

Cloud Forest Living Lab

Annual Report

26/27

Subtropical Cacique pollinating poroton flowers



Masked Trogon

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Letter from Founder

Moss robber frogs steal the silence with a bark-like vocalization.

This year brought moments of joy. The first baby tapir, decorated with its signature polka dots and stripes, was born on the reserve. A spotted juvenile puma was found wandering just below one of our reforestation test plots. **We finally lit up the Crystal Frog research center** with solar power and lighting beyond a few bulbs, including a chandelier crafted from hollow tree trunks.

With each passing year of research and recovery, I am increasingly optimistic **we can reverse extinction of cloud forests**, a delicate but hyper-diverse ecosystem. It's madness to think we can sustain the Amazon rain forest without figuring out how to restore Andean Amazon cloud forests. This is where much of the water originates and where wildlife endemism is outsized. So many species originate up here!

Nature and our onsite team surprised me with advances I never could have fathomed when we started. The results are both data-supported and sensorial.

As you peruse this annual report, try to imagine awaking to a concert of bird sounds, whose species count grew from 89 here in 2021, to 155 unique species today, many at risk of extinction such as the Andean Eagle.

Environmental education and community interaction is also a growing part of our work.

This year, we were approved educators in the local schools. An Ordinance passed by the local government declaring the entire area one of biological diversity that merits protection, supports our outreach.

We have grown from one initial test reforestation plot in 2021 to six in 2026, in addition to three parcels where we apply syntropic forestry - dense planting that mimics nature's complexity and abundance. Thousands of tree plantings later, our latest trials are showing that **mycorrhizal fungi and mycelium are key to dramatic cost reduction** in reforestation, facilitating sustainable reforestation at scale.

What was 150 acres under our mandate in 2012 – and even that was facing deforestation and invasions when we started– has grown to 1615 protected acres. The trees planted, all native and many with culinary or medicinal properties, are now accompanied by thousands of wild trees that have emerged as pasture grasses lose ground. **We are building a living lab for replication** along the cooler, upper Western border of the Amazon basin, the lungs of the Earth.

Every day I'm impressed with the initiatives of each of our team members, and of the collaborating researchers who put their heart and brain into their work. **A special thank you to those who continue to make charitable donations to support cloud forest recovery**. Please join me as we explore some highlights of this year's work and our plans into 2027.



Craig Daniel Leon
craig@cloudforestorganics.com

Mission

Our mission is to spark **reversal of Amazon cloud forest destruction**, charting a path for recovery.



Flame Faced Tanager



Felix, Anthony, Andrea, Henry, Craig and Alex in Experimental Plot 1



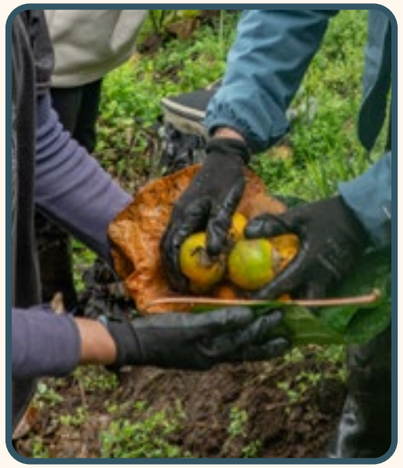
Sorting mushroom species in the onsite lab

Vision

The Cloud Forest Living Lab and onsite Crystal Frog Research Center are **developing ways to convert pastures back to forest while monitoring return of flora, fauna and pure water**.







Our Strategies

We experiment with reforestation methods with respect and scientific implementation of ancestral knowledge.

We collaborate with scientific researchers to find culinary, medicinal, and cosmetic applications of native tree, plant and fungi species to support local community income possibilities.

We engage students, researchers, and community to build out ideas generated on site, for replication at scale and with heart.

We document our advances, and communicate through film and scientific papers, so others can learn from, collaborate with, and improve on our work.

