



CONSERVING BIODIVERSITY WITH BAMBOO

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Bamboo and Rattan Update

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Cover Image

The enchanting *Roridomyces phyllostachydis* at night, found adorning bamboo stems near a stream in Meghalaya, Northeast India. Credit: Stephen Axford.

Editorial Team

Hao Ying

Austin Smith

Leticia Robles

Contributors

Peter Mortimer

Dhanushka N. Wanasinghe

Tamara L. Britton

Ian C. Colquhoun

Lucy Binfield

To Submit

www.inbar.int/bru-magazine/

bru-magazine@inbar.int

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About INBAR

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Regional Offices: Central Africa, East Africa, West Africa, Latin America and the Caribbean, South Asia.

BRU

EDITORIAL

Welcome to the third issue of the Bamboo and Rattan Update for 2023, which places the contributions of bamboo to promoting biodiversity at the center of the conversation.

Established in 1993, the Convention on Biological Diversity (CBD) is an international legal instrument for “the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.” With a broad mandate, the CBD acts as the primary global vehicle for safeguarding biodiversity.

Near the end of the 20th century, the world started waking up to the impact of human activities on the planet. In 1988, the United Nations Environment Programme convened the Ad Hoc Working Group of Experts on Biological Diversity to explore the feasibility of a convention on biological diversity. After working for several years to devise a framework for meaningful global action, the text of the Convention was finalized and opened for signatures on 5 June 1992 before entering into force on 29 December 1993.

As an Observer to the CBD, INBAR advocates for bamboo and rattan as nature-based solutions to conserving biodiversity. Bamboo and rattan are important sources of food for a number of endangered wildlife species, including giant and red pandas, mountain gorillas, apes, Indian elephants, South American spectacled bears and bamboo lemurs. Bamboo also acts as shelter for a wide range of other flora and fauna: The ploughshare tortoise in Madagascar and the South American bamboo rat both reside in bamboo thickets. Even mushrooms that glow in the dark have recently been found to be growing in mutualistic symbiosis with bamboo culms.

Bamboo also has an important role to play in strengthening sustainable development and diversifying genetic resources. It is a renewable resource that is harvestable annually without the need to re-plant, and it has already been made into over 10,000 durable low-carbon products. Absorbing more carbon than some tree species, it can also bolster climate change mitigation efforts as an effective carbon sink. Emissions-heavy materials like plastic, concrete and steel can even be replaced by bamboo, helping to green different sectors of industry while generating jobs. Different bamboo species can also be integrated into agroforestry systems and other integrated tree-crop-livestock models, putting cash in the pockets of rural smallholders.

Bamboo is home to some organisms that might push the limits of our imagination. The first feature article of BRU 4-3 introduces a kingdom of creatures seldom considered in bamboo discussions

– Fungi. Many different types of fungi exist across the world, some beneficial and some harmful to their hosts. The authors of this article estimate that there are approximately 9000 species of bamboo fungi, most of which still remain unknown. Recently, two enchanting new fungi types that grow in partnership with bamboo have been discovered in China and India with the remarkable ability to glow, shining a light on a small piece of that 9000-species-large mystery. The authors go on to argue that fungi deserve more attention in sustainability conversations to unlock their ecological and economic potential, and to shed light on a subject about which we still remain in the dark.



For some endangered species like the Ecuadorian mantled howler monkey and white-fronted capuchin, bamboo is their last available natural shelter. In an area ravaged by deforestation, endangered primates reside in one of Ecuador’s most treasured natural landscapes that is also a biodiversity hotspot: The Pacoche Coastal and Marine Wildlife Refuge. The author of the second article examines the ways in which local ecological knowledge on bamboo harvesting and policies in protected areas intersect with primate behaviors. Communities in the area still use bamboo and engage in sustainable small-scale harvesting. The unique situation provides an example of a beneficial coexistent relationship between people and primates inhabiting a threatened ecosystem.



The third article in this issue takes a close look at native bamboo species that grow across the Amazon and their surprising diversity. Highlighting the integral role bamboo plays in ensuring vibrant ecosystems in the region, the author also points out the array of specialized biodiversity that dwell in bamboo habitats. Bamboo can also help local communities in the area transition to the green economy, reducing the need to rely upon larger tree species in the area. Furthermore, its environmental benefits cannot be understated, as bamboo facilitates the natural recovery of severely degraded land where few other plants grow. A significant gap remains in understanding Amazonian bamboo compared to their Asian counterparts, though, which is in urgent need of being addressed.



The CBD works in tandem with the UN Framework Convention on Climate Change and the UN Convention to Combat Desertification, which were both covered in earlier issues of this year’s BRU. The three sister conventions are collectively known as the “three Rio conventions,” as they were ratified together at the “Rio Earth Summit” in 1992. Synergistic in nature, they provide the foundation for humanity to work together to overcome transboundary environmental problems. We hope you enjoy learning about the ways in which bamboo is intertwined with the planet’s stunning array of biodiversity and its power for addressing environmental challenges.



THE EDITORS

FASCINATING FUNGI: SHINING A LIGHT ON BAMBOO ECOSYSTEMS



The enchanting *Roridomyces phyllostachydis* at night, found adorning bamboo stems near a stream in Meghalaya, Northeast India. Credit: Stephen Axford.

The often-overlooked organism has big implications for diversity in nature.

Fungi are ever-present in the world around us, from the scorched lips of volcanic craters to the crushing depths of the ocean floor. Truly unique organisms in our world, fungi have their own phylogenetic kingdom distinguishing them from plants and animals. They even have more DNA in common with humans than plants.

Bamboo are also no stranger to the resilient organism. Fungi that grow on different parts of bamboo, including leaves, culms, branches, sheathes, flowers, rhizomes and roots are referred to as “bamusicolous fungi.” With so many species of bamboo growing across the globe, a diverse range of bamusicolous fungi have evolved to fit

specific bamboo species, with properties that can be harmful or beneficial to the bamboo plant.

Pathogenic bamusicolous species can cause harm to the bamboo on which they grow. This category of fungi poses a significant threat to bamboo plants, leading to diseases that can lead to reduced growth, yield and even death. Some devastating bamboo pathogens include *Stereostromum corticioides*, *Ceratospaeria phyllostachydis*, *Aciculosporium take* and *Arthrinium phaeospermum*. These pathogens cause problems like culm rust, top blight, witches’ broom and base rot in bamboo. Some of their impact can be severe, affecting both bamboo plantations and natural bamboo forests with profound consequences. For instance, between 1988 and 1990 in China, the top blight on *Phyllostachys edulis*, commonly known as “moso” bamboo, killed off nearly 200,000 bamboo.

