. 2023. Evolutionary origins, macroevolutionary dynamics, and climatic niche space of the succulent plant syndrome in the Caryophyllales. *Journal of Experimental Botany* 76: 576-593.

Villalobos-Barrantes, H.M., Meriño, B.M., Walter, H.E. and Guerrero, P.C. 2022. Independent Evolutionary Lineages in a Globular Cactus Species Complex Reveals Hidden Diversity in a Central Chile Biodiversity Hotspot. *Genes* 13: 240.

Walter, H.E., Cádiz-Véliz, A, Meriño, B.M., Villalobos-Barrantes, H.M. and Guerrero, P.C. 2024. Taxonomic dissection based on molecular evidence of the Eriosyce curvispina complex (Cactaceae): identifying nine endemic species from Central Chile. *PhytoKeys* 237: 117-139.

New Research on Cacti and Succulents

Since our last issue, many new species of succulents have been described, including *Echeveria sotoi* (Rosales-Martínez *et al.*, 2024), *Opuntia eruca* (Millán-Otero *et al.*, 2024), *Opuntia fortanelli* (Reyes-Agüero *et al.*, 2024), *Sclerocactus dawsoniae* (McGlaughlin and Naibauer, 2024), *Tacinga mirim* (Menezes and Alves, 2024), *Eriosyce tuberculosa* (Campbell, 2025) and *Uebelmannia nuda* (Zappi *et al.*, 2024). Walter *et al.* (2024) revised the Chilean *Eriosyce curvispina* complex, identifying nine species, and Meriño *et al.* (2024) showed the importance of Pleistocene climatic fluctuations in driving speciation within this genus. Böhnert *et al.* (2025) revised the taxonomy of *Austrocactus* based on morphological and molecular data, describing several new taxa. Thompson *et al.* (2024) delivered the most well-sampled molecular phylogeny for Cactaceae to date and investigated the drivers of cactus diversification. Vásquez-Cruz *et al.* (2024) found that the evolution of the succulent syndrome occurred after the colonization of drylands by core Caryophyllales, and that while the climatic niche of succulents was narrower than that of non-succulent related species, there was no evidence for niche separation. Soto-Trejo *et al.* (2024) investigated the evolution of endemic cacti in the Tehuacán-Cuicatlán Valley (Mexico). A land bridge hypothesis was proposed for the evolution of the Brazilian island endemic *Cereus insularis* (Franco *et al.*, 2024), while Amaral *et al.* (2024) identified several genetic adaptations associated with abiotic tolerances in this clade. Köhler *et al.* (2024) discussed the evolutionary ecology of cacti of the Brazilian Cerrado. Madagascar was established as the center of origin for the genus *Adansonia* (Wan *et al.*, 2024).

Many studies of the reproductive ecology of cacti and other succulents were published (Albuquerque-Lima *et al.*, 2024; Bezerra-Silva *et al.*, 2024a, b; Blanco-Valenzuela *et al.*, 2024; da Hora and Meiado, 2024; Gudiño *et al.*, 2024; Lariviere *et al.*, 2024; Matus *et al.*, 2024; Mendonça Filho *et al.*, 2024; Yoder *et al.*, 2024). Snell Cordero and Godínez-Alvarez (2024) reviewed nurse plant associations with Cactaceae, highlighting that these interactions are understudied in Central and South America. Lorenzati *et al.* (2024) investigated demographic trade-offs of *Gymnocalycium monvillei*. Jiménez-Guzmán *et al.* (2024) reviewed the current state of demographic modeling of Cactaceae. McCabe (2024) and Roller (2024) gave an overview of the conservation and taxonomy of several species of *Dudleya*, while Beiersdorfer *et al.* (2024) discussed the rediscovery of the type locality of *Lithops opalina*. Taquiri Yanqui *et al.* (2024) reported a range extension for *Austrocylindropuntia pachypus*, and also identified several threats to the species. Reichenbacher (2024) discussed significant climate change-related declines for *Ibervillea macdougalii*, while Félix-Burruel *et al.* (2024) showed the same is true for Carnegiea gigantea. Distribution models for *Tacinga* species of the Cerrado under climate change suggested future declines (Sampaio *et al.*, 2024). High-value conservation areas for Cactaceae in North America were found to have significant overlap under current and future climate, but these areas did not strongly correspond with existing protected areas (de Albuquerque *et al.*, 2025). Possley *et al.* (2024) gave an overview of the first climate-change related local extinction of a vascular plant in the United States: *Pilosocereus millspaughii*. Morrison *et al.* (2025) quantified the expansion of the invasive cactus moth *Cactoblastis cactorum* in Texas (United States), noting a slowdown which could be due to competition with native moth species. Villalobo-Lopez *et al.* (2024) established poaching and habitat degradation as the main drivers of extinction risk for the Chilean genus *Copiapoa*, while Hübschle and Margulies (2024) discussed the need for a socioecological harm reduction approach to reduce illegal trade of succulent plants. Finally, Fawcett *et al.* (2025) recently published the first genome of a prickly pear, *Opuntia basilaris*.