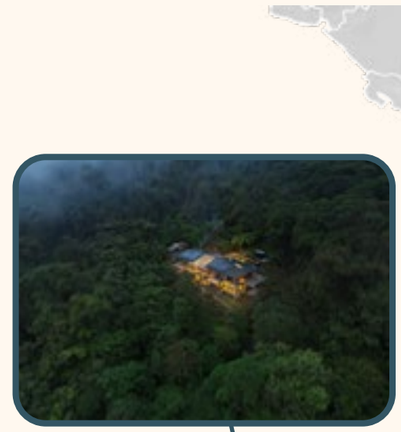
Where we Work

By protecting the Andean-Amazon cloud forests, we protect the entire Amazon basin.

Geologically in the Jurassic Period, with unusual wildlife and plant species that have survived or evolved over 150 million years despite two mass extinctions, our research reserve is only 90 minutes from the Quito airport in Ecuador, plus a two hour hike.

Cloud forests, once 12% of total global forest cover in the 1970s, **have dwindled to less than 2% today** and are on a crash course to extinction. Yet without protecting the cloud forests on the upper ridge of the Amazon, the basin below will likely dry up meanwhile wildlife will lose any chance of moving up to our cooler area.

We've created and continue to expand our protection zone, with a research facility designed to understand and restore this vital biome.



Ongoing Projects



Tony the Amazonian Coati

Artistic rendition by Laura Donoso



Orchids glistening in the humidity

Reforestation Continues

Five-year native tree growth rates have varied by species, averaging 14x growth from 6x among Arrayan and Logmillo species to over 24x in the case of Dragon's Blood, **which are already producing blood red sap known in indigenous cultures to cure ulcers and rejuvenate the skin.**

The tree mortality rate in our first two test plots (Plot 1 and Plot 2) is currently estimated at 30%. In Plot 2, a decline in the *Erythrina edulis* (porotón) population has been recorded. This reduction does not necessarily represent a definitive loss from the perspective of ecosystem regeneration, as the establishment, development, and growth of emerging native plants—which have begun to occupy spaces within the study plots—have been observed.

Any losses were easily compensated in the syntropic forestry parcels, where **wild relatives of the porotón trees planted show a 95% survival rate.**

Regeneration is not limited to the development and growth of the target tree species originally included in the planting matrix; rather, it also encompasses the spontaneous incorporation of native plant species that were not part of the initial design. The presence of these species reflects the area's natural regeneration dynamics and highlights the importance of considering both the planted species and the emerging vegetation when evaluating ecosystem recovery.



Dragon's Blood tree producing sap earlier than expected

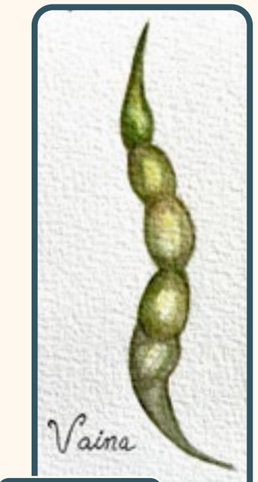
Height Growth Rate — Plot #2

Measurement period: July 23, 2021 – September 25, 2026

		Average seedling height (cm)				*Growth*
Species	***Local name***	***2021***	***2024***	***2025***	***2026***	***% over period***
Erythrina edulis	Porotón	19.00	127.00	146.30	164.34	764.95%
Pouteria sp.	Lucma	18.00	94.00	150.60	209.34	1,063.00%
Juglans neotropica	Nogal	23.00	253.00	301.80	345.19	1,400.83%
Hieronyma duquei	Motilón	42.00	238.00	336.10	420.70	901.67%
Cedrela sp.	Cedro rojo	25.00	315.00	452.60	532.48	2,029.92%
Croton lechleri	Sangre de drago	24.00	538.00	546.20	600.00	2,400.00%
Ceroxylon sp.	Palma de cera	29.00	135.00	175.40	216.93	648.03%
G. kunthiana	Logmillo	21.00	39.00	89.40	140.55	569.29%
Ocotea sp.	Aguacatillo	27.00	156.00	288.50	465.00	1,622.22%
Cedrela sp.	Cedro blanco	32.00	332.00	459.70	551.11	1,622.22%
N. membranacea	Canelo	22.00	86.00	189.20	371.33	1,587.86%
Plot average		**25.64**	**210.36**	**285.07**	**365.18**	**1,324.46%**



