CBI CONGO BASIN INSTITUTE

THE EBONY PROJECT

Developing an Integrative Program for Restoration, Use, and Community-based Livelihoods

Progress Report
November 2021

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DEVELOPING AN INTEGRATIVE PROGRAM FOR RESTORATION, USE, AND COMMUNITY-BASED LIVELIHOODS

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Cover picture: Project participants and staff in Bifolone, Cameroon; photo: Vincent Deblauwe

Congo Basin Institute, Yaoundé, November 2021

PROJECT PARTNERS

The Ebony Project is coordinated by the Congo Basin Institute (CBI) in Yaoundé, Cameroon, and the work is implemented by CBI and the following project partners:

International Institute of Tropical Agriculture
Cameroon

University of California, Los Angeles
United States of America

Institut Supérieur des Sciences Environnementales
Cameroon

Taylor Guitars
United States of America

Madinter
Spain

Crelicam
Cameroon

The Ebony Project is developing activities in collaboration with institutions in Cameroon including:

Université de Yaoundé I, Yaoundé, Prof. N. Niemenak

Ministry of Environment, Nature Protection and Sustainable Development (MINEPDED), Ministry of Forestry and Wildlife (MINFOF), Cameroon, Conservation Services of the Dja Faunal Reserve
National Forestry School Mbalmayo, N. Kingsly

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PROJECT OVERVIEW

Reflections as We Enter a New Phase

The 2021 Annual Progress Report marks the fifth anniversary of The Ebony Project, which was originally launched in 2016 with the goal of conducting basic ecological research and developing a community-based planting program as a pilot project for larger rainforest restoration efforts. The first milestone target was to accompany communities to plant 15,000 ebony trees along with an undefined number of fruit trees as a food and income source for villages that participated in the program.

Over the past five years, The Ebony Project has made steady progress, and has been learning a lot. In 2020, the Project surpassed its goal of planting 15,000 ebony trees, and continues to publish peer-reviewed scientific papers that are quickly becoming the definitive syllabus for the species.

Although day-to-day implementation of the Project is carried out by the scientists and researchers of the Congo Basin Institute, in many ways the evolution of the Ebony Project has been a reflection of Taylor Guitars, resisting rapid growth until it is confident in its output. Now, after slowly establishing proof of concept, The Ebony Project has begun attracting greater attention — and the prospect of significant new funding, including the pending GEF-7 five-year funding cycle.

The Project Team is aware that the next five years will be very different from the first, as the project is projected to double in size and will see the introduction of new layers of stakeholders. As The Ebony Project transitions into the future, we offer some quick reflections and thoughts:

1. **The Project's Flexible, Adaptive Funder Has Been Critical to Success.** Unlike many aid and conservation projects that are designed in advance with strict indicators of success and hierarchical management structures, Bob Taylor has allowed The Ebony Project enormous flexibility in its "start-up" first five years. When something was not working, it was discussed and revised. Institutional focal points Scott Paul (Taylor Guitars) and Virginia Zaunbrecher (UCLA/CBI) speak weekly, monthly Ebony Project team calls take place with Cameroonian-based CBI staff and U.S.-based team members at UCLA and Taylor Guitars, and bi-annual all-day retreats with Tom Smith, Virginia Zaunbrecher, Bob Taylor and Scott Paul allow for ongoing, real time realignment. This close working relationship between funder and implementor has provided the foundation for flexibility that has been crucial to the project's success.

2. **New Funders Will Result in New Stakeholders**. The Ebony Project has greatly benefited from its flexibly and adaptive management style, and while the Fondation Franklinia, University of California and Partnerships for Forests have provided funding, none has required changes to the management or strategic direction of the project. Now, with multiple larger, more complex funding sources looking to support the Project, care must be taken to minimize mission creep or overly cumbersome administrative burdens. This said, the project must also proactively seek buy-in from new partners, and demonstrate a willingness to modify activities, approaches, and even goals to adapt to legitimate new stakeholder needs. Moving forward, success will hinge upon the project's ability to develop

trust within the expanded circle of stakeholders to generate a shared vision, and to share information in a timely and effective manner.

3. **The Growing Importance of Data Analysis and Visualization**. As The Ebony Project grows and new stakeholders join, the project's ability to communicate complex information in a simple, accurate and timely fashion will become increasingly important. With the help of Taylor Guitar's Business Intelligence Manager, The Ebony Project is using Tableau, an interactive data visualization platform originally created to help companies better understand operations through data analysis providing historical, current, and predictive views, including graph-type data visualizations. Now, with a few clicks, an intuitive dashboard allows the Project to share information in an easily understandable way. At any given moment, we know, for example, how many ebony and fruit trees are in any given nursery and what year we expect they will be ready for transplant. We can track annual seed collection, see who planted what and where and how many survived or reached what size to any given year. We can run macro queries across the entire project or zoom in and analyze village-level data. We anticipate that Tableau will become increasingly important communicating project progress to stakeholders and other interested parties.

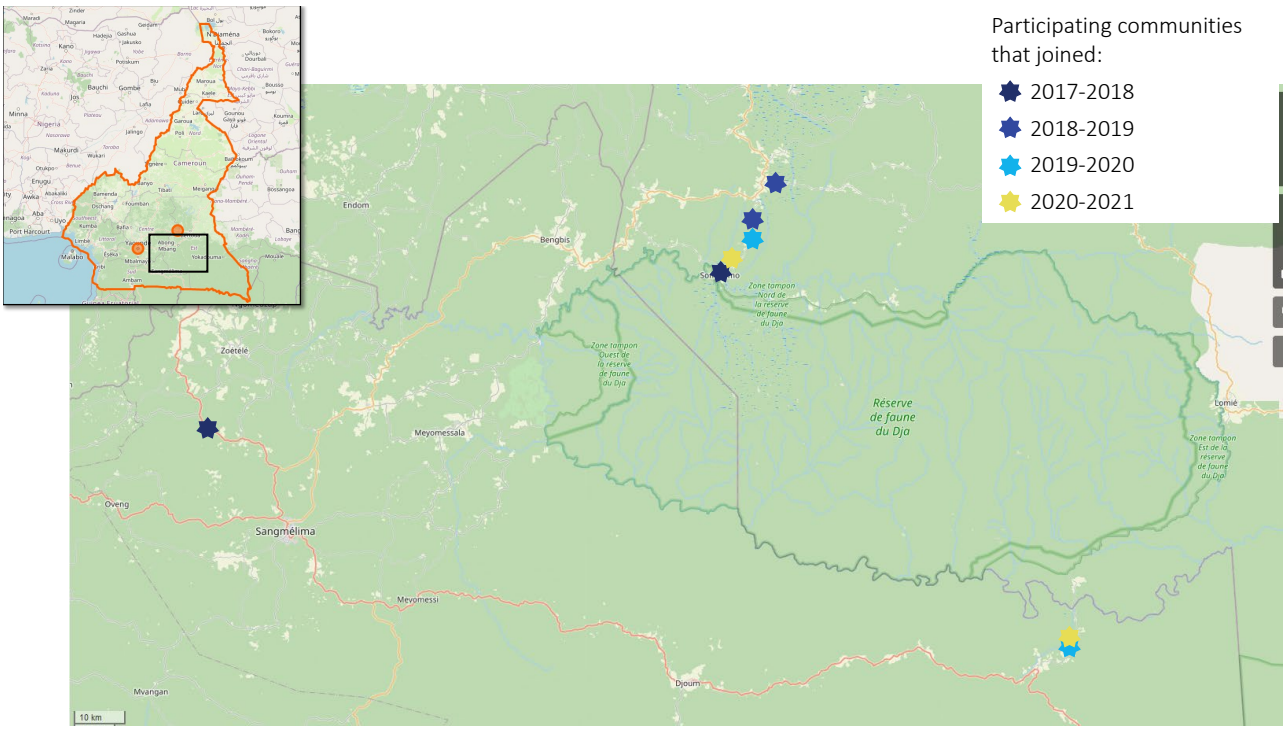
4. **Burgeoning International Reforestation Efforts.** The Bonn Challenge, Paris Agreement, the New York Declaration on Forests, Initiative 20X20, AFR100, the Bezos Earth Fund, and the Trillion Tree Campaign (to name but a few) help illustrate a growing international focus on landscape restoration. Planting trees alone is projected to be a one trillion dollar investment opportunity. With so much activity, projects range widely in quality, and there is a growing body of literature critiquing the tree-planting movement. The Ebony Project has an important role to play in this marketplace of ideas as we learn, shape, and follow emerging best practices.

