CBI CONGO BASIN INSTITUTE

THE EBONY PROJECT

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

Progress Report
2019 December

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Cover picture, an ebony tree planted in Somalomo by project participants. Photo by Vincent Deblauwe.

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 International
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 Forests and Wildlife (MINFOF), Cameroon, Conservation of the Dja Faunal Reserve
National Forestry School Mbalmayo, N. Kingsly

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INTRO

The Ebony Project is funded by Bob Taylor of Taylor Guitars and is a partnership where business, communities, and researchers work together to protect a valuable timber species, reforest degraded land, and improve rural livelihoods.

The project is now in its third year, and this year's annual Progress Report provides an opportunity to reflect. Unlike previous Progress Reports, this document does not provide a lengthy historical background on the project or list of its total accomplishments. For a more comprehensive evaluation please see the 2017 and 2018 Progress Reports, the 2019 scale-up Feasibility Study, and the Taylor's Ebony Project website. Additional perspective can be found in a variety of popular media coverage such as Forbes, National Geographic, The BBC and Euronews. See Annex I for complete list.

This Progress Report will focus exclusively on our successes and challenges in the past year and our assumptions for 2020 and beyond. Principally, this report will cover our work (1) at a community level, (2) growing and planting trees, (3) researching ebony's ecology, (4) on overall project management, and (5) developing project expansion scenarios.

In 2019, the project made important progress on several fronts. Ebony plant production is on course to exceed our initial goals to plant 15,000 trees and we are pleased to report increased interest in the project from villages neighboring existing project sites. We also identify areas where the project must improve, such as in the incorporation of fruit trees and having less ambiguity in community compensation agreements.

Upon reflection, it is clear that the Ebony Project has been succeeding and may ultimately prove to be a robust, durable approach to reforestation, use, and community-based livelihoods in the Congo Basin. The project team is now looking more seriously at expansion scenarios, including how The Ebony Project could best contribute to regional and global initiatives on ecosystem restoration and carbon sequestration.

We hope that by implementing this project, and recording its progress, that we can contribute to a larger effort to conserve the Congo Basin and provide the people who live there with viable livelihoods.

-The Ebony Project Team

COMMUNITIES

Growth and Geography

In 2019, The Ebony Project expanded from two villages (Ekombité and Somalomo) to four (Bifolone and Kompia) (Figure 1), including the first indigenous[1] Baka village (Bifolone) to join the project. At the end of 2019, 36 households were engaged in the project. This year we also began the process of adding two villages—one Bantu and one Baka—for 2020.[2] The two new villages for 2020 are located in the southern buffer zone of the Dja Biosphere Reserve, a priority area for conservation. This area is also part of Tri-National Dja-Odzala-Minkébé (TRIDOM), a transboundary forest area that covers 10% of the Congo Basin rainforest. The TRIDOM region is considered a strategically important mammal stronghold, and is heavily forested with a currently low deforestation rate. However, nearly 65% of the landscape is zoned for logging concessions making the region an obvious conservation priority within the international community. The Project Team believes this region is a strategic location to further test The Ebony Project model as an effective deforestation deterrent and reforestation strategy in buffer zones and corridors between large protected areas.