Poroton leaves



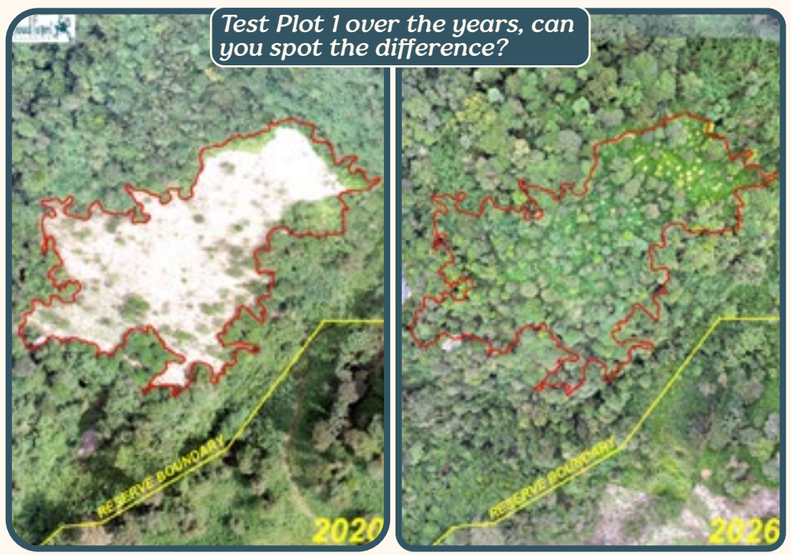
Poroton pod



Poroton flower



Poroton bean



Test Plot 1 over the years, can you spot the difference?



My, you've grown! Data collection with tape measure



That night glow of stored solar in the forest

Crystal Frog Research Center

Building the Crystal Frog Research Center without road access is thanks to the incredible ingenuity of our team.

Constructed out of recycled wood, from fallen trees, this center is a testament to aesthetic beauty and practical design. We decided not to put in windows, so birds, bats and even the clouds could run through the structure freely.

The biodigester, filled with microorganisms, processes the dark waters generated from the kitchen and bathrooms. We are currently installing a second biodigester. Water flows through filters from our own onsite spring, where gravity provides the water pressure and solar tubes heat the water.

Our onsite workshop is where we build everything, from the cabinets for the boots and ponchos, to the dining room table and shelves.

The showers have been constructed out of recycled fence posts, and the kitchen is ample for culinary experimentation and for good conversation around the table.

The floors are a mix of recycled wood and stone found on site. This year, we've taken measures to strengthen the contention walls and endemic functional edible plants around the center.

An internal garden serves to provide herbs to the kitchen. We've also planted some of the 8 wild passion fruit species in front. **The goal is a functional space for long-term research in harmony with nature.**

We finally have a working lab. We've been thrilled to host scientific researchers and neighboring groups, who find this space to feel like home in the forest.


To think this is recycled wood


Soup Time


Sleeping pods on the second floor


A bucolic way to freshen up



Getting ready for the day's work


We're the guinea pigs to Ceci's forest food


Turning every wood scrap into something useful

Crystal Frog Laboratory



Tiny discovery ready for DNA sequencing and biochemical analysis

One of the main objectives of the project is to **contribute to scientific knowledge of the flora and fauna** found on the Amazonian slope of the Andes. A review of the available literature has highlighted research gaps on the biodiversity of these ecosystems, underscoring the need to strengthen scientific knowledge and increase recognition of the ecological importance of cloud forests.

The Crystal Frog Research Laboratory has its own story, shaped by the research experiences and fieldwork that have taken place within the forest. As a researcher, I have developed and implemented various methods and tools to obtain reliable, well-documented samples for subsequent analysis in collaboration with the scientific institutions and laboratories with which we have established partnerships.

A rewarding aspect of this journey has been learning about the fungal kingdom from the ground up. Through hands-on experience, I have learned to locate, sample, document, and characterize fungi inhabiting the cloud forest. This work has become a fundamental component of our laboratory's research, particularly in the exploration and characterization of fungal species with potential edible and medicinal value.