On the other hand, beneficial bambusicolous species form mutualistic associations with bamboo plants, providing a diverse range of benefits. For example, one type of beneficial fungi known as “arbuscular mycorrhizal” fungi forms symbiotic relationships with bamboo roots, building structures in the soil that act like highways for transporting nutrients across ecosystems. This interaction enhances growth and overall plant health, while also boosting their adaptive capacity to different environmental conditions. As part of the agreement, the fungi benefit from essential nutrients provided by the bamboo plant in exchange. Furthermore, using these underground fungal highways, older or healthier bamboo plants support the rest of the bamboo community by feeding seedlings or weaker plants, alerting them to pests, herbivores or pathogens, and sharing their own nutrients with nearby plants. Another group of beneficial fungi that grow inside bamboo are called the “endophytes.” These have the capability to enhance the growth and nutrient acquisition of host plants while increasing their tolerance to environmental stressors. At present, this relationship is not well understood, but it is expected to be a rich topic for future research.

Cornucopia of fungi

The distinct and many roles of bambusicolous fungi highlight their importance in maintaining the ecological balance within bamboo ecosystems. The diversity of fungi associated with bamboo is extensive, encompassing a staggering range of taxonomic groups. Two prominent groups commonly found in bamboo ecosystems are Ascomycota and Basidiomycota. Within these groups, numerous species have been identified, highlighting the intricate relationship between fungi and bamboo. Among the Ascomycota, several genera – smaller categories of fungi with similar characteristics – continually appear as entering into a symbiotic pact with bamboo. *Phyllachora*, *Apiospora* and *Rosellinia* are notable examples. In the Basidiomycota group, *Puccinia*, *Ustilago* and *Uredo* are among the genera most commonly associated with bamboo. These groupings help scientists categorize different fungal species by shared attributes and build knowledge trees on the organisms that dwell in

our world – even the ones that elude our eyes.

The exact number of bambusicolous fungi worldwide remains unknown. However, researchers who work with fungi generally assume that fungi outnumber plants by at least six to one. Based on the authors’ estimations, this suggests that the true number of bambusicolous fungi is closer to 9000. It is therefore quite likely that the majority of fungi associated with bamboo remain a mystery to this day. Previous research has revealed that the culm of bamboo harbors the highest number of known bambusicolous fungi species, accounting for around 50% of the cataloged species, followed by the leaves of bamboo plants, accounting for approximately 30%. Notably, studies from Asia have reported almost 500 species of bamboo endophytes, with over 33% of these species found in Japan alone. In the last 20 years, there have been several landmark studies that have greatly increased the species count of fungi that grow with bamboo. All this is to say, if the scientific community devotes more time and resources to investigating bambusicolous fungi, it is extremely likely that many new species, with potentially beneficial applications, will be found.

Bamboo and bioluminescent fungi

So, what might some of these applications be? Some fungi that inhabit bamboo possess the ability to glow – what scientists call “bioluminescence.” This captivating phenomenon, where these fungi emit a notable glow in the dark, has fascinated researchers and nature enthusiasts alike. Though the exact purpose for this ability to glow remains uncertain, several ideas have been proposed, such as helping attract insects who can spread the fungal spores, helping give rise to the next generation of fungi, and also potentially for deterring predators who may be frightened by the bright light. These glowing fungi are typically found on decaying bamboo culms, suggesting a close association between the decomposition process and the fungal bioluminescence. Most recently, two new bambusicolous bioluminescent fungi have been discovered: *Favolaschia xtbgensis* from Southwest China (Yunnan) and *Roridomyces phyllostachydis* from Northeast India (Meghalaya).



The fruit bodies of *Favolaschia xtbgensis* observed on a dead stem of *Bambusa polymorpha* in Xishuangbanna Tropical Botanical Garden. This photo is the mushroom captured under flashlight illumination. Credit: Thilina Nimalrathna.