COMMUNITIES

Growth and Geography

The Ebony Project is now active in seven communities: Ekombité, Bifolone, Kompia, Adjan, Malen IV, Bemba II and Zoebéfam I (Figure 1), with one community (Somalomo) having graduated. This number is up from four communities in 2019 and six in 2020.

Figure 1: Map of project locations.



With the exception of our first project area, Ekombité, participating communities have been selected based on their proximity to the Dja Faunal Reserve. The areas around the Dja have been a focus both because of CBI's pre-existing relationships with communities there, and because of the importance of the area around the Dja for conservation.

Project expansion over time continues to rely on a mix of both **organic growth** whereby neighboring communities seek involvement inspired by what they see happening, and also by **strategic growth** opportunities whereby the Project team identifies a new community in a high conservation value area. For example, the Project expanded to Zoebéfam in 2019 as a strategic growth opportunity because it is within an important corridor between the Dja Reserve and other protected areas to the south. Within a year the Project expanded organically from Zoebéfam to the neighboring Baka community of Bemba II, thus repeating the same pattern originally experienced in the Somalomo region several years earlier.

Expanding the Project to communities along the roadside also provides important conservation benefits. Small scale agriculture is the leading cause of deforestation in the Congo Basin,[1] and the vast majority of it takes place within 10km of a road, where most human settlement is focused. Roadside human settlement in what is otherwise mostly intact forest therefore presents the greatest challenge to maintaining the integrity of migratory corridors or contiguous forest tracks where wildlife can freely move and disperse plants. While the Ebony Project is not designed to protect large swaths of land, it does help maintain and improve habitat connectivity in areas impacted by human settlement, in particular within 10km of roads. Within the project area, trees are planted scattered throughout the landscape with individual plots averaging 0.5 ha each. In other words, while the total area impacted is relatively low (71 ha to date), the Ebony Project is improving habitat precisely where it is being degraded the most, in the areas surrounding where people live along roads—exactly the locations that are hardest to conserve and reforest.

Tracking Community Progress within the Project Cycle

Participating communities have continued to advance through the project cycle, as first discussed in the 2019 Progress Report.

Table 1: Community Participation in the Ebony Project Over Time

Community	Year joined[2]	Number of years of planting	Current status
Ekombité	2017	4	Active
Somalomo	2017	2	Graduated
Bifolone	2018	3	Active
Kompia	2018	3	Active
Adjan	2019	2	Active
Zoebéfam	2019	2	Active
Malen IV	2020	1	Active
Bemba II	2020	1	Active

Community Agreements — Formal written Community Agreements with participating individuals and communities are a foundational document for the Ebony Project and the stakeholders. These documents memorialize what the project will provide and what the individual/community's obligations are in return. These agreements are signed at the beginning of the Project, though

[1] Tyukavina, A., Hansen, M.C., Potapov, P., Parker, D., Okpa, C., Stehman, S.V., Kommareddy, I., Turubanova, S., 2018. Congo Basin forest loss dominated by increasing smallholder clearing. *Sci. Adv*. 4, eaat2993. https://doi.org/10.1126/sciadv.aat2993

[2] This is the year the community elected to join the Project and began project activities. Most communities spend the first year building a nursery, collecting and sowing seeds, and tending saplings in the nursery. The second year is usually when the first planting happens in the field.

communities continue to offer feedback on the Project throughout the lifecycle. In 2021, we caught up with a backlog of signings due to Covid-19 by finalizing community agreements with Bifolone, Kompia, Zoebéfam I, Malen IV and Adjan. We also just signed the agreement with Bemba II, the newest community to join the project.

In 2021, Somalomo cycled out of the program and did not maintain a nursery or plant ebony this year. During their tenure with the project, Somalomo planted 1,316 ebony trees and 180 local fruit trees. Somalomo, by far the most populated community that participated in the project to date, mostly planted as a demonstration and ecotourism plot. The trees there are well cared for, and are growing quickly, with some already reaching 3 meters in height. The Project Team will continue to engage with the community to provide technical support for the trees that the community previously planted, monitor ebony growth, and make support payments for an additional three years for plant maintenance as articulated in their Community Agreement.

Community Preferences

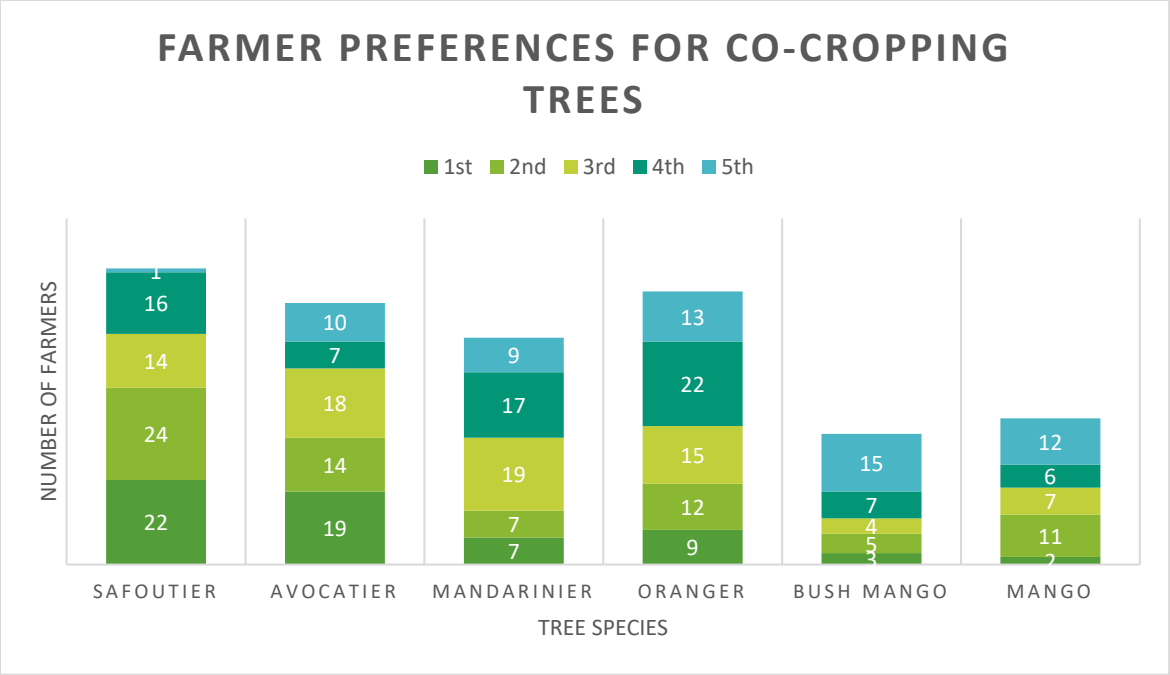
To help us plan and improve the project and make it more responsive to local needs, in July 2020, the Project team surveyed 87 farmers in five participating communities for their feedback on the project. The survey asked respondents about how many trees they had planted, whether they planned to plant ebony next year, and what locally valuable trees they were most interested in intercropping. We also asked some respondents for their opinion on the project, whether it had improved their lives, and what they thought of the financial compensation model.