Auricularia delicata.



Edible gelatinous mushroom

Calocera viscosa.



Terrestrial coral

Corynaea crassa.



Cloud Forest Viagra

Another distinctive aspect of our approach is **the Living Lab concept, which allows research to take place directly within the forest ecosystem**. As a team, we have the privilege of working alongside nature, observing ecological processes, collecting specimens, and gathering field data in the very environment we seek to understand and protect.

Ultimately, the development of the Crystal Frog Research Laboratory aims to **bridge field-based research with scientific collaboration,** generating knowledge about local biodiversity while supporting conservation, ecological restoration, and the exploration of the ecological and practical potential of native fungal species. The laboratory represents not only a space for scientific work, but also an evolving initiative built through direct experience, continuous learning, and a commitment to understanding the cloud forest through research conducted within the ecosystem itself.

Andrea Maldonado, Chemist



Transporting fungi host logs



Mushroom review at Chaco Technical School

Syntropic Forestry


Syntropic forestry test plot


One of nature's little helpers


Taking on the invasive grasses

This year, syntropic agroforestry expert Antonio Betancourt helped us to develop 3 subparcels within our reforestation sites, to accelerate natural regeneration processes and reduce the work cutting back pasture grasses by fostering faster takeover by native species.

That included planting thousands of poroton, tabaquillo and other species to build biomass while pruning back trees to create hormonal stimulus for the entire system. It's working!

This has reduced dependence on fossil fuels, as we switch from gas-fueled brushcutters to handheld sickles and machetes to control the pasture grasses. Branches and stakes of native trees have begun to sprout leaves, while the amount of bees and bugs and birds have multiplied, reducing need for human labor.


Emerging plant seeds disseminated in our test plots

Hydrology



Reforestation can improve water flow

Perhaps our most important research is how to increase water flow to the Amazon basin. The Andean Amazon constitutes only 13% of the entire Amazon basin, but **water generated here is critical to replenish the Amazon basin.**

It's also a source of nutrients and fish species that spawn in the higher altitudes and feed the communities below. **Reforestation improves water quality and flow.**


Monthly hydrological flow check

Field Cameras

Strategically placed field cameras help us to see how the wildlife is responding to our reforestation efforts. Animals at risk of extinction are propagating on the site and moving into our experimental reforestation plots. We trust that the animals know we are working on their behalf. Next year we hope to install cameras into the tree canopies. Now we've confirmed presence of the stump-tailed porcupine and two distinct deer species, the *Mazama rufina* and *Mazama americana complex*, bringing our total mammal species count to 47 so far.



White spectacled bear



Andean eagle nesting



Woolly (Andean) Tapir



Puma

Amphibians and Reptiles

We have currently recorded a total of 29 amphibian and reptile species, while others may either be the same species with different phenotypes or different species altogether. Of these, eight are endemic to Ecuador. The amphibians include *Pristimantis acerus*, *P. bicantus*, *P. gladiator*, *and P. omarrhynchus*, while the reptiles include the snakes *Dipsas klebbai* and *Siphlophis ayauma*, and the lizards *Anolis orcesi and Riama anatoloros*.

The area is home to eight species globally recognized as threatened with extinction. Three are classified as Endangered (EN): the glass frog *Nymphargus siren* and the terrestrial frogs *Pristimantis acerus and P. leucopus*. Another five are classified as Vulnerable (VU): the toad *Osornophryne guacamayo*, the terrestrial frogs *Pristimantis bicantus*, *P. eriphus*, *and P. gladiator*, and the lizard *Riama anatoloros*.