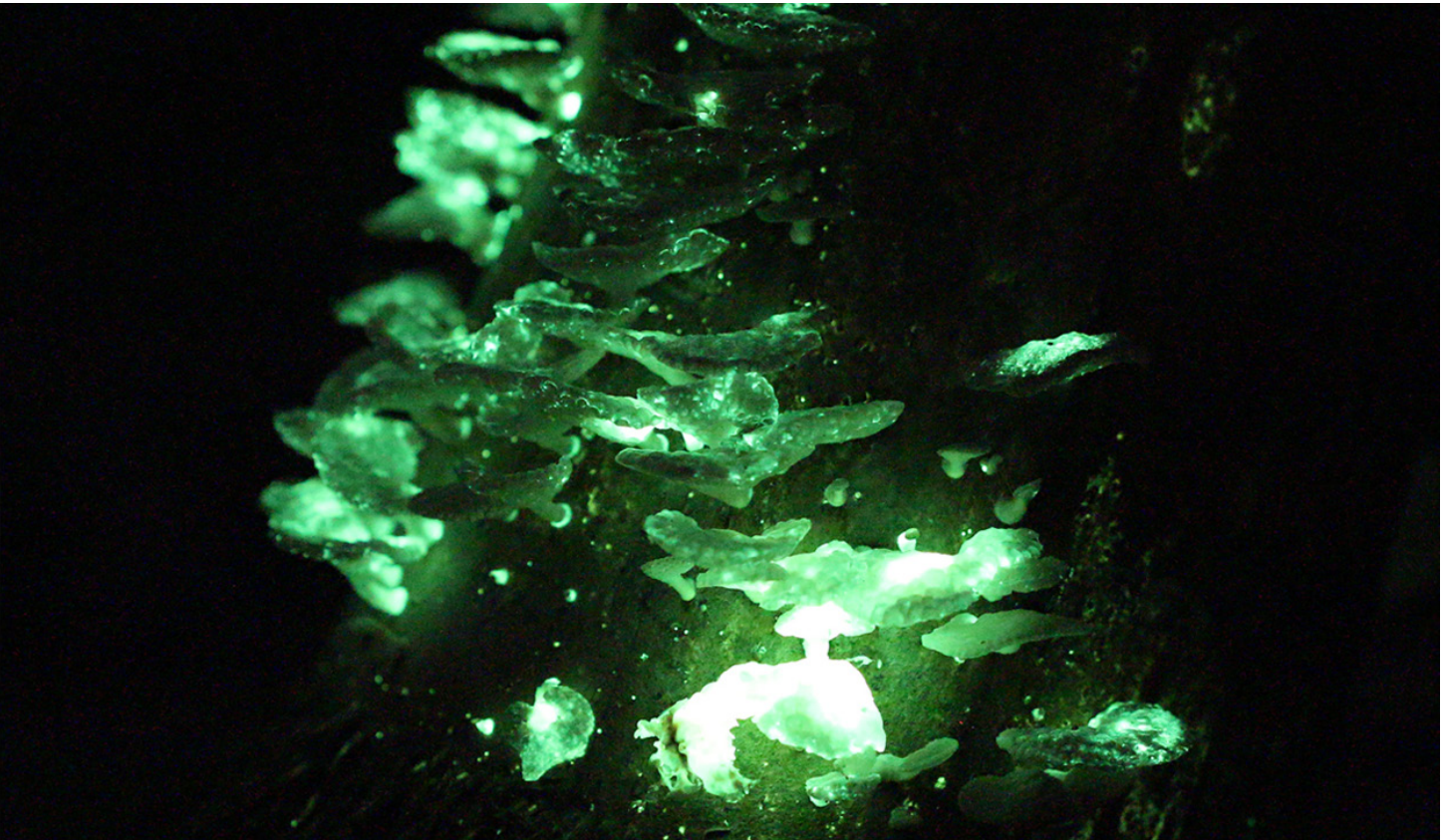
Where bamboo fungi live

Bamboo and fungi grow together in many different places, thriving in bamboo ecosystems around the world. The specific species of bamboo and their geographical locations play a crucial role in shaping the composition and diversity of fungal communities. In tropical regions home to flourishing bamboo forests, there tends to be a higher diversity of fungi compared to temperate bamboo forests. Richer fungal diversity in tropical regions results in quicker decomposition of plant material. In these lush and humid environments, the abundance of fungal species actively contributes to the breakdown of organic matter. The age and health of bamboo stands also influence the fungal diversity within a given ecosystem. Older bamboo forests tend to harbor a more diverse fungal community compared to younger stands. This is likely due to the accumulation of different fungal species over time and the establishment of complex ecological interactions within the landscape. There has been a high degree of attention given to Asia,

in particular, regarding bambusicolous fungi, but our understanding of the fungi in other parts of the world remains much more confined. This is why Asia, with its diverse bamboo species, hosts the majority of reported bambusicolous fungi. A number of bamboo genera in the region such as *Arundinaria*, *Bambusa*, *Dendrocalamus*, *Phyllostachys* and *Sasa* prominently associate with a wide range of fungal species.

Why bamboo fungi matter

The ecological and economic significance of bamboo-associated fungi cannot be overstated, as they play a vital role in maintaining the health and function of bamboo ecosystems. These fungi facilitate the absorption of essential nutrients such as phosphorus and nitrogen from the soil, ultimately promoting the growth and vitality of bamboo stands. Some beneficial fungi also contribute to soil fertility by increasing nutrient availability and improving the soil structure, benefitting the entire ecosystem.



The same photo but taken in complete darkness, highlighting the fascinating bioluminescence. Credit: Thilina Nimalrathna.

In addition to their ecological importance, bamboo-associated fungi also have economic significance. Certain fungal species produce valuable metabolites which may have remarkable applications in industry. The fungus *Shiraia bambusicola*, for instance, is of medical importance due to its production of hypocrellin. Hypocrellin has shown potential in photodynamic therapy as a treatment for cancer. Many similar examples exist from other species. There is thus massive potential for bamboo-associated fungi to contribute to the development of novel pharmaceuticals and therapeutic agents. Potential applications for bamboo fungi could span various sectors, including agriculture, where they could improve the structure of and clear pollutants from soils, along with utilizing their enzyme production for pharmaceutical, bioenergy and industry applications.

The ecological and economic value of bamboo fungi underscore the importance of bettering

our knowledge base around these remarkable organisms and actively working to conserve them. Research and conservation both go hand-in-hand with unlocking their full potential for ecological sustainability and economic development. Encouraging more research on the topic will not only boost the sustainable management of bamboo species but also open new avenues for innovation and discovery.

PETER MORTIMER & DHANUSHKA N. WANASINGHE

Peter is a professor at the Kunming Institute of Botany, Chinese Academy of Sciences, where he runs the Soil Biology Group. Dhanu is a postdoctoral researcher at the same institute, with a research focus on microfungal systematics and biogeography.

BRIDGING THE GAP BETWEEN PEOPLE & PRIMATES



The Pacoche Coastal and Marine Wildlife Refuge is one of the last remaining homes for some endangered primates of Ecuador. Credit: Santiago Mendieta.

PhD Candidate Tamara Britton searches for coexistence exploring the shared value of *Guadua* bamboo for people and endangered primates in coastal Ecuador.

“Snap, pop, crack, creak, the sky-high bamboo culms rub together and sway in the wind overhead as I stand ankle deep in the mud on the forest floor, staring up at these towering giants scanning the canopy for brown blobs in the foliage. On the edge of a forest clearing, I spot an adult male howler monkey

traveling hand over hand between bamboo culms, pulling them towards himself as he glides gracefully, lowering himself down on the next culm – like an elevator. I watch him in awe with a kink in the back of my neck, nearly 30 meters overhead navigating across a gap in the forest canopy with such ease.”

Primates and bamboo

With over 1600 species of bamboo worldwide, the multi-dimensional structure of bamboo groves delivers critical ecosystem functions for a range of species, including our closest living relatives – primates.

Among Neotropical primates, only the Goeldi's monkey (*Callimico goeldii*) is considered a “bamboo habitat specialist.” However, few studies have analyzed the ecological importance of bamboo-dominated forests in the behavioral ecologies of New World monkeys.

Few habitats remain for Ecuador's coastal primates

In coastal Ecuador, over 90% of forest coverage has been lost since the 1990s due to intensive cattle ranching, industrial agriculture and aquaculture activities. The landscape now appears as a series of isolated forest patches and narrow corridors running alongside ravine edges. Here, it is estimated that only 1% of the original forest habitat remains for arboreal species like primates.

The Pacoche Coastal and Marine Wildlife Refuge in the province of Manabí is one of the few nationally protected areas in Ecuador's coastal region. It is a mosaic landscape that consists of 5049 hectares of dry savannah forest, humid tropical forest (with *Guadua angustifolia* ‘Kunth’ – bamboo) and agroforestry plots of coffee, cocoa, sugarcane, toquilla straw and citrus fruits. Due to its altitude and location between two currents – the Humboldt and El Niño – the Pacoche forest has a unique microclimate and is considered a biodiversity hotspot. It is also home to two primate species on the IUCN Red List: The Endangered Ecuadorian mantled howler monkey (*Alouatta palliata aequatorialis*), and the critically endangered Ecuadorian white-fronted capuchin (*Cebus aequatorialis*) which is considered one of the 25 most endangered primates in the world.

Guadua bamboo is fast-growing and self-propagating; thus, it serves a wide range of ecosystem functions in the protected area including providing usable habitats, erosion control, biomass production and water regulation. But it also fulfills valuable socio-economic functions for local communities. As an anthropologist, Tamara Britton is interested in how local ecological knowledge surrounding sustainable bamboo harvesting and policies in the protected area is impacting primate behavior. The overarching aim of her research is to examine how species (human and non-human) are adapting

to an ever-changing environment in mutually beneficial ways.

