

## THE FANTASTIC STORY OF HOW CACTI THRIVE IN THE BRAZILIAN CAATINGA

Danilo T. Amaral<sup>1\*</sup>, Milena Cardoso Telhe<sup>2</sup>, Monique Romeiro-Brito<sup>3</sup> and Isabel A. S. Bonatelli<sup>4</sup>

<sup>1</sup>Centro de Ciências Naturais e Humanas, Universidade Federal do ABC (UFABC), São Paulo, Brazil

<sup>2</sup>Departamento de Biologia, Universidade Federal de São Carlos, São Paulo, Brazil

<sup>3</sup>Florida Museum of Natural History, University of Florida, Gainesville, FL, United States

<sup>4</sup>Departamento de Ecologia e Biologia Evolutiva, Instituto de Ciências Ambientais, Químicas e Farmacêuticas, Universidade Federal de São Paulo, Diadema, Brazil

### YOUNG REVIEWERS:



KARUBAKEE

AGE: 12



THE  
GRANSHAW  
COHORT

AGES: 11–13



YICHEN

AGE: 8

In the sunny and dry land of Brazil's Caatinga, a group of plants called cacti lives and thrives even though it does not rain much. But how do they do it? This article will take you on an adventure, in which you will learn how cacti survive in such a tough place. The *Cereus* cacti are like water-saving wizards, storing water in their bodies. Their spikes, which look and act like armor, also help them catch raindrops. Cacti have a cool way of making food. They do it at night when it is not too hot, to prevent themselves from losing water in the heat of the day. Cacti also have friends, like bats and hummingbirds, that bring pollen from one plant to another, helping the cacti to reproduce. The Caatinga can be a tricky place, with hot days and not much rain, but the story of Brazilian cacti reminds us of nature's fascinating diversity and how life can be strong and beautiful, even in a very dry place.

## CACTI

Special kinds of plants that live in hot, dry places like deserts. They have thick, spiky skin to protect themselves and store water, which helps them survive when it does not rain. Some cacti have beautiful flowers that can be different colors like pink, yellow, or red.

### Figure 1

The blue map shows Brazil in relation to the rest of the world. In the green map, the Caatinga biome is shown in yellow.

## CAATINGA

A region in Brazil known for its unique plants covered with thorns.

## THE BRAZILIAN CAATINGA

In the heart of Brazil's beautiful landscapes, where the sun shines bright and a warm wind blows across the dry land, there is a special group of plants that manage to thrive in this tough place. These amazing characters are the **cacti** of the Brazilian **Caatinga** (Figure 1). Have you ever wondered how these spiky wonders not only survive but do so well in one of the harshest environments on Earth? This article will take you on an exciting journey through the dry and beautiful Caatinga to discover how cacti thrive there.



Figure 1

## SAVING WATER WHEN IT RAINS

Imagine visiting the Caatinga, where the sky is blue, and the wind is hot and dry most days. Here, there is a type of cactus called *Cereus*, which is also called mandacaru (Figure 2). These cacti are like guardians of the dry land and know how to survive in a special way (Table 1) [1]. Even though it does not rain often in this place, cacti have a fantastic ability to save water. They have thick bodies that work like water tanks, and their skin helps keep them safe from the strong sun. Cacti take up water when it rains and save that water for the dry days.

## THORNS: NATURE'S DEFENSE AND HELPERS

You have probably seen the thorns on cacti, which are pointed structures that serve various purposes, including defense and water capture. Thorns are like the armor that helps these plants survive in

## Figure 2

(A) In the tough Caatinga land, the *Cereus* cactus shows how strong nature can be. (B) It has delicate and pretty flowers and (C) special fruits. This cactus reminds us that even in very hard places, beautiful and strong plants can grow.