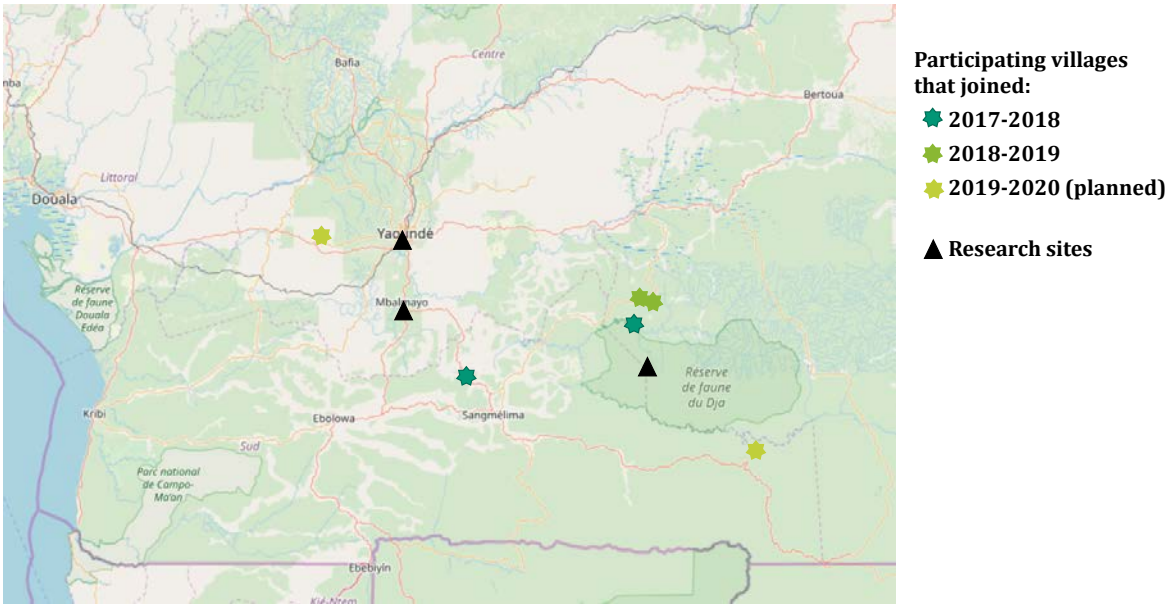

Figure 1: Map of project locations

[1] "Indigenous" is a fraught term in Central Africa. The term indigenous people emanated from the Latin American context, where indigenous communities are homogenous in clearly defined territories. In Central Africa, the term "indigenous" implies that Bantu ethnic groups, who have been present in the area for millennia, are not natives, creating additional tensions between Bantu and Baka ethnic groups. Here, we refer to Baka as "indigenous" in the American understanding of the word, without comment or prejudice towards the lively discussion of the term's meaning within the context of Central Africa.

[2] Project years run from August 1 through July 31 of the following calendar year.

Tracking Community Progress

Three years into the project, we now have a more refined understanding of the timeline for community participation and, eventually, "graduation". As illustrated in Figure 2, the trajectory includes multiple rounds of planting and payment with recurrent trainings and technical support. Articulating the trajectory clearly communicates community work to all stakeholders, and allows us to better plan for project expansion and the graduation of participating villages. The project sometimes moves forward despite not having completed the previous step (represented by the hashed areas). Graphing progress by community has allowed us to identify steps that have not yet been completed. For instance, we have not signed community agreements with Bifolone and Kompia, despite having installed operational nurseries in both locations. We plan to dedicate special attention to the incomplete steps in the 2019-2020 project year. This includes a focus on building the capacity within communities to propagate their own improved fruit trees.

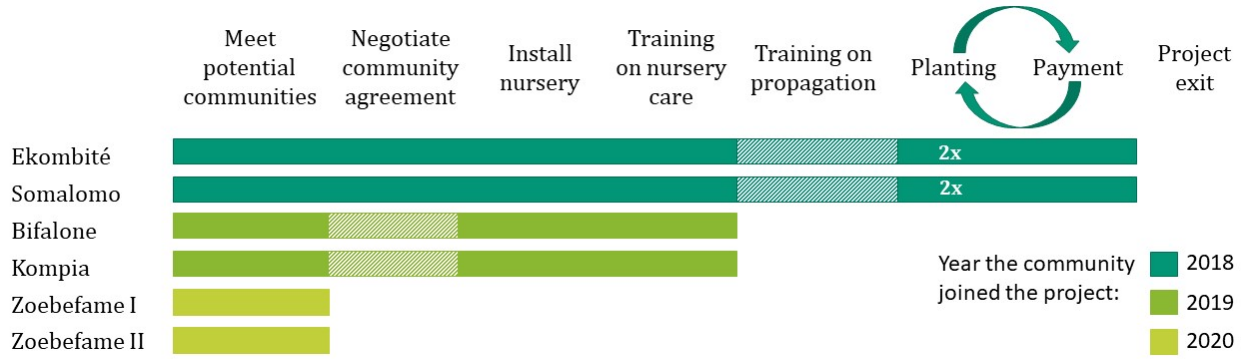

Figure 2: Trajectory of participating communities, organized by year. Bars show the progress in each village along the trajectory; hashed areas have not yet been completed.

Community Compensation

The Ebony Project model includes modest payments to participating communities for their work to establish and maintain a nursery, grow saplings, to plant ebony and fruit trees in various landscapes, and to maintain the planted saplings. The original project design envisioned five years of payments and technical support. After five years the fruit trees should be mature enough that fruit production could begin (depending on the variety), and the ebony saplings will be robust enough to survive without maintenance. Upon graduation, communities can determine whether they wish to continue maintaining the nurseries without incentive payments.