Bamboo as a vital component of cultural heritage and the subsistence economy

Guadua bamboo is a common building material for many across Manabí because of its large circumference, flexibility and strength. In Pacoche, it is a staple component of the subsistence economy, providing a “free resource” that is harvested by smallholders to meet a wide range of infrastructure needs.

Many people in coastal Ecuador continue to live in traditional bamboo homes. However, because of its commonplace nature, bamboo has acquired the label “poor man's timber.” Participants who continue to live in these traditional abodes claim they feel a deep ancestral connection to this resource. Historically, it is said that the entire nearby port city of Manta was originally built from *Guadua* bamboo harvested in the hills of Pacoche. In recent years (since the 2016 earthquake), there has been a revitalization of the use of this material to build seismically resistant infrastructure such as hotels, restaurants and eco-friendly homes.

Local practices support conservation principles

The most recent park management plan indicates little concern over small-scale bamboo harvesting by local people. Interviews with park rangers suggest that the current problem facing the region is outsiders with large trucks clear-cutting bamboo to sell it illegally. While the extraction of bamboo continues to be a business for some, it was more commonly a secondary source of income prior to establishment of the protected area.

Through accompanying farmers in the forest, Britton and the team learned that local smallholders engage in subsistence extraction of bamboo using low-impact practices. Following a sustainable strategy that supports biodiversity conservation, they extract mature culms cyclically aligned with lunar/tidal calendars.

Smallholders describe how regular maintenance of the undergrowth around the rhizomes helps to avoid root rot in humid environments like

Pacoche, and these harvesting processes also prune the overall bamboo grove and encourage the growth of new culms. As the eyes and ears of the forest, smallholders regularly report evidence of outsiders' unsustainable harvesting to community leaders. During a community-based workshop, participants also shared a fear of losing these cultural practices over time, as the younger generations are disinterested in carrying on these labor-intensive traditions. In response, a bamboo infographic was created collaboratively to illustrate this knowledge as cultural heritage and disseminated across the wider community (see page 12).

Bamboo forests provide critical habitats for endangered primates

Historically, the human use of bamboo, combined with slash-and-burn agriculture, created open spaces in the canopy where bamboo later invaded – repopulating forest gaps and forming habitat corridors that have become crucial to the survival of endangered primates in Pacoche.

Bamboo habitats provide a valuable substrate for howler monkeys to travel between feeding and resting trees. Howlers frequently utilize the flexibility of bamboo culms to travel across forest gaps for more secure passage. In particular, adult males, females with offspring, and older females exhibit this behavior, while agile juveniles often prefer to leap. Individuals use their weight to bend the bamboo and then pull or drop themselves on the next substrate, using their prehensile tails as support. Howlers also use culms as substrates while feeding on nearby foliage in areas with lower canopy coverage or interior bamboo-dense forest.

Adult howler males are commonly found resting alone along the top 2–3 meters of the culm. It is estimated that this substrate choice could act as a strategic lookout point for spatial navigation, given the superior height (up to 25–30 meters) of these mature culms, which tower above much of the surrounding vegetation. Vocalization behavior by adult males also favors bamboo, again often taking place near the top of the culm. Overall, howler monkeys show a clear preference for mature bamboo, likely due to its superior

structural integrity, flexibility and developed branch composition.

“I headed back to camp and there they were in my path – capuchins in the bamboo in front of me 15 meters away. I crouched down and gripped my bamboo walking stick tightly as I took deep breaths and accepted that if they wanted to, they could rip my face off.

I watched as two grayish juveniles passed overhead on a horizontal bamboo ‘bridgeway.’ One had a tagua nut in hand and was smashing it against the culm to make noise, likely to try and intimidate me. After 10 minutes, slowly, one by one, they disappeared into the mixed bamboo vegetation; one juvenile male continued to bark at me as we both backed away from each other.”

Capuchins in Pacoche also show a preference for bamboo-dense habitats. They travel along bamboo corridors that frequently coincide with deep ravines, tapping on bamboo culms as part of an extractive foraging behavior known as “tap-scanning.” Tap-scanning functions to gather acoustic information on the whereabouts of insects and frogs embedded in woody substrates by using fingertips or tools such as rocks or nuts to tap on the culm wall and listen if there is something inside worth breaking it open to eat. Additionally, when capuchins leave the shelter of the bamboo grove to forage on a nearby fruit tree, they promptly return to the safety of the bamboo. Britton hypothesizes that they frequent this forest type as a predator-avoidance strategy because animals such as ocelots and harpy eagles would be less agile in this dense, thorny vegetation.

This behavioral pattern is also significant because smallholders report cutting the bamboo back from around their orange trees as a strategy to protect their yield. By removing direct access, the probability that they were targeted was significantly reduced. Solutions like this help to avoid violent altercations between farmers and capuchins who share space in these agroforestry environments on the margins of human settlements and forest land.



Endangered primates of Pacoche and anthropologist Tamara Britton. Credit: Santiago Mendieta.

Coexistence is possible between people and primates

Stories like these in Pacoche highlight the ecological importance of *Guadua* bamboo in connecting forest canopy and providing shelter in areas with few large crown trees or sparse canopy coverage. They also help to illustrate how human modifications to forest ecosystem structure can beneficially impact primate ecologies.

While the development of a bamboo supply chain through Ecuador's National Bamboo Strategy raises questions about pressures on the country's remaining forests, the Pacoche forest provides an example of how sustainable small-scale harvesting practices can lead to coexistent relationships between people and primates inhabiting endangered ecosystems, and the importance of passing this knowledge down to younger generations.

In regions of coastal Ecuador with high rates of forest fragmentation, the preservation and reforestation of bamboo forests and corridors should be considered a top priority by stakeholders to promote the conservation of coastal primate species.

TAMARA L. BRITTON & IAN C. COLQUHOUN

Tamara Britton is a PhD Candidate in Anthropology and Environmental Sustainability, and her supervisor Dr. Ian Colquhoun is an Associate Professor in Biological Anthropology & Primatology at the University of Western Ontario in London, Canada.



Infographic detailing traditional knowledge related to sustainable bamboo harvesting. Credit: Tamara Britton.

FEATURED ARTICLE

THE ‘SURPRISING’ DIVERSITY OF BAMBOO IN THE AMAZON

The plant could be a key tool for enhancing livelihoods, construction and land recovery.

The Amazon rainforest is renowned for its incredible biodiversity and millions of plant and animal species. But the basin of the world’s largest water drainage system also holds a lesser-known treasure within its borders: A diverse array of native bamboo species. While the rainforest canopy is often associated with towering trees and climbing vines, these bamboo species, including the large and spiky *Guadua* as well as smaller, grass-like herbaceous bamboos and solid-stemmed *Chusquea* species, have long been utilized by local communities in the Amazon. However, the global community’s understanding of the potential applications of Amazonian bamboos lags significantly behind their counterpart bamboo species in Asia.

What’s being done?