The results were informative and largely positive. Of the 52 respondents to a question on their opinion of the Project, 47 (90%) responded positively though five (10%) said the Project had been disappointing. Of the 32 people who responded to a question about whether the Project had improved their lives, 78% said yes. 83 of the 86 people who responded to a question about their plans to plant ebony next year answered yes.

The survey also provided critical data regarding what five tree species are most sought after by participants, although we did not use an unlimited listing protocol for simplicity. The results (Figure 2) show preference for a mix of native and non-native species. This demonstrates the balance the Project must strike between providing locally desired fruit species and promoting the planting of native species. See the Replanting Responsibly section below for additional analysis about trade-offs when implementing locally responsive and ecologically valuable tree planting projects. See Table 2: Trees Planted by Species in the Growing and Planting Trees section below for details on the species planted so far.

While conducting the survey was time consuming for both Project staff and participants, we feel it provides participants with an additional opportunity to provide feedback, and offers the Project important and useful data on outcomes. We are likely to undertake similar surveys every 2-3 years.

Figure 2: Rank Choice Farmer Preferences for Co-cropping Tree Species. The six most cited species are represented.



Nursery Establishment and Water Needs

The successful establishment of a plant nursery is an initial step when the Ebony Project starts working with a new community. The community builds a shade house out of local materials to protect the seedlings, and the Ebony Project provides some tools and bags for sowing seeds. Having a reliable nearby water source so the caretakers can care for the saplings, especially during the dry seasons, is another key requirement. Some communities do not have land available for a nursery with conveniently accessible year-round water. In such cases the Ebony Project has assisted the community in acquiring a well to service the nursery. The well also provides a clean water source for the village as a whole. In 2021, the Project team decided that we will provide a well to all new communities that need one.

Nursery water wells funded by the Ebony Project in Bifolone (left) end Kompia (right). *Photo credit: Oumarou Soule.*

Data Management

The Tableau Database

For the past year, the Ebony Project's Dr. Vincent Deblauwe has been working with Taylor Guitars' Business Intelligence Manager, Steve Theriault, to convert data that has been collected in spreadsheets into Tableau, an interactive data visualization platform. Tableau was originally created to help companies better understand operations through data analysis, providing historical, current, and predictive views, including graph-type data visualizations. The idea to incorporate the platform was born at one of the Project's bi-annual UCLA/CBI – Taylor Guitars all-day meetings.

The integration of project data onto the Tableau platform is now operational, and provides a versatile and useful way to assess and communicate project performance. There continues to be a lag between when data is collected in the field, digitized, and reviewed for quality control (see section below on the Sylvicultural Booklet), but the Project team considers it a major success and a giant step forward.

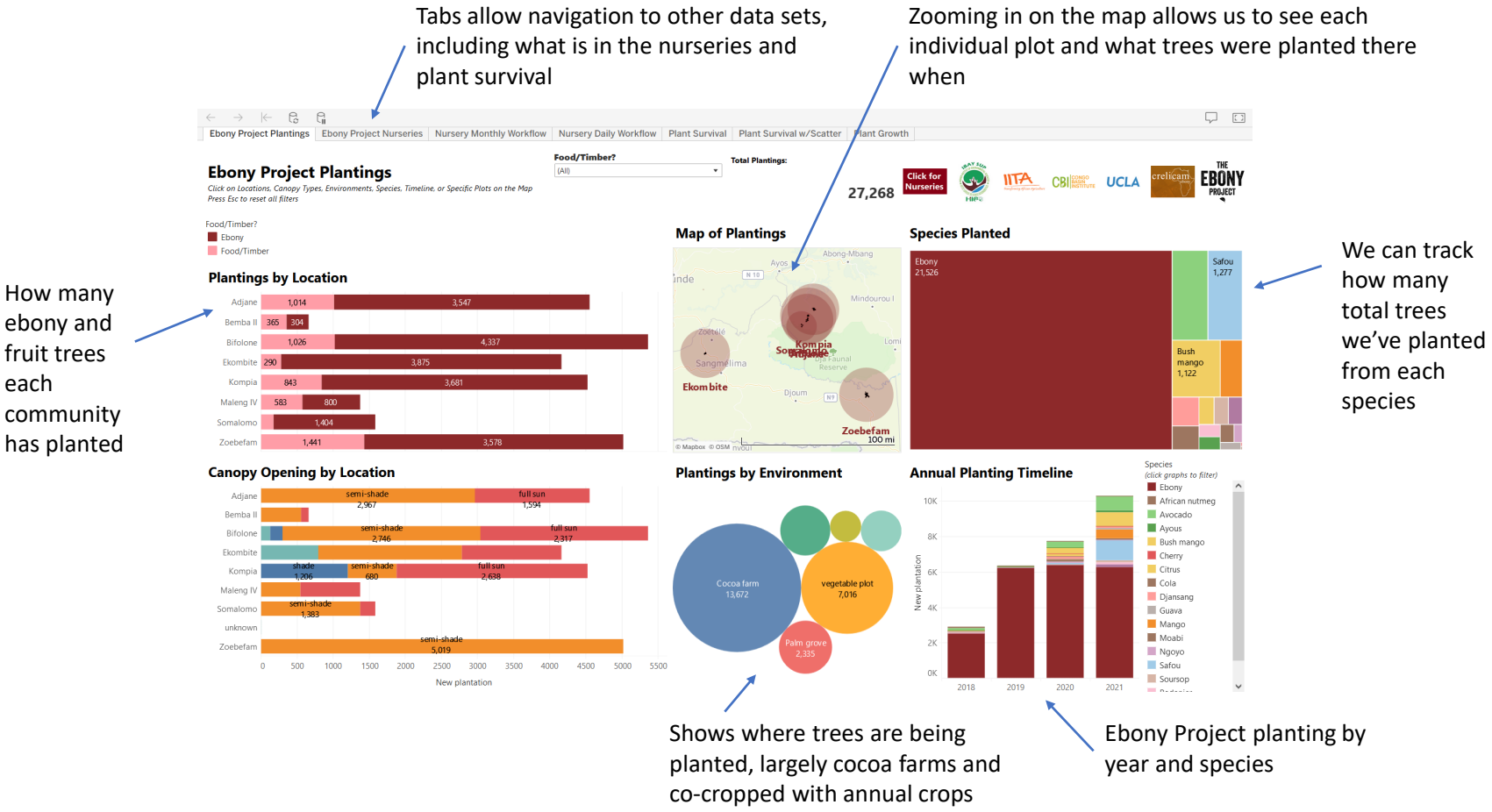
Why is the Ebony Project Tableau site not publicly available?