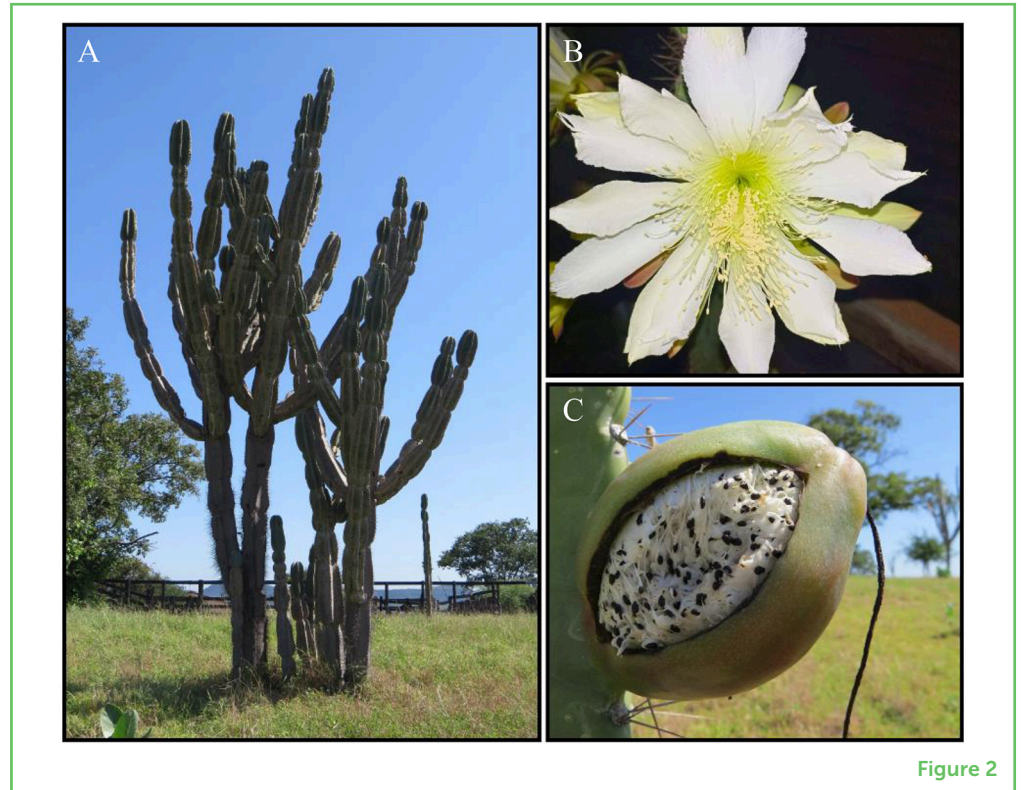


Figure 2

## Table 1

Cacti vs. other plants: an overview of survival in dry environments.

Function	Cacti	Other plants
Water storage	Store water in stem tissue	Limited or no water storage capacity
Root system	Extensive shallow roots	Typically deeper roots
Leaf structure	Modified into thorns	Broad leaves
Stem structure	Thick and fleshy for water storage	Typically not specialized for water storage

Table 1

## PHOTOSYNTHESIS

The process by which plants and other organisms convert light energy into chemical energy in the form of glucose (sugar), using water and carbon dioxide.

## STOMATA

Tiny holes on the surface of plants that can open and close to let gasses in, working like a plant's breathing system and water manager.

the tough desert environment. Thorns do more than just look pretty; they protect the cacti. They have a special job: after a rain shower, the thorns guide raindrops to the plant's roots (Figure 3A). Thorns also help to prevent water loss during the hottest part of the day, by decreasing the area of water loss compare to a big leaf. These help the cactus drink and save water and stay strong.

## CLEVER PHOTOSYNTHESIS

In the Caatinga, where the sun can be a challenge, *Cereus* cacti have a smart way of making food by **photosynthesis** [2]. Instead of opening their tiny pores, called **stomata**, during the day like most plants do to absorb carbon dioxide, cacti do it at night when it is cooler. They can save the carbon dioxide they need and use it to make energy when the

### Figure 3

(A) During a rain shower, the thorns on cacti guide raindrops to the plant's roots. (B) Hummingbirds assist in the pollination of cacti's colorful flowers by transferring pollen from one part of a flower to another or from one flower to another.