Today, bamboo-dominated forests are occasionally seen as a hindrance to the economic profitability of the rainforest, rather than as valuable and fascinating native resources in their own right. This lack of recognition can be attributed to the dominance of Asian bamboo species in research and popular perception, the abundance of other valuable fibrous species found in the Amazon Basin, and the historical focus on tree species in research and trade. Work by groups including INBAR’s Arauclima Project, supported by renowned and dedicated experts such as Colombian botanist Ximena Londoño, regularly clarifies and discovers new species of bamboo. A deeper understanding of rapidly renewing native bamboo species could be an essential part of the sorely needed transition away from economic reliance on large tree species in the region.

Characterizing the forest region

The woody bamboos of the Amazon, larger and

spikier than their Asian counterparts, thrive in vast stands within remote areas of the rainforest, often far from major urban centers, manufacturing zones and ports. Unlike many bamboo species grown in Asia, including “moso” bamboo, which covers about 3 million hectares in China, Amazonian woody bamboo species of the genus *Guadua* grow in large stands and thrive as part of a densely packed forest. Their growth strategy allows them to climb onto trees and reach towering heights, occasionally out-competing other tree species and dominating the forest canopy. These bamboos, primarily the closely related *Guadua sarcocarpa* and *G. weberbaueri*, dominate the Amazon rainforest over a total area of 160,000–200,000 km². Like many large woody bamboo species, they exhibit rapid growth and infrequent flowering cycles. Periodically, large-scale flowering events occur across extensive areas, leading to the simultaneous death and regrowth of vast swathes of bamboo forests. These cycles are an integral part of Amazon ecosystems, including for the Indigenous cultures that have managed the rainforest for millennia.

Although bamboo-dominated forests may have lower overall biodiversity and store less carbon compared to other Amazonian forest types, they play a crucial role as habitats for specific bird species and other specialized biodiversity. Some birds live exclusively in bamboo stands, while others utilize the thickets for nesting. Additionally, several species of ants have evolved to inhabit hollow bamboo culms, and even elusive species like the little-seen Amazon bamboo rat find refuge in bamboo’s upper branches. Water-filled internodes can be punctuated by large insects, and once open can form an aquatic environment in which specifically adapted macrofauna thrive. Many small species use the culm’s inner walls as a retreat from predators, and one poisonous frog species will even deposit its precious tadpoles to grow to maturity in the miniature pools that



The bamboo species *Dendrocalamus asper* left standing on degraded land in Zamora Chinchipe province, Ecuador.

naturally form inside the plant. These unique microecosystems continue to surprise researchers, and further discoveries are anticipated.

As for the even less well understood herbaceous bamboos, the Amazon is the center of origin and biodiversity of these smaller species that belong to the sub-tribe Olyreae, which play an important role in several Amazonian ecosystems. These bamboos, characterized by their small stature and soft, flexible stems, remind us that all bamboos are members of the grass family, known as *Poaceae*. Unlike other grasses found in open plains or grasslands, bamboos are predominantly associated with forest environments and grow in the understory of the dense Amazonian rainforest, making these miniature bamboo species relatively rare in the plant kingdom. With 124 recognized species, all but two of which are endemic to the Americas, ongoing exploration continues to unveil new species.

Intriguingly, only two species of herbaceous bamboo grow wild outside of Central and South America, and researchers assume that these species were probably introduced to other areas

accidentally by humans during colonial times. Unfortunately, some species may disappear before discovery as more and more of the Amazon rainforest continues to be lost to deforestation, forest fires or climate change. Their main applications are currently ornamental, although some communities have used these species in traditional ceremonies or as medicine. The existence of these fascinating species adds a new dimension to our understanding of bamboo biodiversity in the Americas.

The surprising diversity in the area

Across the Amazon Basin, the sheer number and diversity of bamboo species found is in itself surprising. The giant *Guadua* species, some of which can grow up to 30 meters tall, and the world's smallest bamboo species, *Raddiella vanessiae*, which is just 2 centimeters tall, both grow in the region. Other species include many smaller climbing bamboos, like *Atractantha amazonica*, and *Arthrostylidium schomburgkii*, the bamboo with the world's longest internode which can span up to five meters, used by local people to make blowguns. Some bamboo species are

found in the Amazon Basin but are not primarily associated with the region, including several species belonging to the *Chusquea* genus. Many of these bamboos have solid stems, making them potentially suitable for construction. Several other bamboo species have also been introduced to the region, including *Bambusa vulgaris* and *Phyllostachys edulis*.

Tapping into the power of the plant

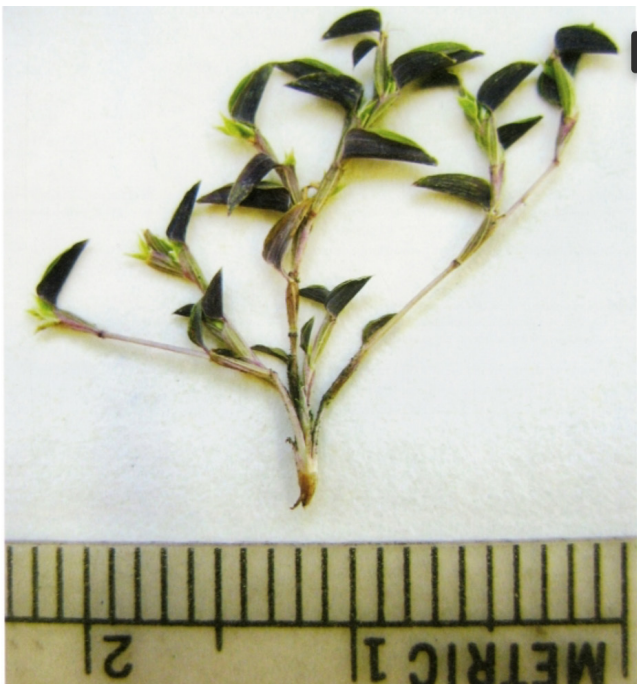
Guadua angustifolia is likely the most widely recognized and extensively used bamboo species in South America. Local communities employ it for construction, and even use it to make pipes. Its impressive strength, large size and high density make it a sought-after material for various industrial applications, and interest in this species as an alternative fiber source is growing fast.

Besides these applications, *Guadua* species may be key tools to mitigate the impacts of poor land use practices and land degradation in the Amazon Basin. Disturbances such as human-ignited fires, mining for heavy metals and logging, once rare events, are becoming increasingly common. The

scale, severity and range of land degradation in the Amazon is such that cost-effective, fast and manageable approaches to land recovery are sorely needed. Equally important are the contribution of thriving and healthy forests to the communities that rely on the Amazon rainforest for livelihoods. As global interest in bamboo as an alternative source of industrial fiber grows, planting native bamboo species in Amazonian riparian zones could become a human-centric, environmentally beneficial strategy for both livelihoods and biodiversity.