This was the second year in the program cycle for the villages of Ekombité and Somalomo and thus the first year the project made financial payments. Negotiating these first payments was an important early step for the project and set a precedent for those that will follow. Compensation will continue to be an important issue to monitor moving forward; finding equilibrium between fair and appropriate payment for services rendered and a price that will allow the program to be sustainable will be fundamental to our success. See Table 1.

Item	Amount and unit	Remarks
Sowing in pots	10 CFA/plant	
Planting trees	60 CFA/plant	Farmers can plant additional trees in subsequent years
Nursery maintenance	120,000CFA/year/person	This can be paid for up to five years to tend the planted ebony saplings
Field maintenance	30 CFA/plant/year	This is payed at the end of the calendar year according to the yearly inventory done by project technicians

Table 1: Community Compensation Schedule

According to current terms, an individual will be compensated for planting up to 400 trees each year and must plant at least 200 to qualify for a payment. Because the nursery maintenance costs are a lump sum independent of the number of trees planted in the community, the cost per tree decreases as the number of trees planted rises. Compensation for planting 400 trees and tending them for the five-year project cycle is 520 CFA (~$0.87 USD currently) per tree.[3] A community planting 2,400 trees (6 hectares), as it happened in Kompia this year, will receive a compensation of 270 CFA (~$0.45 USD) per ebony tree over five years. The project does not compensate the planting of fruit trees, so the cost per tree for every tree planted is lower. The project team is currently revising language in the payment agreements for newer villages to make the terms clearer. The total costs for future agreements will be approximately the same as those first negotiated, and will be enshrined in the pending agreements with Kompia and Bifolone.

For several reasons, the community payment formula was difficult to estimate at the beginning of the project. Firstly, and in hindsight, the wording in the first community agreements was somewhat vague, stating that CRELICAM will "pay a symbolic sum corresponding to 70% of the maintenance price." The method for calculating that maintenance price, including the cost of labor, was not included in the agreement and thus needed to be negotiated afterwards. Secondly, the project underachieved delivering fruit trees at the rate originally planned, and fruit trees are an important part of the value proposition for communities. Overcoming this deficiency is discussed below in the section Fruit Tree Production.

Finally, the process of initiating the program in a new village is also evolving. Originally, the project began working with a relatively large group of individual participants in each village, but experience has shown that a sizable percentage of any larger group is only interested in short-term economic remuneration. We now believe that starting with a smaller number of highly motivated individuals who are interested in the long-term, broader project objectives helps grow the project more successfully as neighbors see the results.

[3] This includes only one year of nursery maintenance costs.

Based on these experiences, the new MoU that will be signed by the communities of Kompia and Bifolone will include specific fees for nursery maintenance, sowing and planting.

Land Use Planning and Documentation

Under Cameroonian law, the forest belongs to the state, but if a person plants a tree, it is supposed to belong to the individual. Proving ownership decades later, however, is a challenge. The fact that The Ebony Project aims to create agroforestry settings that mimic mature forest as much as possible will only complicates future claims. There are efforts at the national level to find a regulatory or legislative fix to this challenge, but they have not yet come to fruition.

To address this, the Ebony Project planned to create a "sylvicultural booklet" that would document tree plantings in an effort to bolster an individuals' future claim of ownership of a fruit or ebony tree they planted under the project. However, production of a booklet remains a challenge owing to regulatory uncertainty and practical considerations. For example, sylvicultural booklets would provide more security if they included an official sanction, such as the certification from a government official or a fiscal stamp. However, the process of getting government certification of the planting is murky—it is not clear who has the authority to provide the certification, and whether and how that person would need to be compensated. The project has not budgeted for costs associated with certification.

Obviously, The Ebony Project does not have the authority of the state—only the Government of Cameroon has the ability to grant property rights to planted trees. However, in an attempt to bolster future claims, it is a priority for the Project in the coming year to develop a simple, single page form that documents plantings, including the name of the farmer, the specific location, and the number and type of trees planted. It must be made clear that the document is not legally binding or guarantee future state recognition.

In 2019, two communities planted ebony for the second time. Somalomo and Ekombité planted 80% and 30% respectively of the number planted in 2018, suggesting a declining trend over the years. However, it is too soon to assess the capacity of an average community to plant trees year over year. This year, the demand for ebony trees by the community members exceeded the available stock. The two communities that joined the project in 2019 attracted more participants and planted more trees than Somalomo in its first year. As a result, the approximately 2,000 ebony trees planted so far in Ekombité can be considered as the minimal total planting capacity of a community. The approximately 2,500 ebony trees planted in 2019 in Kompia suggests that the maximum annual capacity of a single community can exceed this number.