Pristimantis bicantus



Dipsas klebbai



A crystal (or glass) frog
Nymphargus posadae



Juan C. showing pictures from the day

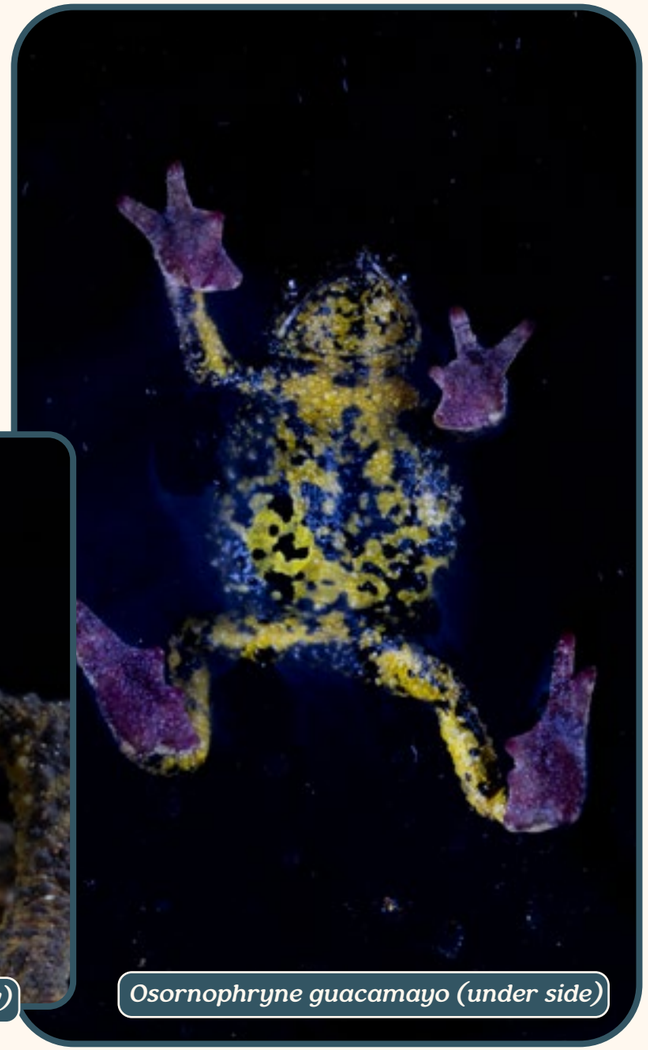
Despite these significant levels of endemism and the presence of threatened species, **the area also harbors species whose taxonomic identity remains unresolved.** These include a frog in the genus *Hyloxalus*, *caecilians* in the genera *Amazops and Caecilia*, and a snake in the genus *Clelia*. Other species, such as the terrestrial frog *Pristimantis omarrhynchus* and the snake *Dipsas klebbai*, still require formal conservation assessments. The lack of conclusive information on the taxonomic identity and conservation status of some of these species means that the known diversity may increase as research progresses. Future assessments may also reveal that a greater number of endemic or threatened species have at least part of their populations protected within Cloud Forest Organics (CFO).

There is still much to learn about the amphibian and reptile fauna of CFO, but we hope to share some exciting discoveries in the not-too-distant future.

Juan C. Sanchez Nivicela, Herpetologist



Eastern Lightbulb Lizard



Osornophryne guacamayo (under side)



Osornophryne guacamayo (front view)

Descendants of Dinosaurs

The diversity and richness of birdlife in the Amazonian cloud forest of the Cloud Forest Organics reserve are remarkable for its size, and our ornithological analyses indicate that there are still more species yet to be recorded. This suggests that the area remains connected to significant tracts of forest within Cayambe-Coca National Park, despite existing threats.