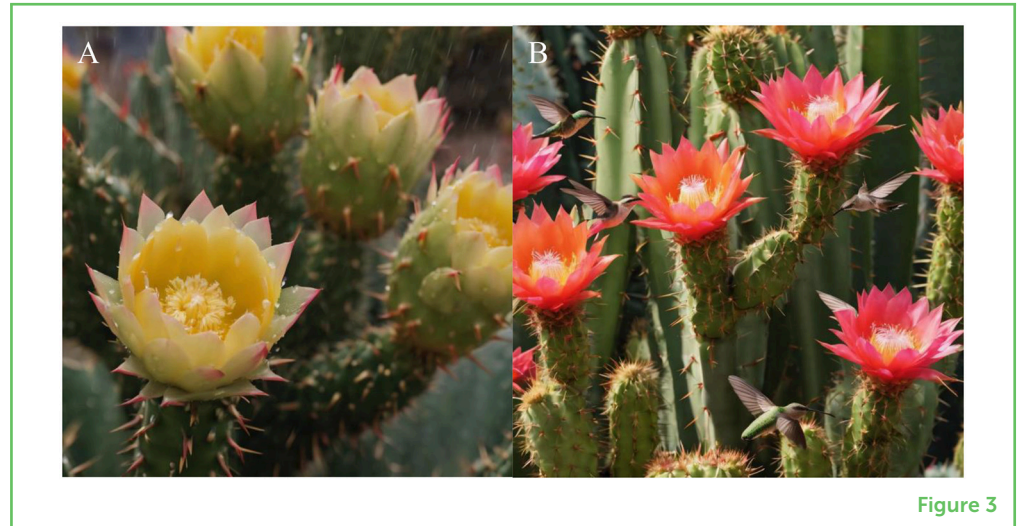


Figure 3

sun is out. This way, cacti can make energy while not losing too much water through their stomata in the hot sun.

### NATURE'S FRIENDS: SURVIVING TOGETHER

Cacti have special friends in the Caatinga, like bats, hummingbirds, and insects, who help them by **pollinating** their colorful flowers. Pollination involves transferring pollen from one part of a flower to another or from one flower to another (Figure 3B) [3]. Usually, the flowers are located far from the thorns, which helps prevent the pollinators from being harmed by these spiky weapons. The cacti's pollinating friends make sure the cacti can reproduce, while the cacti help other desert creatures by providing shelter, food, and water with their flowers and fruits. Cacti are like the hosts of a party for all the creatures in the desert!

### A STORY OF STRONG PLANTS

The Caatinga is a place of big challenges, like hot days and long periods without rain, when living things struggle to get enough water [4]. But cacti show us how to be strong and keep going, even when things are tough. These plants have special tricks like saving water after it rains, protecting themselves with thorns, making food at night when temperatures are cooler, and working with friends to survive. The cacti's way of living shows us that nature can be very clever. Even in hard places, life can grow and turn challenges into something beautiful.

So, if you ever see a tall *Cereus* cactus in the Caatinga, remember the fascinating story it tells. Cacti show us that, even when life is tough, it can still be an amazing adventure even in the middle of a challenging desert.

### POLLINATING

A process that helps plants make seeds, which can grow into new plants. It happens when pollen, a powdery substance from the male part of a flower, is moved to the female part of a flower. This can be done by insects like bees, or birds, or even the wind.

## REFERENCES

1. Amaral, D. T., Minhós-Yano, I., Oliveira, J. V. M., Romeiro-Brito, M., Bonatelli, I. A. S., Taylor, N. P., et al. 2021. Tracking the xeric biomes of South America: the spatiotemporal diversification of Mandacaru cactus. *J. Biogeog.* 48:3085–103. doi: 10.1111/jbi.14265
2. Hernández-González, O., and Villarreal, O. B. 2007. Crassulacean acid metabolism photosynthesis in columnar cactus seedlings during ontogeny: the effect of light on nocturnal acidity accumulation and chlorophyll fluorescence. *Am. J. Bot.* 94:1344–51. doi: 10.3732/ajb.94.8.1344
3. Rocha, E. A., Machado, I. C., and Zappi, D. C. 2007. Floral biology of *Pilosocereus tuberculatus* (Werderm.) Byles & Rowley: a bat pollinated cactus endemic from the “Caatinga” in northeastern Brazil. *Bradleya*, 2007:129–44. doi: 10.25223/brad.n25.2007.a10
4. Santos, M. G., Oliveira, M. T., Figueiredo, K. V., Falcao, H. M., Arruda, E. C., Almeida-Cortez, J., et al. 2014. Caatinga, the Brazilian dry tropical forest: can it tolerate climate changes? *Theor. Exp. Plant Physiol.* 26:83–99. doi: 10.1007/s40626-014-0008-0