GROWING AND PLANTING TREES

Ebony Production

To date, **the project has transplanted 7,507 ebony saplings** and we expect to reach our original goal of planting 15,000 ebony trees by the end of 2020, when we plan to plant at least 8,000 ebony trees. The 2020 planting will be largest to date, as the ebony seeds collected in 2018 have now reached the point of maturity in nursery settings. There are two stages to planting:

1) **Producing the saplings**: We produce plants by sowing seeds or asexual generation through cuttings, grafting, or marcotting. This step occurs in the nurseries. Figure 3 shows the ebony plant production by year.

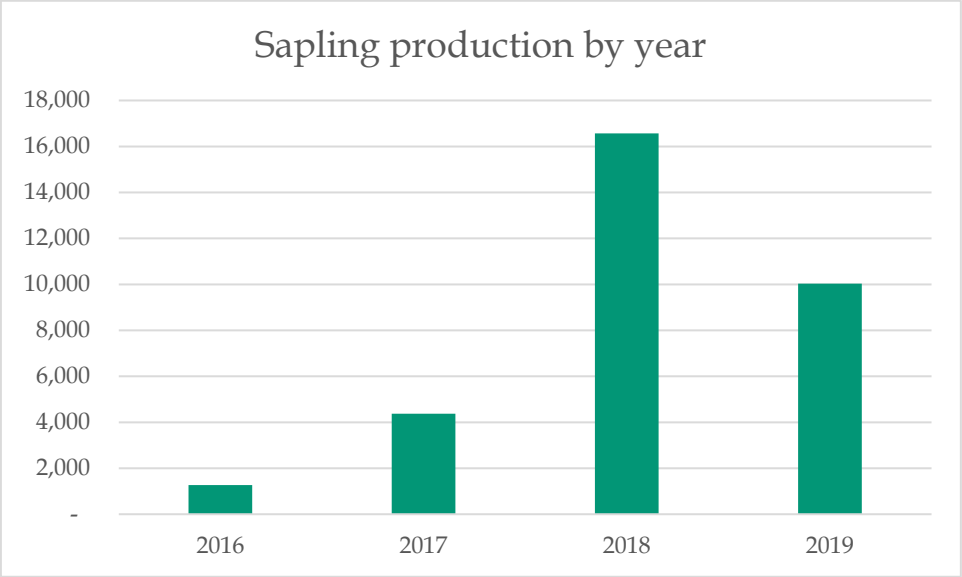

Figure 3: Ebony plant production by year

2) **Transplantation**: After the plants have grown in the nursery, they are transplanted in various field settings. Trees have been planted in a variety of settings ranging from open field to mixed agroforestry with moderate canopy cover to a mature secondary forest with closed canopy. Survival rates after the first year after transplanting range from 60 to 100% with higher mortality associated with less shade cover. Farmers will need to continue to tend trees once a year until they are well-established, three to five years after transplantation.

   Figure 4 summarizes the transplantation of all species by year and by community.