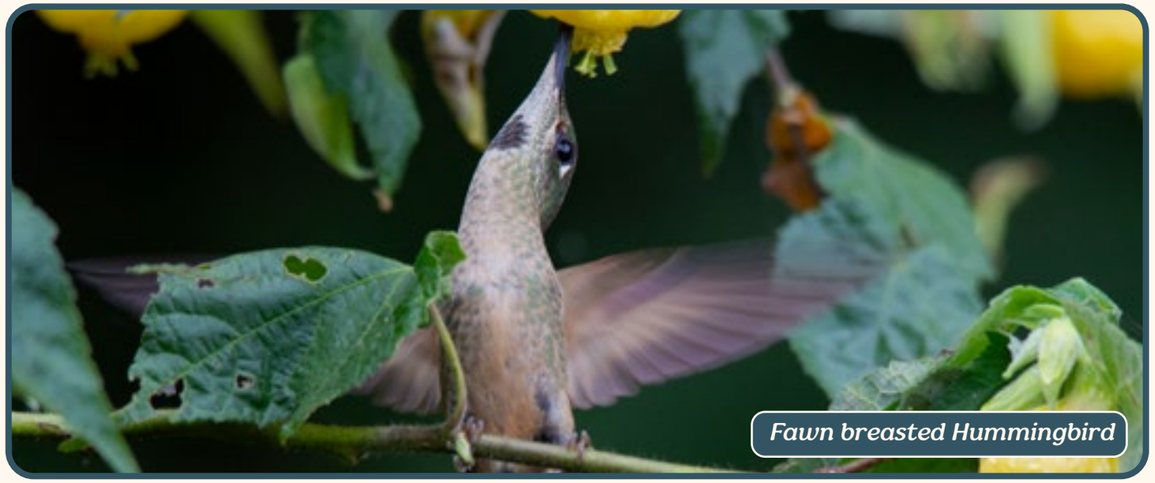


White faced Nunbird

Between 2021 and 2026, through rapid surveys supported by acoustic monitoring, the number of recorded species rose to 155, with figures fluctuating according to the month and the rainy season. In October 2026—over the course of just five nights and four mornings—approximately 25 additional species were documented compared to 2021; however, some species recorded



Cock of the Rock



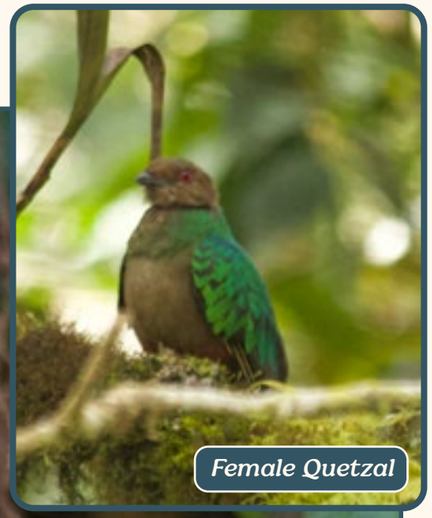
Fawn breasted Hummingbird

in 2021 were not detected. Future monitoring, conducted at different times of the year, will help determine whether birds that were absent in October 2026—but present in February and August 2021—are still in the area or will return to the reserve. This could be due to factors such as their status as boreal migrants, food availability, breeding cycles, or the possibility that remaining silent is part of their survival strategy.

Manuel Sanchez, Ornithologist



Manuel setting up



Female Quetzal

Andean Motmot

GPS mapping of recording locations



Wild naranjilla fruit

Jurassic Ingredients

Novel ingredients unknown or forgotten, can be preserved, replanted, and part of our world if we let the highest reaches of the Amazon basin thrive.

The hope is to rethink "*bioeconomy*" by putting nature first, while providing new livelihood opportunities to communities. This requires longer-term culinary, medicinal and cosmetic experimentation with native plants.

One of our commercial allies, Delizium, makes gelato from our wild logma and naranjilla. Wageningen University in Holland continues to test *Erythrina edulis* seeds to tackle hospital borne microbial diseases. Ceci, our team cook, makes pizza from ferns, salad from "*cow's tongue plant*" and wild watercress, and tea from *zunfillo*, a wild mint.



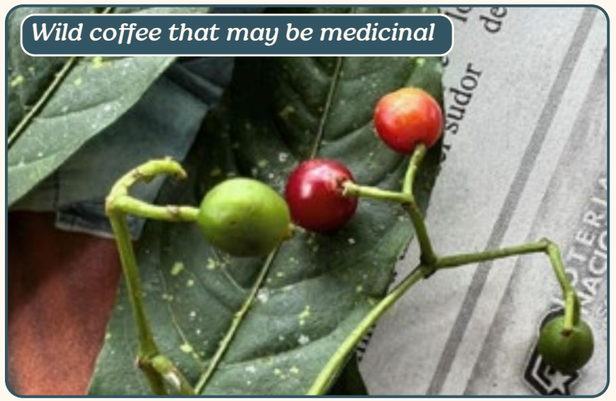
"Cardo espinoso" combats baldness?