**SUBMITTED:** 15 September 2023; **ACCEPTED:** 31 May 2024;

**PUBLISHED ONLINE:** 17 June 2024.

**EDITOR:** David Hiller, Yale University, United States

**SCIENCE MENTORS:** Fei Peng, Ryan Thomas Weir, and Biswajit Panda

**CITATION:** Amaral DT, Telhe MC, Romeiro-Brito M and Bonatelli IAS (2024) The Fantastic Story of How Cacti Thrive in the Brazilian Caatinga. *Front. Young Minds* 12:1295005. doi: 10.3389/frym.2024.1295005

**CONFLICT OF INTEREST:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**AI TOOL STATEMENT:** This article incorporates English grammar text corrections generated by artificial intelligence (AI) tools, ChatGPT. Authors take full responsibility for the content of the article and affirm that they have employed their critical scientific judgement to thoroughly review and verify all contents to ensure accuracy, originality, and compliance with the journal’s standards.

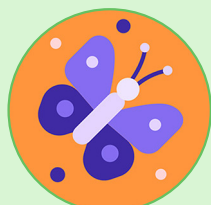
**COPYRIGHT** © 2024 Amaral, Telhe, Romeiro-Brito and Bonatelli. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

## YOUNG REVIEWERS



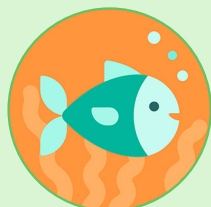
### KARUBAKEE, AGE: 12

I like to read about space related facts and am highly interested in knowing about the world history. I also like to read fantasy books and listen to music.



### THE GRANSHAW COHORT, AGES: 11–13

This group of young people are enthusiastic about understanding the world around them from fungi to fruit bats and turtles to trees! This group of young people attend quarterly science reviews with their science mentor Ryan at Granshaw presbyterian church in Northern Ireland.



### YICHEN, AGE: 8

Yichen is an 8-year-old boy who will turn 9 this month. He has always been fascinated by nature and technology. When he was around 4 or 5 years old, he was immensely curious about various insects, leaves, and fruits. As he grew a little older, he developed a keen interest in dogs and other animals. He consistently maintains his love for nature and biodiversity, much like his preference for reading factual rather than fictional books.

## AUTHORS



### DANILO T. AMARAL

I am a passionate bioinformatician and computational biologist, exploring the intersection of science and technology. Enchanted by the wonders of bioluminescence, I unravel nature's luminous secrets. In the adventure of knowledge, I am also captivated by the spines of cacti, symbols of adaptation and resilience. My journey involves deciphering the code of life and the beauty of living systems, blending science and curiosity in a universe brimming with discoveries.

\*[danilo.trabuco@ufabc.edu.br](mailto:danilo.trabuco@ufabc.edu.br)



### MILENA CARDOSO TELHE

I am an enthusiastic biologist, and since I was a kid, I have been wondering how and why we have so many different species around the world. As a Ph.D. student, I am passionately engaged in exploring the many species and their evolutionary histories in the arid regions of the Neotropics, such as the Caatinga. To do so I am using cacti as a lens to examine these dry and enigmatic landscapes.



### MONIQUE ROMEIRO-BRITO

I am a biologist who is excited about finding ways to conserve the enormous biodiversity that we have in South America. For this, we need to understand where the diversity is allocated and the origin of multiple taxa in Neotropics. In the time being, I have been excitedly studying the diversity and origin of species that occurs in harsh environments, as the cacti a plant group which is largely threatened by human activities in the America. Now I am blooming my interest to understand diversity of other flowering plants that are underexplored in the Americas.



**ISABEL A. S. BONATELLI**

I am a curious biologist who seeks to understand why there are so many species in the world, why these species possess such distinct characteristics, and why they are distributed where they are. All of this can be elucidated by the theory of species evolution, which constitutes my primary area of study. Through my teaching endeavors, I strive to kindle the flames of curiosity within my students, igniting their own quests to comprehend the intricate history of life on Earth. I hold the aspiration that scientific knowledge can guide us in cherishing and conserving all facets of nature's beauty.