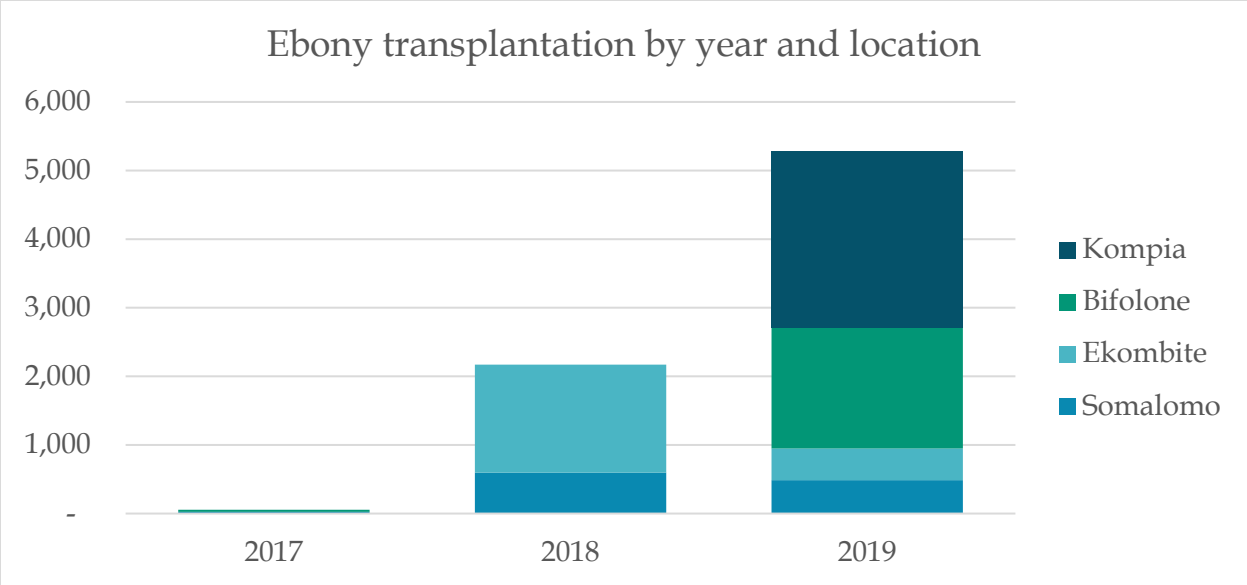

Figure 4: Ebony transplantation by year and location

Our experience demonstrates that all of the ebony production methods have benefits and deficiencies:

- *Seed production* is variable (and possibly cyclical)[4] in nature and requires significant person power to collect and germinate the seeds. However, creating an inventory of mother trees near a community allows a relatively stable seed supply, even during low fruit years. Our experience suggests that a 2 by 2 km plot of pristine forest can provide around 20,000 seeds during a medium to low fruit year. Ebony seeds lose most of their ability to germinate after two weeks at ambient temperature. However, when enough seeds are available, collected, and properly planted, the resulting saplings are usually high quality. There is no seed dormancy and the seeds germinate after a few days. A germination protocol developed at IITA of pre-germinating seeds in wet jute bag has consistently allowed us to achieve a germination rate of 90 - 100%. In community nurseries the germination rate often falls between 70 and 80% depending on stewardship. Communities germinate seeds directly in earth pots, as it is less labor intensive.
- *Cuttings* are an important way to address concerns about seed availability, but grow slowly, exhibit a plagiotropic (horizontal) growth habit, and initial results suggest they have a high mortality rate. We observed up to 70% of plants rooted after 22 weeks. The extended period of time needed before apical growth resumes makes the cutting particularly vulnerable to occasional lack of maintenance in the nursery. There are also some concerns

[4] The three years the project has monitored ebony fruit and seed production is insufficient to make a comment on cycles of ebony reproduction.

about the quality of wood these plants will ultimately produce; their plagiotropic growth focuses energy on horizontal growth, rather than a tall, thick, central trunk.

- *Tissue culture* has been pursued as it offers an opportunity to produce clones of high-quality plants, disease free on a large scale. The main advantage of tissue culture is to remove the need to set up large scale ebony tree inventories to secure a constant annual seed collection. It gives the potential of producing plants independently of the natural fluctuations of seed production, simplifying project scale up. After initial successes in achieving micro-propagation, there have been some technical hurdles that the current staff has not been able to solve. Specifically, achieving good rooting continues to be a challenge. The project team recommends putting this part of the project on hiatus while we search for the additional expertise to help move the tissue culture forward.

Table 2 summarizes the advantages and disadvantages of the different methods.

Production Method	Pros	Cons
Seeds	Produces high quality plants	Collecting seeds is resource intensive Production dependent on fruiting
Cuttings	Nearly unlimited production with little effort Can clone high-quality trees	Slow growth Plagiotropic (horizontal) growth High mortality rate
Tissue culture	Can clone high quality trees Would allow for large scale production	Not yet a viable production method

Table 2: Comparison of ebony production methods

As plant production in the nursery has improved, transplantation has increased. The 2019 spring planting was the largest to date. The 2020 transplanting season will be even larger.

Fruit Tree Production

The project's success at producing and transplanting ebony has not been matched by our production of local fruit trees, which are important for the logic model of the project but have been under-produced. **We have planted 509 locally valuable fruit and medicine trees to date**, including wild mango, cola, djansang, safou, avocado and soursop (Table 5). The saplings were produced from seed at the village nurseries, IBAY and other research nurseries. This year, we have set a goal of producing 5,000 fruit trees. We have gathered over 5,000 fruit seeds; 2,270 of those seeds have already germinated (Table 3), and we expect more to germinate in the coming weeks. We have included additional culturally important fruit trees: Allanblackia floribunda and Trichoscypha spp. We also plan to lay the ground work to produce more improved trees that are selected for the quality of their fruit and will begin producing within 3-5 years.