References

Albuquerque-Lima, S., Milet-Pinheiro, P., Navarro, D.M.A.F., Taylor, N.P., Zappi, D.C. and Machado, I.C. 2024. Intermediary floral traits between natural hybrid and its parents in the *Xiquexique* (Cactaceae). *Organisms Diversity & Evolution* 24: 17-34. https://doi.org/10.1007/s13127-023-00634-7.

Amaral, D.T., Bonatelli, I.A.S., Romeiro-Brito, M., Telhe, M.C., Moraes, E.M., Zappi, D.C., Taylor, N.P. and Franco, F.F. 2024. Comparative transcriptome analysis reveals lineage- and environment-specific adaptations in cacti from the Brazilian Atlantic Forest. *Planta* 260: 4. https://doi.org/10.1007/s00425-024-04442-x.

Beiersdorfer, P., Lepson, J.K., Mouton, H. and Mouton, F. 2024. Rediscovery of the Type Locality of *Lithops opalina* and Taxonomic Implications. *Cactus and Succulent Journal* 96: 86-94. https://doi.org/10.2985/015.096.0109.

Bezerra-Silva, A., Albuquerque-Lima, S., Gomes, V G.N., Fagundes, A.C. de A., Gomes, M.T. D., Silva, M.T. da, Machado, I.C. and Funch, L.S. 2024a. When Are Cacti Found with Flowers and Fruits? Estimation of the Reproductive Phenology of the Genus *Xiquexique* Based on Herbarium Data. *Diversity* 16: 79. https://doi.org/10.3390/d16020079.

Bezerra-Silva, A., Gomes, V.G.N., Albuquerque-Lima, S., Nadia, T.L., Machado, I.C. and Silveira Funch, L. 2024b. Double mutualism involving *Melocactus* (Cactaceae) and lizards in the Brazilian Caatinga: Another isolated case or is it an established interaction? *Austral Ecology* 49: 1-7. https://doi.org/10.1111/aec.13494.

Blanco-Valenzuela, G., Calderón, K., Ochoa-Meza, A., Peñalba, M.C. and Tinoco-Ojanguren, C. 2024. Enhanced mycorrhization in four species of columnar cacti under the Sonoran Desert tree *Olneya tesota*. *Botanical Sciences* 102: 765-778. https://doi.org/10.17129/botsci.3454.

Böhnert, T., Merklinger, F.F., Sarnes, E., Sarnes, N., Kiesling, R., Weigend, M. and Luebert, F. 2025. Systematic and taxonomic revision of the genus *Austrocactus* (Cactaceae) based on morphology and genome wide SNP-data. *Taxon*. https://doi.org/10.1002/tax.13311.

Campbell, S. 2025. *Eriosyce tuberculosa* (Cactaceae), a New Species from the Atacama Region, Chile. *Cactus and Succulent Journal* 97: 11-23. https://doi.org/10.2985/015.097.0103.

da Hora, I.S. and Meiado, M.V. 2024. The absence of light during discontinuous hydration affects the viability of a cactus species. *Plant Ecology* 225: 583-591. https://doi.org/10.1007/s11258-024-01413-w.

de Albuquerque, F.S., Macías-Rodríguez, M.Á., Búrquez, A. and Cavalcante, A. de M.B. 2025. Potential effects of climate change on cacti distribution and conservation in North American drylands. *Journal of Arid Environments* 226: 105282. https://doi.org/10.1016/j.jaridenv.2024.105282.