The data is hosted via Taylor Guitars' Tableau subscription, which includes the company's proprietary business information. Buying a separate license that could be hosted publicly is currently cost prohibitive.

Further, there is an issue of real-time public access syncing with real-time data collection from remote field sites. The delay in processing and uploading the data, and in correcting data entry mistakes, could result in the presentation of misleading information. Finally, some data points the database tracks (e.g. individual's name) should not be public. Accordingly, the Project team has decided to share static screen shots at fixed intervals (see Figure 3).

Now with a few clicks, a highly intuitive dashboard (Figure 3) allows us to share information in an easily understandable way. At any given moment, the Project Team knows, for example, how many ebony and fruit trees are in any given nursery and what year we expect they will be ready for transplant. We can track annual seed collection, and we know who planted what and where. Plant survival and growth are also recorded on an individual basis. We run macro queries across the entire project or zoom in and analyze village-level data. More recently we have started using the platform to track planting survival.

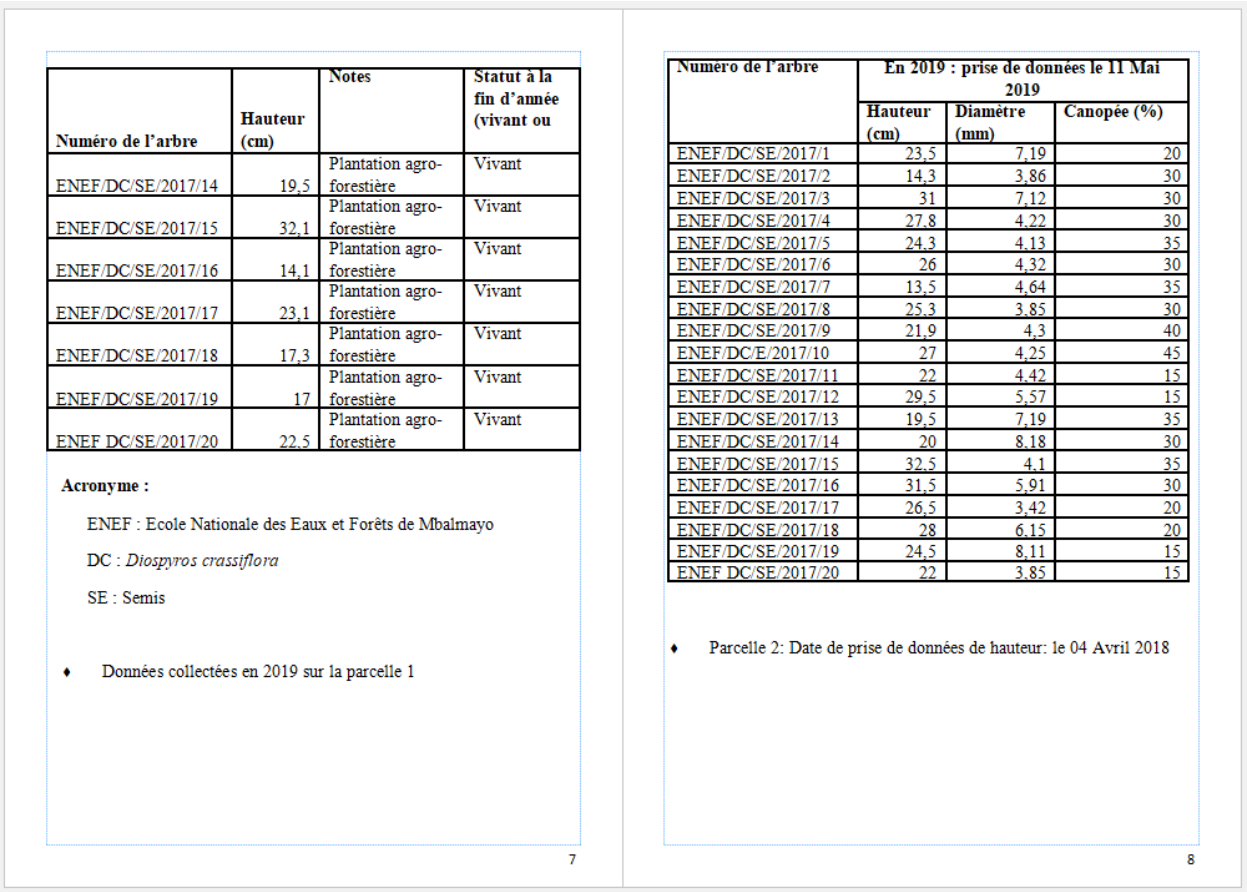
Figure 3: Image from the Tableau database showing plantings through 2021.



The Sylvicultural Booklet

While land ownership in Cameroon is complex, there may be grounds for program participants to claim individual ownership of trees they plant.[3] Proving ownership of a single tree or multiple trees across a landscape decades later, however, will be a challenge. This year the Project fully implemented Sylvicultural booklets across all of the project sites to help document who planted what, where, and when. While these booklets themselves do not provide land tenure, they do contribute evidence for both local/customary ownership and formal recognition.

Figure 4: Two pages from a completed Sylvicultural Booklet.



Numéro de l'arbre	Hauteur (cm)	Notes	Statut à la fin d'année (vivant ou
ENEF/DC/SE/2017/14	19,5	Plantation agro-forestière	Vivant
ENEF/DC/SE/2017/15	32,1	Plantation agro-forestière	Vivant
ENEF/DC/SE/2017/16	14,1	Plantation agro-forestière	Vivant
ENEF/DC/SE/2017/17	23,1	Plantation agro-forestière	Vivant
ENEF/DC/SE/2017/18	17,3	Plantation agro-forestière	Vivant
ENEF/DC/SE/2017/19	17	Plantation agro-forestière	Vivant
ENEF DC/SE/2017/20	22,5	Plantation agro-forestière	Vivant

Acronyme :

ENEF : Ecole Nationale des Eaux et Forêts de Mbalmayo

DC : *Diospyros crassiflora*

SE : Semis

- Données collectées en 2019 sur la parcelle 1

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Numéro de l'arbre	En 2019 : prise de données le 11 Mai 2019		
	Hauteur (cm)	Diamètre (mm)	Canopée (%)
ENEF/DC/SE/2017/1	23,5	7,19	20
ENEF/DC/SE/2017/2	14,3	3,86	30
ENEF/DC/SE/2017/3	31	7,12	30
ENEF/DC/SE/2017/4	27,8	4,22	30
ENEF/DC/SE/2017/5	24,3	4,13	35
ENEF/DC/SE/2017/6	26	4,32	30
ENEF/DC/SE/2017/7	13,5	4,64	35
ENEF/DC/SE/2017/8	25,3	3,85	30
ENEF/DC/SE/2017/9	21,9	4,3	40
ENEF/DC/E/2017/10	27	4,25	45
ENEF/DC/SE/2017/11	22	4,42	15
ENEF/DC/SE/2017/12	29,5	5,57	15
ENEF/DC/SE/2017/13	19,5	7,19	35
ENEF/DC/SE/2017/14	20	8,18	30
ENEF/DC/SE/2017/15	32,5	4,1	35
ENEF/DC/SE/2017/16	31,5	5,91	30
ENEF/DC/SE/2017/17	26,5	3,42	20
ENEF/DC/SE/2017/18	28	6,15	20
ENEF/DC/SE/2017/19	24,5	8,11	15
ENEF DC/SE/2017/20	22	3,85	15

- Parcelle 2: Date de prise de données de hauteur: le 04 Avril 2018

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While the Tableau database is digital and dynamic, the booklets are hardcopy and locally-based—important traits to ensure they are useful and locally accepted. We use the Tableau database to track data for project management and scientific publications, while the Sylvicultural booklet is designed to meet the needs of participants to track their plantings and contribute evidence of ownership. We often collect the data to populate both systems together, and all data kept in the

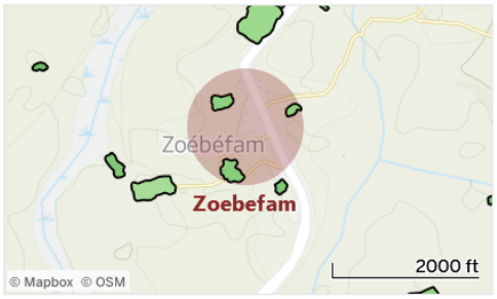
[3] See the 2019 Progress Report for a more thorough description of land use and documentation in Cameroon.

booklets is also kept in the dashboard (e.g. growth data for trees), but there are significant differences in the data layout and the methods of communicating between the two systems.