Why fruit trees are important for the project. Since ebony's time to wood maturity is over 60 years, the project must find a faster way for the reforested land to provide value to local communities. The project design relies on locally-valuable fruit trees, preferably improved versions that can fruit within 3-5 years of transplantation, to provide near-term value to farmers.

	Wild Mango	Moabi	Djansang	Safou	Cherry	Citrus	Thévetia	Trichoscypha sp.	Allanblackia
Ekombité	571	230	0	0	0	0	0	0	0
Somalomo	105	19	0	0	0	0	0	46	0
Kompia	24	0	0	0	0	0	0	8	0
Bifolone	355	123	6	0	6	0	0	92	0
IBAY	136	163	0	177	0	4	205	0	0
TOTAL	**1,191**	**535**	**6**	**177**	**6**	**4**	**205**	**146**	**0**

Table 3: Fruit trees germinated this year, as of December 2019, in each nursery.

There are three sources for the fruit trees: seeds collected by the farmers themselves, marcotting in communities, and purchasing from commercial nurseries. See Table 4 for a summary of the production methods. While the ultimate goal is to rely largely on marcotting—it allows for the cloning of high-performing trees and results in saplings that can produce fruit in 3-5 years after transplantation—in 2020 the project will need to rely on seed-produced and commercially procured fruit trees to supplement supply.

Method	Availability for transplantation	Fruiting timeframe	Improved?	Community production?
Seeds	6-18 months	5-20 years	✓	✓
Marcotting	2 years	3-5 years	✓	✓
Purchase	immediately	3-5 years	?	✗

Table 4: Comparison of fruit tree sources

The project provided training on fruit tree propagation using an air layering technique on safou, mango, and avocado in five communities: Ekombité (10 men, 8 women), Bifolone (12 men, 2 women), Adjan[5] (11 men, 9 women), Kompia (14 men, 2 women) and Somalomo (7 men, 2 women). The project taught the benefits of multiplying fruit trees using vegetative propagations techniques, and explained why farmers see a loss of desirable characteristics in seed progeny. The farmers learned how to select the best trees based on organoleptic quality of the fruits, and how to initiate root growth on mature stems. Next year, we will inventory the rooted stems obtained by the farmers on their own trees using the material given by the project. Those plants will be ready for planting in 2021.

	Avocado	Mango	Bush mango	Moabi	Cola	African nutmeg	Djansang	Safou	Ayous	Soursop	Cherry
2017	10	11	9	0	0	0	0	9	0	0	0
2018	100	0	15	36	2	100	20	7	3	52	2
2019	21	0	23	28	0	0	14	47	0	0	0
Total	**131**	**11**	**47**	**64**	**2**	**100**	**34**	**54**	**3**	**52**	**2**

Table 5: Fruit trees transplanted to the field at the time of writing

Avocado (Persea americana Mill.), mango (Mangifera indica), bush mango (Irvingia gabonesis), moabi (Baillonella toxisperma Pierre), cola (Cola acuminata (P. Beauv.) Schott & Endl.), African nutmeg (Monodora myristica (Gaertn.) Dunal), djansang (Ricinodendron heudelotii (Baill.) Pierre ex Heckel), safou (Dacryodes edulis H.J. Lam), ayous (Triplochiton scleroxylon K.Schum.), soursop (Annona muricata L.), cherry (Dacryodes macrophylla (Oliv.) Lam.).

The project focuses on areas in Cameroon that are in the buffer zone of important protected areas, and are currently experiencing conversion pressure from forest to agroforest and agricultural fields. Participants involved in the project are also engaged in small scale land conversion activities, for example the planting over 7,000 cacao plants in the past two years. While the Ebony Project discourages deforestation and does not promote cacao, the communities we work with have demonstrated significant interest in co-cropping ebony and local fruit trees with cacao. Such an approach should increase the biodiversity, carbon sequestration, and forest cover in cacao plots.

[5] Adjan is a village between Somalomo and Bifalone. The community there has been very interested in participating in the project, and has voluntarily joined project activities.

In the coming year the project team will discuss whether cacao should have a role in the project, aided by an assessment on cacao co-cropping in the Feasibility Study and IITA's extensive experience with cacao in Cameroon.