Fawcett, S., Escalona, M., Marimuthu, M.P.A., Nguyen, O., Chumchim, N., Beraut, E., Seligman, W., Fairbairn, C.W., Toffelmier, E., Miller, C., Shaffer, H.B. and Majure, L.C. 2025. The reference genome of the beavertail cactus, *Opuntia basilaris*. *Journal of Heredity* esaf027. https://doi.org/10.1093/jhered/esaf027.

Félix-Burruel, R.E., Larios, E., González, E.J. and Búrquez, A. 2024. Population decline of the saguaro cactus throughout its distribution is associated with climate change. *Annals of Botany* 135: 317-328. https://doi.org/10.1093/aob/mcae094.

Franco, F.F., Amaral, D.T., Bonatelli, I.A.S., Meek, J.B., Moraes, E.M., Zappi, D.C., Taylor, N.P. and Eaton, D.A.R. 2024. A historical stepping-stone path for an island-colonizing cactus across a submerged “bridge” archipelago. *Heredity* 132: 296-308. https://doi.org/10.1038/s41437-024-00683-4.

Gudiño, W., Torres, D.E., Merino, G., Martínez-Barajas, E. and Márquez-Guzmán, J. 2024. Nectary microstructure and nectar production in two species of *Cephalocereus* (Cactaceae) and their natural hybrid. *Flora* 313: 152482. https://doi.org/10.1016/j.flora.2024.152482.

Hübschle, A. and Margulies, J. 2024. The need for a socioecological harm reduction approach to reduce illegal wildlife trade. *Conservation Biology* 38: e14335. https://doi.org/10.1111/cobi.14335.

Jiménez-Guzmán, G., Arroyo-Cosultchi, G., Martorell, C., Martínez-Ramos, M. and Vega-Peña, E.V. 2024. What do we know about the demographic modeling of cacti? A systematic review of current knowledge. *Journal of Arid Environments* 224: 105226. https://doi.org/10.1016/j.jaridenv.2024.105226.

Köhler, M., Romeiro-Brito, M. and Telhe, M. 2024. The Cerrado through cacti. *Journal of Biogeography* 51: 1827-1841. https://doi.org/10.1111/jbi.14846.

Lariviere, D., Anderson, V., Johnson, R. and Larsen, R. 2024. What Is in the Bank? Assessing Persistent Soil Seed Bank Density of *Sclerocactus wrightiae* (Cactaceae). *Diversity* 16: 133. https://doi.org/10.3390/d16030133.

Lorenzati, M.A., Aliscioni, N.L., Delbón, N.E. and Gurvich, D.E. 2024. Growing or reproducing? Assessing the existence of a trade-off in the globose cactus *Gymnocalycium monvillei*. *Plant Biology* 26: 476-484. https://doi.org/10.1111/plb.13626.

Matus, R., Perroni, Y., Flores, J. and Miranda-Jácome, A. 2024. Light stress conditions affect variability in the phenotypic expression of germination in *Mammillaria carnea* from different origins and genetic families. *Flora* 315: 152522. https://doi.org/10.1016/j.flora.2024.152522.

McCabe, S.W. 2024. *Dudleya* of the Channel Islands: Conservation Successes and Taxonomy. *Cactus and Succulent Journal* 96: 95-110. https://doi.org/10.2985/015.096.0110.

McGlaughlin, M.E. and Naibauer, S.K. 2024. *Sclerocactus dawsoniae* (Cactaceae), a New Species from Western Colorado, U.S.A. *Novon, A Journal for Botanical Nomenclature* 32: 79-83. https://doi.org/10.3417/2024771.

Mendonça Filho, C.V., Souza, J.P., Lopes, L.L. and Antonini, Y. 2024.. Long-term monitoring of the columnar cactus *Cipocereus minensis* reveals unforeseeable reproductive phenology. *Journal of Arid Environments* 224: 105202. https://doi.org/10.1016/j.jaridenv.2024.105202.