Native woody bamboo species belonging to the *Guadua* genus grow fast, colonize an area quickly and bind tightly to the soil. They are often among the first native plants to repopulate forest land after a natural disturbance such as fire. Indeed, parts of the Amazon rainforest that have burned have been found to have higher concentrations of bamboo than others. Although some researchers are concerned that bamboo growth may impede the growth of other species, particularly economically important tree species, these characteristics also make them ideal plants to facilitate the natural recovery of severely degraded land on which few other plants can thrive.

Several projects that explore this possibility in Ecuador's Amazonian region are currently underway, particularly along the banks of the Zamora and Nangaritza Rivers. Native woody bamboo species were planted on land abandoned by small-scale gold mining. Projects like these are currently collecting data and learning from experience planting these light-loving pioneer species for land recovery. Will native bamboo species support the reclamation of the Amazon for the communities of the future?



The world's smallest bamboo species, *Raddiella Vanessiae*, found in the Amazon rainforest. Credit: *Journal of the Botanical Research Institute of Texas* © 2007 The Botanical Research Institute of Texas, Inc.

LUCY BINFIELD

Lucy Binfield is a PhD Candidate in the Faculty of Forestry at the University of British Columbia in Vancouver, Canada. Her research looks at the social, economic and environmental impact of global efforts to develop the bamboo industry.

Collating the latest international news and activities around bamboo and rattan sectors development.



Nairobi Design Week 2023, where bamboo was showcased for creative designs. Credit: Nii Nortey.

Bamboo at Nairobi Design Week 2023

Bamboo, as a versatile and sustainable material with “tremendous potential” in building, is now being recognized for its applications in creative industries. Recently, INBAR and the Kenya Forestry and Research Institute have been increasing efforts for community training in the country, helping to increase efforts to reach out to the youth and improve trade balance using bamboo products. These efforts include bamboo study tours and workshops, culminating in the passage of the National Bamboo Policy of 2022.

As part of Nairobi Design Week 2023, a Sensory Bamboo Dome was built to reveal to onlookers the possibility for using bamboo in furniture, baskets, interior decor, and more. We are just now beginning to unlock the potential of bamboo.

Source: Nairobi Design, 17 April

Mbale locals plant bamboo to check floods

Residents of Mbale City in Uganda are fighting back against floods in the area with a mass bamboo planting project along the city’s river banks. In 2022, the river flooded, killing 29 people and destroying 800 homes.

Aiming to plant 50,000 saplings, they hope the many beneficial qualities of the plant will help mitigate the negative effects of the floods. Bamboo features the remarkable ability to absorb excess water and also stabilize soil structure, making it a fantastic tool in flood prevention strategies around the world.

The project also hopes to capitalize on some of the other uses of bamboo, including as a source of food, construction material, fuel, paper pulp, fibers, textiles, cosmetics, medicine, handicrafts, building materials and more. Value addition can put extra cash into the pockets of locals through

the production and sale of bamboo products.

Mr. Hamza Banja, the deputy resident city commissioner of the industrial city division, had this to say about the project: “The initiative aligns with the city’s and government’s broader sustainable development goals and climate change mitigation strategies so that our people can live without fear of devastating floods.”

Source: UG News24, 9 April

Bamboo homes helping Pakistan’s post-flood rebuild

In 2022, Pakistan suffered the worst flooding in its nation’s history. Over 1700 people were killed and 900,000 homes damaged or destroyed by the waters. Sindh province was hit the hardest by the natural disaster.

While waiting for government funds, the province began building one-room homes with bamboo, in large part thanks to help from the Heritage Foundation of Pakistan, founded by renowned architect Yasmeen Lari. With prefabricated bamboo frames build on raised platforms and walls made of bamboo canes and plastered mud, these homes are both resilient and easy to assemble.

These huts will not be swept away if the floods come again. They also feature other advantages to typical homes found in the area, such as being airier and brighter due to the window, keeping moisture low inside. It is also a relatively simple process to install an extra loft or courtyard to expand the structure.

These sustainable homes are affordable and resilient, with applications in helping mitigating the effects of the climate crisis as well. However, some worry that building authorities cannot see beyond concrete and steel when building homes in urban areas, overlooking the potential of bamboo and other good indigenous materials that may have numerous benefits in sustainable housing.

Since September, the foundation has contributed to building over 5000 of these homes, helping provide displaced residents with

comfortable and vital living space while they await the government’s distributing of funding for awarding new permanent homes.

Source: The Guardian, 25 July

Weaving Cambodia’s precious heritage

Cambodia has a rich heritage of rattan weaving. In one part of the country, that centuries-old tradition is alive and flourishing.

In the commune of Bralay, Kampong Thom province, nearly 200 families are engaging in ropeak (rattan) weaving. Harvesting the material from the forest in a sustainable manner, the items they create using rattan are more than just objects: They represent an ancient cultural practice and skill set refined over hundreds of years.

One local interviewed in the article stated that they focus on applying modern and aesthetic designs, while also preserving the craftsmanship. This balanced approach has led to items fetching fair prices in markets, which helps put cash in the pockets of rural communities. However, rattan weaving is a labor-intensive process. Locals can typically only make four to five small gift baskets a day. However, demand is high for the community’s artisanal products, so there is a consistent flow of new orders. This demonstrates the material’s application for establishing a new sustainable industry in the area, with reliable market demand.

The traditional practice is deeply felt by the entire community, with artisans ranging from 30 to 60 years old. Most families in the area are engaged in rattan-weaving. Linkages between old and new will live on in the Bralay commune with rattan.

Source: The Phnom Penh Post, 30 August



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For regular updates on bamboo- and rattan-based news, sign up here:

www.inbar.int/newsletter

INBAR commissions research, conducts project work and raises awareness about bamboo and rattan across its 50 Member States.



INBAR'S large exhibition space at 2023 CIFTIS in Beijing held at the China National Convention Center.

2023 CIFTIS convenes in Beijing

Momentum is growing for nature-based solutions to the plastic crisis facing the planet. From 2 to 6 September 2023, INBAR hosted a spacious exhibition at the 2023 China International Fair for Trade In Services (CIFTIS) in Beijing. A total of 59 countries and 24 international organizations participated in this year's fair.

The main theme of the INBAR exhibition was the Bamboo as a Substitute for Plastic (BASP) Initiative, aimed at combating plastic pollution and addressing climate change. Key components of the sustainable initiative, products on display at the exhibition were sourced with bamboo, showing how the green, alternative material can be substituted for plastics. The BASP Initiative seeks to not only reduce plastic pollution, which has crippling impacts on planetary wellbeing, human food security and many other transboundary issues, but also directly address

climate change by promoting bamboo as a renewable resource that functions as a powerful carbon sink. And, durable products made from bamboo lock in carbon for the duration of their lifespan.