THE ECOLOGY OF EBONY

1) In 2018, the project team conducted extensive field research, including the deployment of camera traps set up for a period of 2-months to study of 10 fruiting trees in hunted forests (HF) and 7 trees in non-hunted forest (NHF) forest respectively. We found that:

- the yellow backed duiker (*Cephalophus silvicultor*) was the main documented seed eater in HF
- inspection of more than 150 elephant dungs showed that a quarter of them contained germinating ebony seeds
- rodents predate seeds in both treatments
- in HF, most seeds are not dispersed or eaten, and just germinate from inside the rotting fruits

2) We established two 400 ha research plots in NHF and one in a HF. We found that:

- The number of saplings to mature tree ratio is ca 50% lower in HF (low regeneration)
- Saplings are clustered at a radius of 60m around mother trees in HF, suggesting a limited dispersal of seeds
- Saplings are randomly distributed in the NHF, suggesting effective long-distance seed dispersal

3) We conducted a telemetric thread tag experiment in NHF by attaching radio transmitters to seeds to follow dispersal by rodents. We found that:

- All removal events where due to Emin's pouched rats (*Cricetomys emini*).
- Most removed seeds where cached at less than 20 m from the mother tree, suggesting that Emini pouched is dispersing the seeds, but at short distance.

4) We developed and installed camera traps in the canopy of ebony trees at the national school of water and forests (ENEF) arboretum in Mbalmayo and in Kompia community forest. We found that:

- Identification of pollinators and their frequency (moths, Halictidae nocturnal bees and stingless bees)
- video documentation of the daily cycle of flower opening and insect visits
- Documented occasional predation event on flowers by small rodents and insects

5) We monitored the growth, flower set, and fruit set of 306 ebony trees in Ekombité since 2017. This provides insight on the growth rate and reproductive activities of ebony under different conditions. We found that:

- Growth rate in open cacao field and in closed forest
- Allocation to Reproduction and Relative Reproductive Costs differ in male and female trees: female trees completely stop growing when they set fruits (April-September)

6) W monitored the phenology of leaves, flowers and fruit production at the arboretum of Mbalmayo National Forestry School, and found that:

- Fruit and flower production are extremely variable from one year to the other. While the proportion of trees that have produced flowers is similar in 2018 and 2019, the production of flowers and fruits was 6 and 10 times lower in 2019, respectively.
- During years of large fruit production, leaf production is low, and inversely, female trees produce much less flowers than male.