The teams work with program participants at the village level to map all of the plots using GPS, documenting the number of each species planted, and follow up on the growth and survival from the previous years. We encode this data into a database that can be conveniently browsed using the Tableau dashboard, and provide it to the communities in the form of printed Sylvicultural booklets (Figure 4). We use the database as the basis for community payments (**Figure 5**).

Figure 5: Detail of planting polygons from Tableau dashboard.

a) **Map of Plantings**



b)

PA094

New plantations: **99**

Owner:
Site Type: **Cocoa farm**
Canopy: **semi-shade**
Spacing (m): **5x5**

		Date		
Food/Timber?	Species	2020	2021	Grand Total
Food/Timber	Avocado	1	8	9
	Bush mango	7	5	12
	Citrus	1		1
	Safou		4	4
	Strophanthus		4	4
Ebony	Ebony	50	19	69
Grand Total		59	40	99

a) Screen shot from Tableau database showing the polygons where planting has occurred near one project community.
b) Details of what has been planted and when in a specific polygon in the database.

Ideally, the Project would streamline the process by encoding data directly in the field and uploading it to the cloud. For example, the Project team has identified an open source application called Open Data Kit (ODK), but not yet tested it. Implementing an ODK system in the future would eliminate the process of transferring data collected on paper in the field to a database. Instead, field staff would use handheld devices to collect data in the field using digital forms, which could then populate both digital versions of the Sylvicultural booklet and Tableau. Such an approach would reduce the risk of errors, avoid omissions, and decrease the amount of work and time needed to populate the database, the dashboard, and the booklets.

The process of developing the form, putting it on the devices, training staff, and connecting the data outputs to the database is resource-intensive. Currently, the project is trying to find a Master's student who could undertake it as their thesis project.

Growing and Planting Trees

In 2021, the Ebony Project surpassed its original goal of planting 15,000 ebony trees. Accordingly, we set new five-year goals:

- By the close of 2026, 30,000 additional ebony trees planted
- By the close of 2026, 25,000 additional fruit trees planted

Table 2: Trees Planted by Species

Common name	Scientific name	Native?	Total planted[4]
Ebony	*Diospyros crassiflora*	Yes	21,438
Avocado	*Persea americana*	No	1,314
Safou	*Dacryodes edulis*	Yes	1,307
Bush mango	*Irvingia spp.*	Yes	1,122
Mango	*Mangifera indica*	No	660
Djansang	*Ricinodendron heudelotii*	Yes	313
Moabi	*Baillonella toxisperma*	Yes	265
Citrus	*Citrus spp.*	No	166
Soursop	*Annona muricata*	No	162
Strophanthus	*Strophanthus spp.*	Yes	156
Badamier	*Terminalia catappa*	No	114
Ayous	*Triplochiton scleroxylon*	Yes	113
African nutmeg	*Monodora myristica*	Yes	100
Ngoyo	*Trichoscypha spp.*	Yes	65
Guava	*Psidium guajava*	No	61
		Total	**27,365**

Ebony Production and Planting

In 2021 the Ebony Project planted 6,262 ebony trees, bringing our overall total to 21,438. Further, in 2021 the Project fully transitioned away from ebony plant production via cuttings and now depends completely on producing plants via seed. This has proved to be a far simpler and more efficient approach than trying to produce plants via cuttings or tissue culture as was done at early stages of the project.[5]

The transition to seed is, in part, the result of a much more profound understanding of the ebony tree fruiting cycle thanks to Project-funded research. Today, despite annual fluctuations in fruit production, the Project can collect a high volume of ebony fruits annually (and therefore grow a relatively constant number of ebony plants). The Project has been consistently planting around 6,300 ebony trees each year for the last few years. If we continue at this pace, we will be well-positioned to meet our goal of planting an additional 30,000 ebony trees in five years.

Fruit Tree Production and Planting

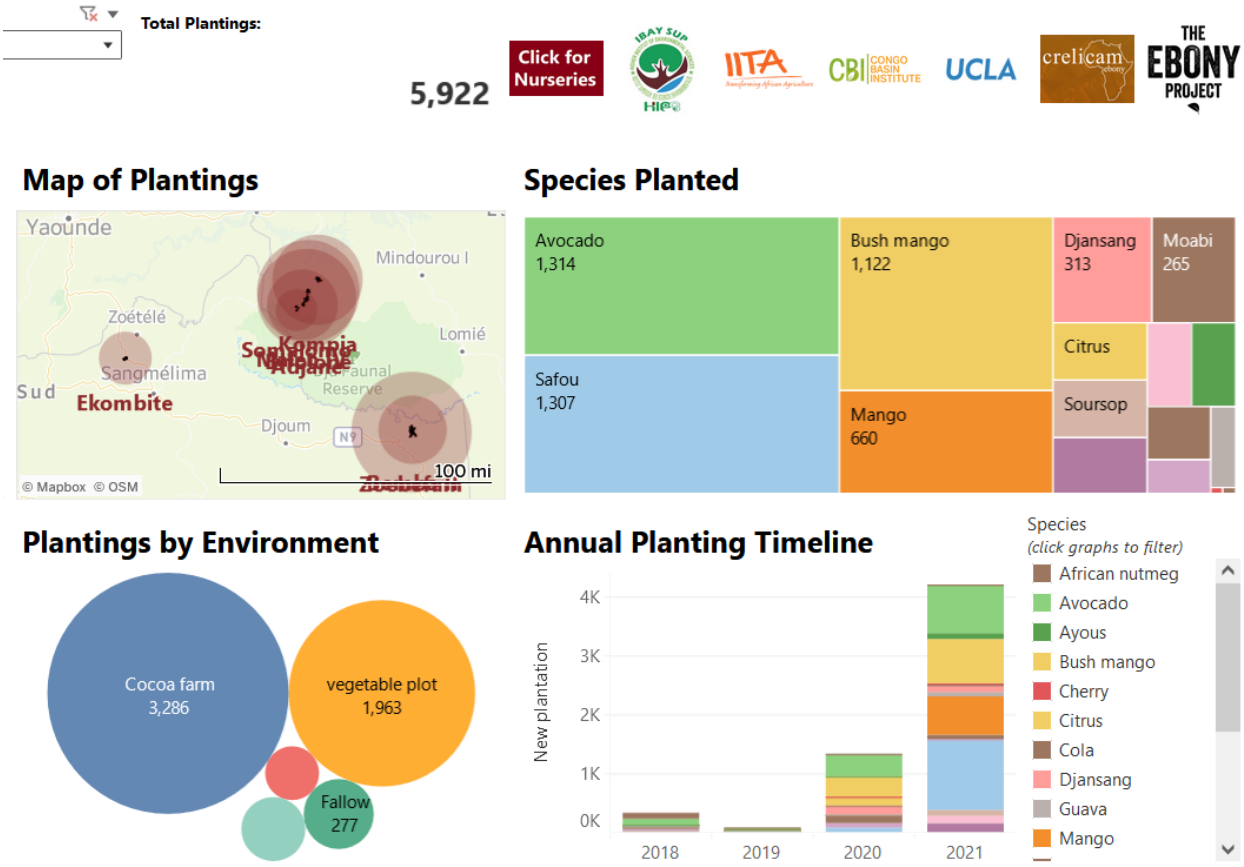
Fruit tree production and fruit tree planting increased substantially for the second year in a row. This year the Project team planted over 4,000 locally valuable fruit trees, bringing the Project total

[4] As of 2021 planting season.