With over 10,000 products made with bamboo, and over 1600 bamboo species known to science growing across 50 million hectares, much of which is spread across the Global South, many diverse applications of bamboo were highlighted at the exhibition, ranging from tableware, daily goods, and art supplies to bicycles, construction materials and furniture.

INBAR at the 2023 United Nations General Assembly

In September, high-level meetings were held in New York as part of the 78th session of the United Nations General Assembly (UNGA 78). The centerpiece of the week's events was the UN

2023 SDG Summit, arriving at the halfway point for implementing the Sustainable Development Goals by the 2030 deadline. The Summit sought to respond to the “impact of multiple and interlocking crisis facing the world and [was] expected to reignite a sense of hope, optimism, and enthusiasm for the 2030 Agenda.”

INBAR’s presence was felt at the Summit and other key meetings convened on the sidelines of UNGA 78 throughout the week. Ali Mchumo, INBAR Director General, and Borja De La Peña, INBAR Global Policy Officer, participated in events and held discussions with government heads, organization leaders and other dignitaries on a wide range of related topics.

INBAR Bamboo Survey: Putting bamboo on the map in Pakistan

Held between 19 to 21 June 2023 in Peshawar, Pakistan, the Mobile-App Based Bamboo Resource Assessment Training for Pakistan was attended by 35 experts from the Forestry Departments of Punjab, Khyber Pakhtunkhwa, Sindh, Balochistan, Azad Jammu and Kashmir, and Gilgit Baltistan as well as participants from Pakistan’s Ministry of Climate Change and Environmental Coordination as well as the Pakistan Forest Institute.

The main objective of the workshop was to build the capacity of selected forestry officers and experts to facilitate conducting bamboo resource assessment in Pakistan. Participants would learn how to use the INBAR Bamboo Survey mobile app to collect, analyze and manage survey data as well as upload these data to the web server, forming a comprehensive and synchronized map of bamboo resources.

After the app was installed in the mobile phones and laptops of the trainees, they were next instructed in its specific functions, including how to survey different types of bamboo, operate the survey form and workflow as well as navigate the web application for analyzing, aggregating and downloading data. In addition, the training also covered the use of QGIS, a popular free and open-source software that empowers users to prepare offline maps for the mobile app. This type of software is particularly crucial when assessing

bamboo resources in remote locales that may lack a reliable internet connection.

On the last day of the training, participants were divided into groups and undertook a field or practical demonstration in an experimental bamboo forest. Each group was allocated a specific area of bamboo to survey using the mobile app. Afterward, field challenges and solutions were discussed. Finally, each group presented its generated maps and data, with the consultant providing useful feedback and support.

INBAR hosts dialogue on substituting bamboo for plastics

From 10 to 16 August 2023, the Ministerial Workshop on Comprehensive and Sustainable Development of Forests in Developing Countries and South-South Cooperation Policy took place across China. As part of the tour, the delegation arrived at INBAR Headquarters in Beijing on 11 August to learn more about the potential of bamboo to replace plastics and contribute to global sustainable development.

Professor Jiang Zehui, Co-Chair of the INBAR Board of Trustees, attended the event and delivered a speech to welcome all the participants in the seminar. Professor Lu Wenming, Deputy Director General of INBAR, and Zhao Yutao, Vice-President of National Academy of Forestry and Grassland Administration (NAFGA) were also in attendance, accompanying the visitors during their tour of the Bamboo and Rattan Exhibition Hall.

The dialogue was hosted by the Ministry of Commerce of China and the China International Development Cooperation Agency. In total, 23 senior officials from seven countries including Ethiopia, Sri Lanka, Nigeria, Tonga, Nepal, Zambia and Cuba participated in the event. Among the participating countries, all but Zambia are INBAR Member States.

Focusing on the BASP Initiative co-launched by the Government of China and INBAR as well as the contribution of bamboo to global sustainable development, the dialogue was also attended by experts from NAFGA and INBAR.

Training for farmers in crisis-hit zone of Cameroon

On 27 September 2023, a workshop adopting the training of trainers model kicked off in Dschang, Cameroon. The workshop organized by INBAR intended to introduce non-timber forest products (NTFPs) including bamboo to 20 smallholder farmers, mainly women and youth from villages in and around the Kimbi-Fungom National Park in the northwestern region of the country.

Since 2016, the North West region of Cameroon has experienced high levels of insecurity and armed violence caused by outbreaks of violence between separatist militias in the area and the country's defense and security forces. This security situation negatively impacts project activities and constitutes a major risk for implementation teams in the villages around the Kimbi-Fungom National Park. To overcome this major obstacle in the area, INBAR and the management of the Kimbi-Fungom National Park agreed to select beneficiaries from the intervention zone, train them in Dschang located in the West region, retain them and send them to train other beneficiaries in the conflict-hit area as well as in the support of implementing other activities.

After the opening, the next four days comprised three days of classroom study and one day of fieldwork, through which participants learned about the socio-economic and environmental importance of bamboo, acquired knowledge on the establishment of nurseries, gained new skills in propagation techniques, discovered how plantations are established and observed the development of bamboo and other NTFPs in agroforestry systems.

Bamboo to boost climate resilience and livelihoods in eastern Uganda

Uganda is a country of lakes and rivers, earning it the nickname the "Pearl of Africa." The main source of the Nile River, Lake Victoria, is connected to a sprawling matrix of rivers and tributaries. Currently, the Government of Uganda is implementing the Parish Development Model as an all-encompassing strategy that addresses the social, economic and environmental aspects

of poverty in order to stimulate growth. As the flagship project of Uganda's Government, it attempts to promote economic opportunities and environmental sustainability while expanding access to essential services including water, sanitation, healthcare and education.

The Manafwa River originates in eastern Uganda. Flowing from Mount Elgon, the water's course takes it through the districts of Bududa, Manafwa, Mbale and Butaleja. The district of Bududa, in particular, is extremely susceptible to natural disasters like landslides and flooding. In 2022, a series of powerful landslides in the district resulted in the loss of human life and widespread damages as well as the shrinkage of agricultural lands, unexpected floods and soil erosion, leading to many substantial negative impacts on livelihoods.

People from the area approached the Dutch-Sino East Africa Bamboo Development Programme in Uganda in search of a feasible way to stabilize the Manafwa River, safeguard the environment and strengthen livelihoods. H.E. Ms. Agnes Nandutu, Minister of State for Karamoja Affairs, spearheaded efforts to organize the community and district officials for a bamboo plantation campaign in the Bududa District, also promising to include bamboo in the Parish Development Model. Additionally, INBAR also used radio and television to raise awareness about the versatile nature of bamboo in order to motivate farmers, many of whom are from the riverine community, to set up local nurseries and participate in value-added training.