Menezes, M.O.T. de and Alves, L.I.F. 2024. A new tetraploid species of *Tacinga* (Cactaceae) from Ceará, Northeastern Brazil. *Rodriguésia* 75. https://doi.org/10.1590/2175-7860202475048.

Meriño, B.M., Villalobos-Barrantes, H.M. and Guerrero, P.C. 2024. Pleistocene climate oscillations have shaped the expansion and contraction speciation model of the globose *Eriosyce* sect. *Neoporteria* cacti in Central Chile. *Annals of Botany* 134: 651-664. https://doi.org/10.1093/aob/mcae087.

Millán-Otero, M.G., Puente-Martínez, R., Pío-León, J.F. and Márquez-Salazar, G. 2024. *Opuntia eruca*, una especie nueva de Cactaceae, de Sinaloa, México. *Acta Botanica Mexicana* 131: 1-17. https://doi.org/10.21829/abm131.2024.2408.

Morrison, C.R., Plowes, R.M., Springer, L.E., Sanchez-Peña, S. and Gilbert, L. E. 2025. Establishment and range expansion of invasive *Cactoblastis cactorum* (Lepidoptera: Pyralidae: Phycitinae) in Texas. *Florida Entomologist* 108: 20240052.. https://doi.org/10.1515/flaent-2024-0052.

Possley, J., Lange, J.J., Franck, A.R., Gann, G.D., Wilson, T., Kolterman, S., Duquesnel, J. and O’Brien, J. 2024. First

U.S. vascular plant extirpation linked to sea level rise? *Pilosocereus millspaughii* (Cactaceae) in the Florida Keys, U.S.A. *Journal of the Botanical Research Institute of Texas* 18: 211-223. https://doi.org/10.17348/jbrit.v18.i1.1350.

Reichenbacher, F. (2024). Calescent Drought, Fortuitous Climates and Decline of a Sonoran Desert Cucurbitaceous Vine. *Haseltonia* 31: 57-79. https://doi.org/10.2985/026.031.0108.

Reyes-Agüero, J.A., Orta-Salazar, C., Heindorf, C. and González, E.C. 2024. *Opuntia fortanelli* (Cactaceae), a New Species from the Huastec Region of San Luis Potosí, México. *Haseltonia* 31: 26-33. https://doi.org/10.2985/026.031.0104.

Roller, C. (2024). *Dudleya farinosa*: Environmental Challenges, Human Threats, and Conservation. *Cactus and Succulent Journal* 96: 41-48. https://doi.org/10.2985/015.096.0105.

Rosales-Martínez, C.S., Quirarte-Tejeda, J.A. and Hernández-Campos, J.D. 2024. *Echeveria sotoi* (ser. Gibbiflorae, Crassulaceae), a new species from coastal Michoacán, Mexico. *Phytotaxa* 633: 125-137. https://doi.org/10.11646/phytotaxa.633.2.3.

Sampaio, A.C.P., Cavalcante, A. de M.B., de Albuquerque, F.S. and von Randow, C. 2024. The impacts of the exposure of cactus species of the genus *Tacinga* to climate change in the Caatinga biome. *Acta Botanica Brasilica* 38: 1-12. https://doi.org/10.1590/1677-941x-abb-2023-0177.

Snell Cordero, J. and Godínez-Alvarez, H. 2024. Association between cacti and nurse plants: a quantitative literature review. *Botanical Sciences* 102: 1032-1042. https://doi.org/10.17129/botsci.3520.

Soto-Trejo, F., Robles, F., Lira, R., Sánchez-González, L.A., Ortiz, E. and Dávila, P. 2024. The evolution of paleo- and neo-endemic species of Cactaceae in the isolated Valley of Tehuacán-Cuicatlán, Mexico. *Plant Ecology and Evolution* 157: 42-54. https://doi.org/10.5091/plecevo.110352.

Taquiri Yanqui, W., Capcha Ramos, J.B., Orellana Garcia, A., Ostolaza Nano, C., Moat, J. and Whaley, O. (2024). Distribución geográfica y estado de conservación del cactus endémico *Austrocylindropuntia pachypus* y nuevos registros para el sur del Perú. *Revista Peruana de Biología* 31: e25847. https://doi.org/10.15381/rpb.v31i1.25847.