[5] See 2019 and 2020 Progress Reports for a full discussion of ebony production methods.

to 5,922. Graphing the fruit tree planting over time shows a clear upward trend (**Figure 6**) as the Project has focused specifically on improving fruit tree production. We are also successfully increasing the diversity of the fruit trees planted, with 16 species currently represented and no single species making up more than 25% of total fruit plantings (**Figure 6**).

Figure 6: Locally valuable fruit tree data from Tableau.



We will need to continue the current growth trend to meet our goal of 25,000 fruit trees.

That growth trend has been hard fought. Fruit production has been a challenge for the project, and in the past year we have made a number of changes and improvements to address the problem, specifically:

- **Share responsibility for fruit tree production more widely across the Project Team**: CBI's team based at IITA became more involved in fruit plant propagation activities. This is being led by a mid-level project manager who was hired this year.

- **Greater decentralization of fruit to production**: Multiple villages now gather and germinate fruit seeds.
- **Development of a fruit action plan**: With the support of the U.K. government-funded Partnerships for Forests (P4F), the Ebony Project conducted in-depth analysis of five key species. We reviewed all of the literature available for each species, and defined key metrics driven by five goals (see sidebar).

5 goals of the fruit action plan:

1) More fruit trees
2) Produced mostly in communities
3) Improved varietals
4) Short time to production
5) Cost-effective

In the coming year we plan to implement the fruit action plan, and depending on the availability of funding will hire a staff member dedicated to fruit tree production and planting.

Ecological Work on Ebony

Ebony threats

In 2021 Project lead scientist Dr. Vincent Deblauwe completed a comprehensive literature review to better understand the known ecological range of and long-term threats to *Diospyros crassiflora* Hiern. and concluded that the ebony species is widespread but was never abundant. The primary long-term threats to the species are largescale forest conversion to agriculture and widespread hunting of large mammals on which the species relies for seed dispersal. It is currently logged principally to make musical instrument parts and for the Asian hongmu furniture market. Trade statistics suggest that exports from source countries where the species is cut under a forest concession system with a management plan (i.e. Republic of Congo and Central African Republic) are relatively low compared to Cameroon. Exploitation of ebony in Cameroon is focused in the relatively small non-permanent forest domain, an area of forest which is not allocated to conservation or forestry and may in the future be converted to other uses including agriculture, urbanization, and industry.

Cameroon has seen a recent increase in exports, and logging remains a concern where the exploitation and trade of *D. crassiflora* are managed in response to demand rather than informed by current stock levels, growth rate, and the particular reproductive biology of this species. The recent successes of private sector initiatives like the Ebony Project to ensure the long-term supply of ebony in Cameroon are promising, but policies for the sustainable management of the species are required.

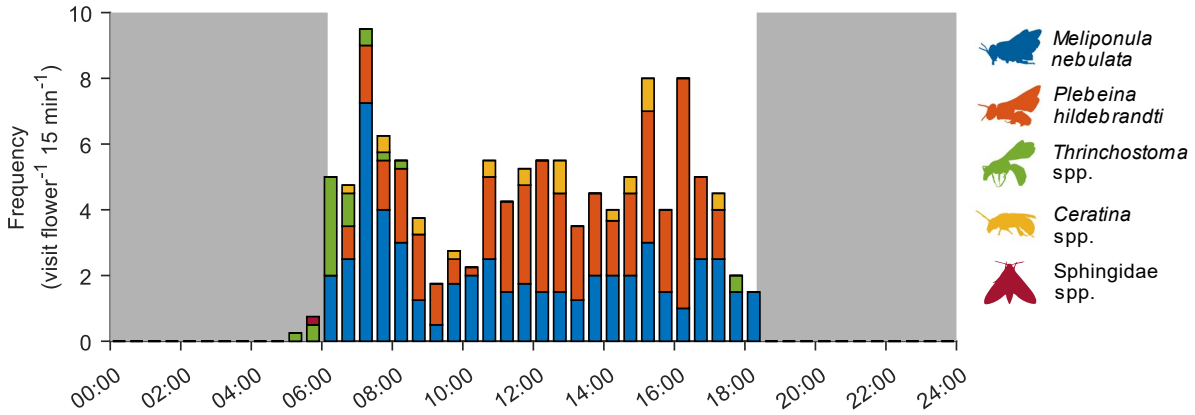
For more information, the full peer-reviewed publication is available here:

- Deblauwe, V., 2021. Life history, uses, trade and management of *Diospyros crassiflora* Hiern, the ebony tree of the Central African forests: A state of knowledge. For. Ecol. Manage. 481, 118655. https://doi.org/10.1016/j.foreco.2020.118655

Ebony pollinator survey

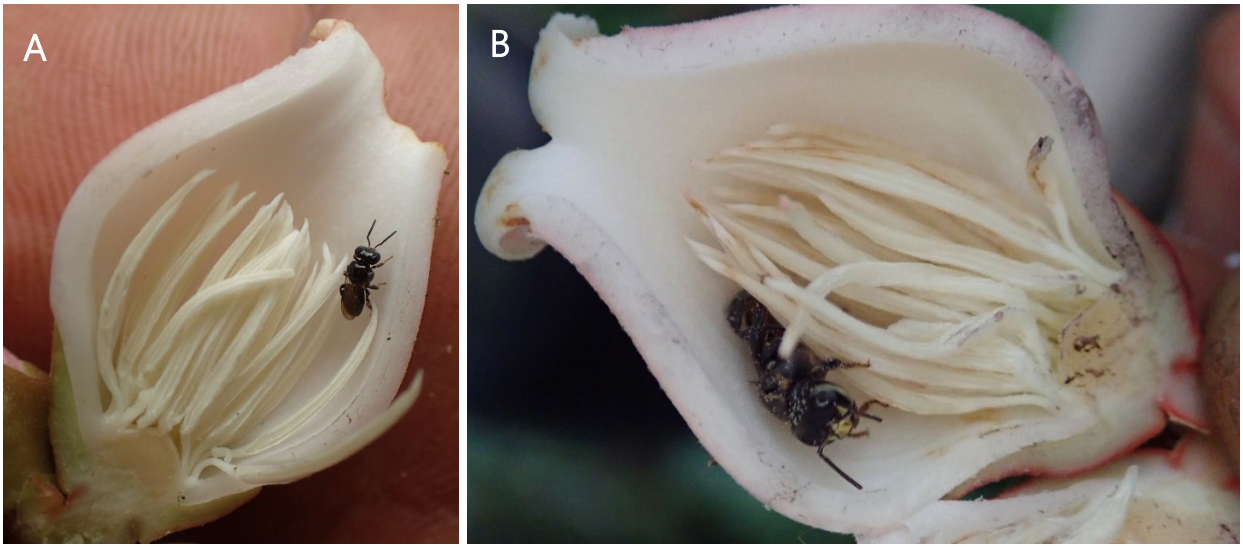
The Project lead scientists, Dr. Vincent Deblauwe, and his colleagues designed a camera trap system based on a Raspberry Pi computer to monitor pollinator activity of *D. crassiflora* in the canopy. The frequency of visits throughout the 24 hours of flower lifespan are shown in **Figure 7**.