The bamboo planting campaign included a three-tier plantation model, which was designed by a team of experts from INBAR to mitigate soil erosion, introduce bamboo agroforestry to improve local communities' lives, and provide a source of energy, feed and fodder. To address the economic and environmental concerns, site-specific matching bamboo species were selected for use. In order to make planting materials widely available for locals, the program supported decentralized bamboo nurseries through training and capacity building across farmer networks and established demonstration nurseries including homestead farming system development.

IN REVIEW



Building Materials and the Climate: Constructing a New Future

A new publication argues that rising urbanization demands urgent policy action to transition building material life cycles toward regenerative methods.

Building Materials and the Climate: Constructing a New Future published by the United Nations Environment Programme (UNEP) tackles one of the key sectors contributing to climate change: Construction. Responsible for at least 37% of global emissions, the built environment sector is the largest emitter of greenhouse gases. Despite its significant role in exacerbating climate change, it has received a relatively small amount of climate-smart funding and attention compared to other sectors like agriculture.

The publication points out the abundance of renewable materials available for utilization in the construction sector. These can substitute for cement, steel, aluminum and other high-carbon materials that dominate global supply chains. To promote decarbonization as well as the scaling up of regenerative materials, authors of the report have identified the synergistic potential of linking the production of building materials with the management of carbon cycles of forests and agricultural lands. This has the potential to drive many beneficial knock-on effects such as lowering the risk of forest fire and strengthening the

productivity of forest and agricultural land through related environmental restoration.

The report further outlines three pathways which must be implemented simultaneously to address the complex nature and large scale of the problem: 1) Avoid the extraction and production of raw materials; 2) Shift to regenerative material practices wherever possible; and 3) Improve methods to radically decarbonize conventional materials such as concrete, steel and aluminum, and only use these non-renewable, carbon-intensive, extractive materials when absolutely necessary.

Bamboo can play a significant role in facilitating this process. As the authors point out, it has key applications in sustainable construction. It is a bio-based material with renewable properties, and many new processes and technologies have been developed in the last two decades to enhance its applications. To fully exploit this resource, several challenges must first be overcome. Renewed investment is needed into lowering the CO₂ footprint of bamboo products, most of which originates from treatment chemicals and toxic glues for laminated products. Accordingly, devising low-carbon, biobased and non-toxic solutions will be key to this endeavor.

These obstacles do not detract from the potential of bamboo as a superior building material, given its high tensile and compressive strength, which allow it to be used in columns and beams, foundation, flooring, roofing and walls. The report also notes that bamboo can be used in the construction of disaster-proof structures, such as in areas experiencing seismic activity or flooding. And, bamboo can act as a powerful carbon sink, capable of sequestering 1.46 times the carbon of fir forests and 1.33 times tropical rainforests. Because of this, UNEP concludes that the plant resource is a potential frontrunner for driving global afforestation practices to mitigate climate change.

United Nations Environment Programme (2023). *Building Materials and the Climate: Constructing a New Future*. Nairobi

BAMBOO CROWNS: DU FU'S “MANAGING THE HOUSE”



An artist's rendition of Du Fu. Credit: Qing Palace Collection.

Written by Du Fu (712–770) during the Tang dynasty, “Managing the House” is a somber reflection on the passage of time. Du Fu is one of China’s most renowned poets, whose works are studied daily in the classroom. Raised in a family of scholars, he spent much of his youth on the road, where he studied Confucianism and received praise for his poetry. He was well regarded by the imperial court, though not offered an official title. Later, during the An Lushan rebellion, he lost everything and entered into a period of severe destitution. He regained some land and status later in life, before legend states that he died while traveling on a boat, feasting and drinking for 10 days straight.

His unique life experiences allowed him to write poetry about a vast range of subjects. In the poem, we are first given an idyllic picture of soaring bamboo culms beside a body of water that seems to nearly scrape the sky. These bamboo groves are home to otherworldly spirits, and the speaker is reluctant to disturb them. However, he does eventually remove bamboo to allow for a patch of sunlight to shine, also granting visibility of the turgid waters beyond, after which he

reflects on his tranquil and quiet existence. In this poem, we see bamboo as a potential harbor for metaphysical entities that bewitch humans; but it is after noting the arrangement of the eastern lands and its suitability for clearing that the speaker summons the resolve to clear an opening. This suggests bamboo as a metaphor for enacting the orderly nature of Confucianism, in which the natural world submits to proper landscape management. Spirits it seems are powerless before good home governance.

“Managing the House”

*I have bamboo groves south of the river
Cooling the summer scorch.
The river its coolness retains:
Bamboo crowns the clouds attain.
Suspicious they harbor spirits,
I can bring myself to cut not one.
Then I note an open space in the east, as suits the
terrain,
Fine to remove obstructions from my window for good.
This morning I cut a thousand stems,
Tended by me for six years.
Through the sparse boughs, I see the bright sun.
Torrents, now unchecked, over open land run.
I appraise my house: No luxury. Enough for
My humble self, if not for a sage hermit.
My cottage covered with thatch,
I feel my ailments healed a touch.
Meekly to my fate I resign,
Better than augmenting my food.
With the chopping axe now hushed for sure,
Fine it would be to rest at leisure.*

Written by **Du Fu** and translated by **Wen Jingen, Wang Weidong** and **Huang Shaojie** in *The Charm of Bamboo: 100 Selected Ancient Chinese Poems on Bamboo*.

EVENTS

3–6 July

51st UNIDO Industrial Development Board
Vienna, Austria

17 July

World Day to Combat Desertification and Drought

10–19 July

ECOSOC High-Level Political Forum
New York, USA

27 July

First International Meeting of RIUCI BAMBOO
Panama

16 August

International (Anji) “Bamboo as a Substitute for Plastic” Innovation Conference
Anji, China

2–6 September

2023 China International Fair For Trade In Service (CIFTIS)
Beijing, China

5–19 September

78th Session of the UN General Assembly
New York, USA

12 September

International Day for South-South Cooperation

18 September

World Bamboo Day

18–25 September

Peru Bamboo Week
Cusco, Peru

19–20 September

2023 SDG Summit
New York, USA

28–30 September

Regional Forum on Urban and Housing Financing
Quito, Ecuador

*For more information, please see INBAR’s event page:
<https://www.inbar.int/events/>.*

FIRST INTERNATIONAL SYMPOSIUM ON BAMBOO AS A SUBSTITUTE FOR PLASTIC

When: 7–8 November 2023**Where:** China National Convention Center, Beijing, China

Overview: The main theme of the symposium is “Innovative Technologies Piloting Plastic and Carbon Reduction Actions.” This symposium will be a good platform for global stakeholders to exchange knowledge and best practices, explore innovation opportunities, improve market mechanisms and encourage policy formulation.

The event encompasses an opening session, keynote presentations, four parallel sessions and a closing ceremony.



A panda happily munches on bamboo leaves. Credit: Mark de Jong.



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AND RATTAN ORGANIZATION

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