ENHANCING CANOPY ECOSYSTEMS: INTEGRATING VASCULAR EPIPHYTES INTO HABITAT RESTORATION FOR THE CONSERVATION OF *ABRONIA CAMPBELLI*

UPDATE

Campbell's alligator lizard (*Abronia campbelli*) is critically endangered due to severe habitat loss, with only a fraction of its original forest habitat remaining. Ensuring its survival requires not only restoring forest structure but also reinstating the intricate microhabitats within the canopy that are essential for the species. While reestablishing trees and epiphyte communities is a complex challenge, accelerating the restoration process is critical to providing suitable conditions as quickly as possible, allowing *A. campbelli* populations to stabilize and recover.

This project represents a pioneering effort to restore canopy habitat for *A. campbelli*, addressing the urgent need for epiphyte recolonization in restored areas. The progress achieved in the first half of the project demonstrates that we are on track to meet our objectives. Through this work, we are gaining essential knowledge and technical expertise to refine restoration strategies and ensure long-term conservation success for *A. campbelli.*

EPIPHYTE RICHNESS AND ABUNDANCE

A critical first step in enhancing the canopy ecosystem for *A. campbelli* is understanding the biodiversity that defines this essential microhabitat. To achieve this, we are conducting an assessment of species richness and relative abundance within mature forests that serve as high-quality habitat for the species. Preliminary results indicate the presence of 13 vascular epiphyte species, though we anticipate this number will increase as data collection continues.

Assessing epiphyte abundance in this ecosystem presents unique challenges. These plants often grow at considerable heights near the top of trees, can number in the hundreds on a single tree, and vary significantly in size and condition, from small recruits to large, mature specimens, some of which may be partially decayed. Additionally, abundance patterns differ across species: some are scarce but large, while others are numerous yet tiny, making simple counts an unreliable metric.

Instead, we adopted a methodology based on the space occupied by each species on its host tree, providing a more accurate reflection of ecological significance. However, existing methods for measuring epiphyte abundance are scarce, and traditional count-based approaches proved imprecise during initial trials. To address this, we integrated digital photography, image processing, and drone technology, modern tools that have been underutilized in epiphyte research. This approach yielded reproducible results and allowed for efficient, cost-effective data collection while minimizing disturbance to the ecosystem.

Our sampling involved capturing digital photographs of each tree using a wide-angle lens and drones for an optimal perspective. Images were taken in RAW format from a consistent height. We processed these images in Adobe Photoshop, enhancing darker areas and overlaying a 5% grid to generate 361 sampling points per image. Each point was classified as host tree, background, or a specific epiphyte species. The percentage area occupied by each species relative to non-background points was then calculated, providing a reliable measure of relative abundance across ten sampled trees per zone.

With this methodology in place, we will continue to collect and analyze data to further refine our understanding of epiphyte abundance and distribution within the canopy.

EPIPHYTE TRANSPLANTATION

Given the strong ecological association between *A. campbelli* and epiphyte-rich habitats, facilitating the establishment of epiphytic plant communities in restored areas is crucial. Natural colonization of epiphytes in newly planted forests is often slow and unpredictable, limiting the restoration of essential microhabitats. By actively reintroducing adult epiphytes early in the restoration process, we can create localized seed sources that enhance natural dispersal and establishment. This strategy accelerates habitat recovery, replicating the biodiversity and structural complexity of mature forests, ultimately improving the long-term viability of *A. campbelli's* habitat.

To assess the feasibility of this approach, we conducted an experiment involving the transplantation of 450 bromeliads. These bromeliads were collected from the forest floor, where they would have otherwise perished, ensuring that their removal did not negatively impact existing populations. The selected bromeliads represented a diverse range of species and life stages. They were carefully attached to the branches of young oak trees (less than four meters in height) in reforested areas. Over the next year, we will monitor their survival, growth, and integration into their new environment to evaluate their potential for long-term establishment.

Preliminary results are promising, suggesting that adult bromeliads can successfully adapt to new host trees. This approach has the potential to significantly enhance the structural complexity of restored forests while promoting the development of a self-sustaining epiphyte community.

GREENHOUSE CONSTRUCTION

To further support habitat restoration for *Abronia campbelli*, we initiated the construction of a greenhouse dedicated to propagating key vascular epiphyte species. This facility will enable large-scale cultivation of epiphytes, ensuring a steady supply of plants for future restoration efforts.

In preparation for this initiative, FUNDESGUA staff participated in capacity-building visits to a local commercial bromeliad producer. These visits provided invaluable hands-on training in sustainable greenhouse management, equipping our team with the technical expertise needed to propagate and maintain epiphytes effectively.

Construction of the greenhouse is currently underway, with operations expected to commence in the coming months. Once fully operational, this facility will play a pivotal role in scaling up restoration efforts, accelerating the recovery of epiphyte communities, and enhancing the habitat quality for *A. campbelli.*