Figure 7: Effect of time of day on African ebony Diospyros crassiflora flower visitation rates. *Every taxon observed entering the flowers or sucking nectar at least one time is represented. Grey shadings indicate night-time.*



Project research has identified five taxa in three families (two orders) of insects visiting the flowers: bees *Thrinchostoma* sp. (Halictidae), *Ceratina* sp., *Plebeina hildebrandti* Friese, *Meliponula (Meliplebeia) nebulata* Smith (Apidae) and one moth, Sphingidae. Up to 141 independent visits per flower were observed and were concentrated during the daytime. *M. nebulata* and *P. hildebrandti* were the most frequent visitors. The nocturnal *Thrinchostoma* spp. bees were relatively rarely observed, but being the first to enter the flowers, they are potentially an important pollinator species. These results constitute an important first step towards the understanding of pollen dispersal and gene flow in ebony.

Figure 8: *African stingless bees, ~4.6 mm long Plebeina hildebrandti (A) and 6-7 mm long Meliponula (Meliplebeia) nebulata (B) found alive in staminate flowers that we dissected. Mbalmayo Forest Reserve. Photo credit: Vincent Deblauwe.*



As part of the effort to identify pollinators, the Project developed a new kind of remote camera that can record small insects. The project recently published instructions for building the open source camera.

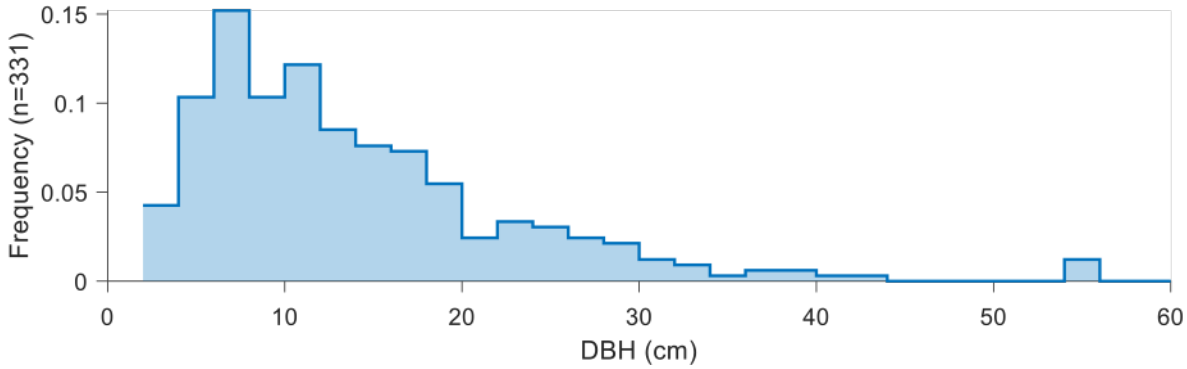
For more information, the full peer-reviewed publications are available here:

- Droissart, V., Azandi, L., Onguene, E.R., Savignac, M., Smith, T.B., Deblauwe, V., 2021. PICT: A low-cost, modular, open-source camera trap system to study plant–insect interactions. Methods in Ecology and Evolution 12, 1389-1396. https://doi.org/10.1111/2041-210X.13618
- Droissart, V., Azandi, L., Onguene, E.R., Savignac, M., Smith, T.B., Deblauwe, V., 2021. How to build and use "PICT". A user-friendly practical guide. In, Zenodo. https://doi.org/10.5281/zenodo.4139838

Impact of bushmeat hunting on ebony regeneration

Ebony is a large fruit tree that depends on large mammals to disperse its seeds. To investigate the impact of human hunting of animals on ebony, a new 400 ha forest inventory was set up in the Mbalmayo Forest Reserve, where a relatively intact patch of forest still persists within an area with a long history of human activities. We found that ebony is still relatively abundant compared to other trees we inventoried. However, the lack of saplings <10 cm in diameter suggest that regeneration is occurring at a very low rate in hunted forests, suggesting seeds are no longer being effectively dispersed (**Figure 9**), which may be due to the hunting of elephants and large antelopes from in the region.

Figure 9: Relative frequency of ebony breast height diameter class in Mbalmayo Forest Reserve.



THE EBONY PROJECT IN CONTEXT

Operations Under COVID-19

Operating under Covid-19 continued to be a defining element of the Project this year. Unfortunately, the communities we work with do not yet have widespread access to vaccines. The field team continued to take precautions before visiting communities, and our permanent local presence continued to be critical to project implementation during the pandemic.[6] International Project team members have also cancelled most in-country visits until further notice.

Replanting Responsibly

The Ebony Project came of age at a time when tree planting became a significant global trend. Internationally, multi-lateral tree planting projects and goals have seemingly increased by orders of magnitude from millions to billions to one trillion. With such high-profile announcements also came a chorus of critiques[7] citing examples where, for example, high profile projects had planted "the wrong trees in the wrong places" and in some cases displaced important non-forest biomes. Other examples included projects where native forests were replaced with biologically simplified commercial operations bringing into question whether such efforts will actually sequester carbon, mitigate climate change, or provide needed ecosystem services.

The Project team has been following these discussions with interest and asking ourselves whether and how the Ebony Project can contribute to the debate. While we set relatively modest planting goals, the project has always been designed as a model for larger rainforest restoration, and a "partnership where business, communities, and researchers work together to protect a valuable

[6] See the 2020 Progress Report for additional information on the impact of Covid-19 on the Ebony Project.

[7] For a thoughtful example, see Holl and Brancalion, *Tree Planting is Not a Simple Solution* published in *Science* and available at https://www.science.org/doi/abs/10.1126/science.aba8232.

timber species, reforest degraded land, address local food security issues, and improve rural livelihoods."

There is now a growing body of literature on best practices and how to plant trees responsibly. Below we assess the Ebony Project against Di Sacco and Hardwick et al's *Ten golden rules for reforestation to optimize carbon sequestration, biodiversity recovery and livelihood benefits*[8] (**Table 3**). The comparison shows that the Ebony Project is performing adequately or better on all of the metrics, and has sparked a conversation within the team about how we can improve.