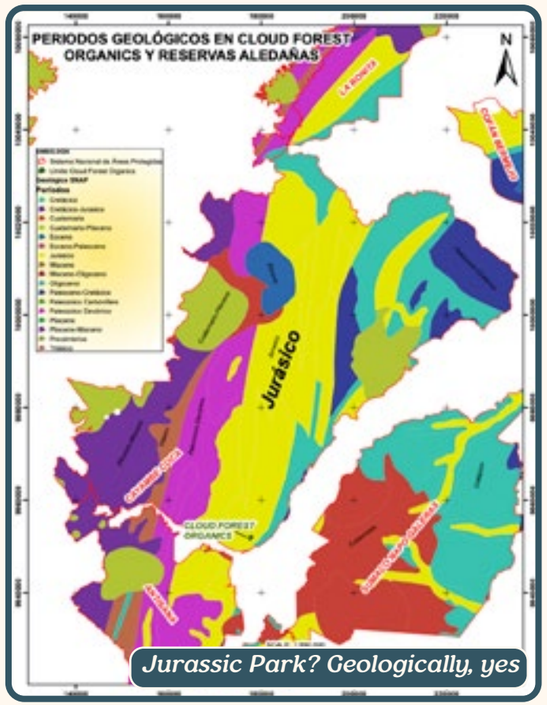


Edible Fern hearts

Many plants and fungi in the Amazon cloud forest survived two extinctions, including the polar caps melting 150 million years ago.

With scientific accessibility, we can conduct biochemical analyses and DNA sequencing to understand their properties and support human health.


Wild coffee that may be medicinal



Jurassic Park? Geologically, yes



Vegan gelato by Valerio – Delizium


Extracting oil from nearly extinct nuts

Academic Collaboration


IDGen Genetics Lab


Prepping petri dishes for mushroom innoculation


At the UDLA Research Lab

Universities

Universidad de Las Américas
Pontificia Universidad Católica del Ecuador
Universidad Yachay Tech
Wageningen University & Research
USFQ Universidad San Francisco de Quito
Northeastern University

Research

GRUNtec Environmental Services
Goetheanum Agriculture
Revista Latinoamericana de Herpetología
UTE EC
Crows Feat Farm
Nature Scientific Reports
Multianalityca S.A.
INIAP
Agrocalidad
IDGen Biología Molecular

Community



Our network of allies keeps growing every year

Weaving a Network

Our academic program on cloud forest recovery and the secret world of mushrooms has been received by local students with great enthusiasm. One student lit up the the vials of mushrooms with his cellphone, recalling similar gelatinous species on the family farm, which his grandma would cook.

We've formed a dynamic network among ecologically-minded land holders converting pasture back to forest. We'll take DNA samples from other reforestation sites to confirm if species are the same.

We'll strategize on ways to control pasture grasses. We'll share seedlings and plants with indigenous villages at lower altitudes to compare growth results.

Having local and international students on site has been a great way to provide youth with a way to learn about this ecosystem. They've helped with everything from building the mushroom nursery to planting poroton trees, gaining real life experience on what conservation really is about.



CINE ECUATORIANO INSPIRA CONCIENCIA MEDIOAMBIENTAL

"Ecuadorian Films Inspire Environmental Awareness"



Interns Maria Emilia from Tena and Emmett from U. Syracuse



Andrea teaching about mushrooms at local school



Q&A after a film screening in El Salvador

Cloud Forest on Tour

We're getting the word out. Our talk on **Endemic Species Agroforestry** at the Royal Agricultural University's biodynamic agriculture conference in the UK has broadened our circle of university collaboration in Europe.

Our award-winning documentaries **Crystal Frog** and **Dipsas Speaks** have screened in 18 countries, and are part of school programs. Meeting with business leaders, environmental changemakers, students and civil society in diverse settings from the Chaco Technical College and the French Alliance to Harvard Business School, is helping us understand how to put Amazon cloud forests on the map and generate more local and international involvement.