Thompson, J. B., Hernández-Hernández, T., Keeling, G., Vásquez-Cruz, M. and Priest, N. K. 2024. Identifying the multiple drivers of cactus diversification. *Nature Communications* 15: 7282. https://doi.org/10.1038/s41467-024-51666-2.

Vásquez-Cruz, M., Loera, I., DelAngel, M., Nakamura, M., Hultine, K.R. and Hernández-Hernández, T. (2024). Evolutionary origins, macroevolutionary dynamics, and climatic niche space of the succulent plant syndrome in the Caryophyllales. *Journal of Experimental Botany* 76: 576-593. https://doi.org/10.1093/jxb/erae428.

Villalobo-Lopez, A., Peña, C.M., Varas-Myrik, A., Pillet, M., Jahnsen, P., Pliscoff, P., Goettsch, B. and Guerrero, P.C. 2024. Effects of trade and poaching pressure on extinction risk for cacti in the Atacama Desert. *Conservation Biology* 38: 1-13. https://doi.org/10.1111/cobi.14353.

Walter, H.E., Cádiz-Véliz, A., Meriño, B.M., Villalobos-Barrantes, H.M. and Guerrero, P.C. 2024. Taxonomic dissection based on molecular evidence of the *Eriosyce curvispina* complex (Cactaceae): identifying nine endemic species from Central Chile. *PhytoKeys* 237: 117-139. https://doi.org/10.3897/phytokeys.237.107403.

Wan, J.-N., Wang, S.-W., Leitch, A.R., Leitch, I.J., Jian, J.-B., Wu, Z.-Y., Xin, H.-P., Rakotoarinivo, M., Onjalalaina, G.E., Gituru, R.W. *et al*. 2024. The rise of baobab trees in Madagascar. *Nature* 629: 1091-1099. https://doi.org/10.1038/s41586-024-07447-4.

Yoder, J.B., Andrade, A.K., DeFalco, L.A., Esque, T.C., Carlson, C.J., Shryock, D.F., Yeager, R. and Smith, C. I. 2024. Reconstructing 120 years of climate change impacts on Joshua tree flowering. *Ecology Letters* 27:1-14. https://doi.org/10.1111/ele.14478.

Zappi, D.C., Taylor, N.P., Costa, F.N., Fonseca, S.N., Ferreira, P.L., Romeiro-Brito, M., Telhe, M.C., Köhler, M., Franco, F.F. and Moraes, E.M. 2024. A microendemic and enigmatic new cactus species from the campo rupestre of Minas Gerais, Brazil: *Uebelmannia nuda* (Cactaceae, Cactoideae). *Taxon* 73: 992-1000. https://doi.org/10.1002/tax.13206.

Events and Opportunities

Conferences and Congresses

- The International Cactaceae Academic Network (iCAN) organizes Zoom seminars on current cactus research. Please register on their website to receive seminar announcements.
- iCAN is organizing the second edition of the International Virtual Cactaceae Symposium, set to take place August 25 to August 27, 2025. Event registration closes August 24.
- The Cactus and Succulent Society of America organizes an online seminar series featuring cactus and succulent experts from around the world. Please register on their website.

Grants and Funding

- Applications for the Mohamed bin Zayed Species Conservation Fund are open. This global fund has been established to provide targeted grants to any individual threatened species' conservation initiatives, recognize leaders in the field and elevate the importance of species in the broader conservation debate.
- The Cactus and Succulent Society of America Research Grants Program supports research projects involving succulent plants through small grants. Deadline: February 1 and July 1 annually.
- The Cactus and Succulent Society of America supports conservation projects involving succulent plants through small grants. Deadline: rolling basis. For more information, email vicepresident@cactusandsucculentsociety.org.
- The Tucson Cactus and Succulent Society provides small grants for both research and conservation projects involving succulent plants. Deadline: rolling basis.

صندوق محمد بن زايد
للمحافظة على الكائنات الحية
The Mohamed bin Zayed SPECIES CONSERVATION FUND

ABOUT THE NEWSLETTER

The Cactus and Succulent Plants Specialist Group Newsletter is an important tool to keep members informed of SG activities and accomplishments.

CSSG ANNUAL REPORT

2023 Report