[8] https://onlinelibrary.wiley.com/doi/10.1111/gcb.15498

Table 3: Ebony Project performance on 10 golden rules of reforestation

Rule No.	Rule*	Rule Explanation*	Ebony Project Performance	Analysis
1	Protect existing forest first	Before planning reforestation, always look for ways to protect existing forests, including old- and second-growth, degraded and planted forests.	Good	Most trees are planted in degraded forest (usually cocoa plantations).
2	Work together	Involve all stakeholders and make local people integral to the project.	Good	We sign MoUs with all communities, and the communities are critical to project implementation. Coordination with relevant government offices could be improved.
3	Aim to maximize biodiversity recovery to meet multiple goals	Restoring biodiversity facilitates other objectives—carbon sequestration, ecosystem services and socio-economic benefits.	Excellent	The project takes a holistic approach that seeks to balance biodiversity, climate change, and the needs of local populations.
4	Select appropriate areas for reforestation	Avoid previously non-forested lands, connect or expand existing forest, and be aware of displacing activities that will cause deforestation elsewhere.	Good	All land where the project plants was previously forested. We still have work to do to understand the role the Ebony Project plays in broader land use decisions in the areas where we work.
5	Use natural regeneration whenever possible	Natural regeneration can be cheaper and more effective than tree planting where site and landscape conditions are suitable.	Okay	The CBI team would like to test natural regeneration and methods to promote it in the Congo Basin. Such findings could be incorporated into the Ebony Project.
6	Select species to maximize biodiversity	Plant a mix of species, prioritize natives, favor mutualistic interactions and exclude invasive species.	Good	The project plants mostly native species, but this has to be balanced with community preferences

				(e.g. communities often request avocados and citrus species, which are non-native).
7	Use resilient plant material	Obtain seeds or seedlings with appropriate genetic variability and provenance to maximize population resilience.	Okay	The CBI team is very concerned with species survival under climate change, and maintaining genetic variation. While we gather seeds from multiple trees, in multiple localities, there is still work to do to understand and ensure species resilience in the face of climate change.
8	Plan ahead for infrastructure, capacity, and seed supply	From seed collection to tree planting, develop the required infrastructure, capacity and seed supply system well in advance, if not available externally. Always follow seed quality standards.	Very good	This is a lesson we learned the hard way as we worked to increase first ebony production and then fruit tree production. While at the beginning we were probably only okay, we have improved considerably as we have increased local capacity to generate plants.
9	Learn by doing	Base restoration interventions on the best ecological evidence and indigenous knowledge. Perform trials prior to applying techniques on a large scale. Monitor appropriate success indicators and use results for adaptive management.	Excellent	The Ebony Project has grown slowly and learned from our mistakes. We are not just relying on ecological evidence, we are generating it. And our participating communities, including indigenous ones, provide critical input and feedback.
10	Make it pay	Develop diverse, sustainable income streams for a range of stakeholders, including carbon credits, NTFPs, ecotourism, and marketable watershed services.	Very good	Our logic model provides short term maintenance payments to communities for five years, which is approximately when the first fruit trees will begin producing. We are also exploring the possibility of carbon credits (see Exploring Carbon).

* From Di Sacco and Hardwick et al, 2021.

Exploring Carbon

In 2019, the Congo Basin Institute (CBI) was approached by the University of California (UC) to explore whether it would be appropriate for the Ebony Project to generate carbon credits at scale for potential purchase as part of UC's Carbon Neutrality Initiative. The UC's Carbon Neutrality Initiative seeks to significantly decrease carbon emissions across all 11 campuses, and to then offset emissions it cannot eliminate through the voluntary carbon credit market.

After a significant amount of research, the Project team is planning to apply to register the Ebony Project under Plan Vivo's standard. We would use Plan Vivo's Small-holder Agricultural Mitigation Benefit Assessment (SHAMBA) methodology, and a peer verification process through UC. There are still many questions regarding carbon credits that need to be answered before proceeding, and regardless the Ebony Project will remain, fundamentally, a restoration and community livelihoods project. Any possible carbon credits would be coordinated to comply with Cameroonian law.

Our Approach to Conservation Programming

A frequently observed shortcoming in the world of conservation funding is that there are rarely honest conversations about what has worked and what has not. Donors and implementers feel pressure to show results and justify funding, which incentivizes everyone to focus on the positive. But there is risk in conservation funding. Conservation projects are complex, with many variables and uncertainties, and it is inevitable that some activities will not work. The Ebony Project has a donor who accepted the risk that the project might fail, and was willing to hear about failures as well as successes. That created a dynamic where the implementer was honest about progress, and we worked together to fix problems. These annual reports document that approach. They provide a forum to share what we have learned—including missteps and failures. We also hope they provide a model for accepting risk and learning from mistakes in conservation programming.

The Next Five Years (Phase II)

We envision the upcoming year as a step change in the Ebony Project. To date, Bob Taylor of Taylor Guitars has provided CBI with the resources to implement the project and has been the project's primary funder, but our funding profile is now poised to change substantially.

The first five years (Phase I) saw slow and steady growth as the project expanded from planting in two communities to planting in eight. The Project team made important scientific discoveries and published several peer-reviewed articles in scientific journals. A Public-Private-Partnership between Taylor Guitars and The Government of Cameroon was signed at the 2017 UN Climate Change Conference resulting in the World Bank commissioning a $50,000 project *Scale Up Feasibility Study* carried out by CBI.

Over its first five years, the Ebony Project accepted small, focused grants (usually on the order of ~15% of annual operating costs) from Fondation Franklinia that supported expansion to another

village and funded additional research; from the University of California that allowed us to explore the possibility of integrating carbon credits into the project; and from the Partnership for Forests (P4F) which supported work to improve fruit tree production and connect products to local, regional, and national value chains. While these partnerships all enhanced the project in their respective ways, they did not fundamentally alter the scale or stakeholder structure of the project.

In October of 2021 Global Environmental Facility (GEF) Council approved a packet of funding that includes a $1.37 million, five-year sub grant to CBI, part of GEF's *Integrated management of Cameroon's forest landscapes in the Congo Basin Project*. Although it will take many months for these funds to be available, GEF funds will essentially double the size of the Ebony Project over the next five years.

The prospect of GEF funds alone represents an inflection point in the life span of the Ebony Project and a transition to the next phase. The next five years promise not only a substantial increase in the scale of the project, but will also likely require changes in how the project operates as new stakeholders join.

To date, the Ebony Project has developed in a dynamic and adaptable atmosphere that allowed us to adapt timelines, goals, and priorities as facts on the ground changed. A business-like "start-up" mentality allowed the CBI's Ebony Project team a level of flexibility that is uncommon in the world of conservation project financing, and crucial to the Project's early successes. The close involvement of both Bob Taylor and Scott Paul of Taylor Guitars in project activities and their familiarity with the country itself allowed honest, real-time assessments of the Project at any given point in time without being hamstrung by previously conceived indicators or matrices of success. If something worked, the Project kept doing it. If it did not work, we stopped or adapted. As a result, the Project had the resources and space to iterate a project that *does* work, and that others want to invest in. Bob and Cindy Taylor recently made an additional three-year commitment to fund CBI to work on the Ebony Project. This will allow the Project continued space to experiment, improve, and explore new avenues opportunistically.

The Ebony Project has always been intended as a pilot project for broader reforestation efforts in the Congo Basin and to accomplish this additional funders will be required. But each new opportunity presents new challenges, and the Ebony Project must be prepared to adapt to the incorporation of more traditional bureaucratic structures with stricter reporting mechanisms that are likely to be less flexible and adaptable. Important new stakeholders in Cameroon and Washington, DC in both the public and private sectors will require enhanced communication and coordination.

Finally, as the Ebony Project's profile increases, we will also receive increasing requests to host visiting filmmakers, reporters, politicians, prospective funders, VIPs and others. While such visits are important they can also be a considerable strain on Project staff as logistics can be daunting. Developing a coordinated approach to share the Project without placing undue burden on the small team of people who make it work will be critical.