Fielding questions at Harvard B School





Keynote and screening at Alliance Française

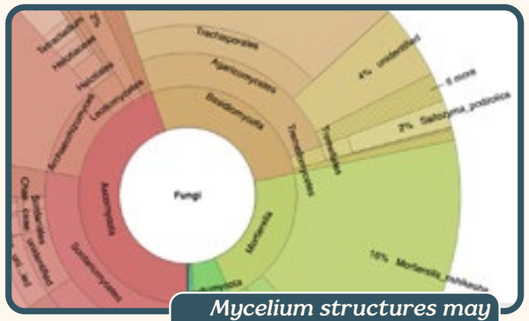
Recent Talks

Harvard Business School · Royal Agricultural University · Goetheanum Agriculture · Alliance Française San Salvador · Unidad Educativa El Chaco

See you in Switzerland!

We have been invited to host a 3-day workshop at an Agricultural Conference in Switzerland entitled "***Working with the Intelligence of Life***". Our topic, **Arboreal Intelligence in the Amazon Cloud Forest**, will address the following question: **Are mycorrhizal networks, when gravitational curves are created, able to provide enough nourishment to young native tree species to eliminate the need for potting soil?** This could dramatically reduce manual labor involved in reforesting, while providing insights into the nature of Nature.





Mycelium structures may prove forest consciousness

Jury at SunChild Environmental Film Festival

Our documentary Crystal Frog was finalist for the John Burton Conservation Award at SunChild last year, an Armenian film festival dedicated to biodiversity conservation, focusing on the protection of species, habitats, ecosystems, and the intricate relationships that sustain life on Earth. This year, Craig was invited as Jury member.

SunChild 14th International Environmental Festival

Check out our films!

Dipsas Speaks (2022)
A film by Craig Leon



Crystal Frog (2025)
A film by Damian Sanchez



2027+

Long term biodiversity monitoring, and study of cloud forest recovery systems are critical if we are **to achieve our goal of reversing extinction of Andean Amazon cloud forests.**

With Ecuador elected to host the 2028 UN Biodiversity Summit, we see this as an opportunity to show how this ecosystem, 90% deforested since the 1970s, can come back to life.

As we plan our next steps, there are some immediate actions we hope to take.

· Trail safety and signage – The landscape is volatile, and mountain shifts require constant **upkeep and improvements in our trails,** both to the site and between reforestation plots. Improved signage and trails supports the educational experience **as scientific and academic researchers come to the Crystal Frog Research Center** and help us understand what is driving the changes in each of the experimental reforestation test plots.

· Bat survey – **Bats are a barometer of forest recovery**, and they co-evolve with botanicals. We need to update our 2025 survey in which 24 unique species, all fruit, insect and nectar eating (no carnivores yet) were confirmed on site.

· Orchid ID – Cloud forests are known for orchid diversity, and many are still unidentified in the Western Amazon. Several of the 53 identified so far on our reserve could be new to science, and academic research is required to confirm.

· Entomological survey – **The world of insects, spiders, and invertebrates is mindboggling**. This is an area we yearn to explore scientifically.













· Canopy wildlife trials – **How have tree-dwelling mammals and amphibians been impacted by conversion of pasture to forest?** We look forward to collaborating with tree-climbers to place field cameras high into the canopy and find out.

· Mushroom greenhouse – We hope to complete our mushroom greenhouse in 2027, to replicate the most promising of the 123 unique species we've found on the reserve.



Please join us in our quest to assure that methods to recover cloud forests are developed, scientifically studied and shared for replication. The Amazon needs these upper, cooler areas to survive, as do all the wildlife that inhabit them.

Follow us on social media and visit our webpage for more information

cloudforestorganics.com **@cloudforestorganics**

How you can Help



DONATE LINK

To support our work, please scan this QR to make an online donation.

Check Information
Jocotoco Conservation Foundation
Att: Cloud Forest Restoration
P.O. Box 496, Garrett Park, MD 20896
Please write Cloud Forest Restoration on lower left of check.
You will receive a tax-deduction letter from the Jocotoco Conservation Foundation, a 501(c) 3 non-profit.
EIN: 83-2027203

Thank you for your continued support of the Amazon Cloud Forest