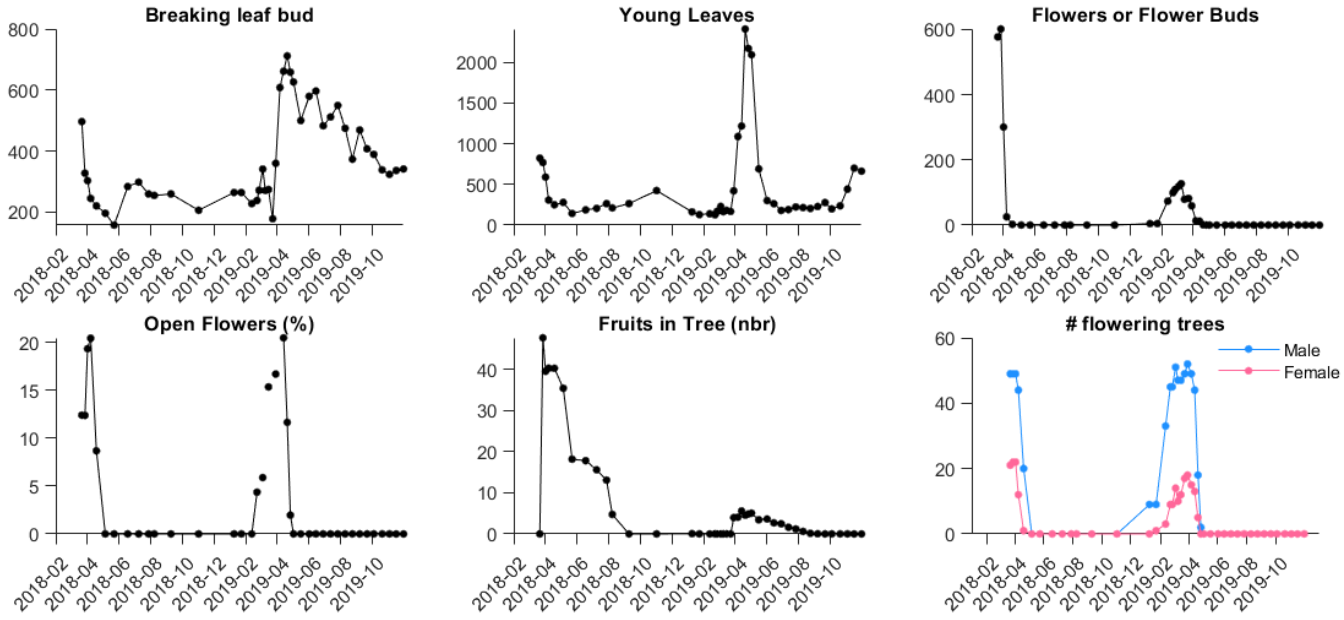

Figure 5: Phenophases of 102 ebony trees at Mbalmayo National Forestry School. The trees were planted ca. 2003 and 54 and 25 trees were observed producing male and female flowers, respectively.

7) We completed the parentage analysis from the three ebony plots (each 2 by 2 km) established in 2017 and 2018 in the Dja reserve and near the village of Kompia. We were able to identify the parents of every sapling, provided that they are present in the plot. This was the subject of a master thesis that was defended in Université Libre de Bruxelles.

- In the two plots in the protected forest of the Dja Reserve, we found the parents of 5% and 8% respectively of the saplings (<10 cm in diameter), a very low number compared to what has been observed with other timber species. This means that in the Dja, almost all the young plants in the 400 ha plots have their parents outside of the plot. This is probably the "elephant effect" which results in dispersal at longer distances. By contrast, in the hunted forest near Kompia, we found the parents of 39% of the saplings. The average seed dispersal distance in Kompia was 958 m (CI 95%: 702 – 1507 m). These results suggest that ebony seeds are dispersed at longer distances in pristine forests, and at shorter distances, or not dispersed at all, in a hunted forest.
- Pollen dispersal distance (from father tree to mother tree) for ebony is relatively short compared to other tree species: 261 m (CI 95%: 231 - 302 m) at Kompia and 465 m (CI 95%: 369 - 627 m) at Bouamir. The distance is higher at Bouamir probably because there are fewer ebony trees, and they are further apart from each other. For comparison, the average distances of pollen dispersal of other timber species with higher abundance in the Dja (meaning shorter distance between adult trees) than ebony are: Sipo (*Entandrophragma utile*): 1854 m; Movingui (*Distemonanthus benthamianus*): 700 m; Tali (*Erythrophleum suaveolens*): 294 m. This short pollen dispersal distance of Ebony should be considered when selectively logging trees.
- Most pollination of female flowers happened from the closest male tree (sometimes the closest two or three trees).
- As a consequence, several big and healthy male trees never or seldom mate.
- Self-breeding (sapling with father and mother being the same individual) was never observed even though we know that around 1 tree out of 100 is hermaphrodite in old ebony plantations.
- We know that the number of trees decrease with increasing diameter. An important question is therefore: are the biggest trees, the ones that are logged, responsible for most of the regeneration? In fact, the biggest trees, even if they are few, contributed the most to the next generation. But since the biggest trees in the plot were around 60 cm in diameter, we cannot assess what the contribution is for very big trees.

2020 research next steps:

1. Observation of ebony fruit and seed set in natural forest.
    - Logging the largest ebony trees of the forest is likely limiting the regeneration success by increasing the distance between trees and the success of pollen dispersal. To identify possible pollen dispersal limitation, we will test the association between the distance to the nearest male tree and the fruit and seed set of female trees.
2. Set up of a new plot in a hunted-logged forest in Mbalmayo. This will
    - Provide a replicate for the HF
    - Provide information about the impact of logging the largest trees on regeneration
3. Continue the follow up of growth in the Dja (natural forest), Ekombité and ENEF (plantation)

- Ebony a slow growing species and we need several years of measurements to get a good estimate growth rate for each diameter class. These results will help us document carbon sequestration by ebony trees.

4. Establish new 400 ha ebony plot in Dzanga-Sangha reserve, Central African Republic (CAR).
    - Explore creation of a permanent forest plot in Dzanga-Sangha reserve to monitor establishment and survival of ebony and other trees saplings in a pristine forest with a density of large mammals close to carrying capacity.
    - Identify possible additional ebony seed dispersers like gorilla and chimpanzee. The latter have been observed in captivity by our team, at Mefou sanctuary, eating fruits and defecating entire seeds.
    - investigate the effect of removal of elephant on the forest structure and composition and its impact on carbon storage

The decline of large animals in tropical forests due to the loss of habitat and the bushmeat trade and poaching has reduced important seed dispersal mechanisms for several tree species. As a result, undispersed seedlings are thought to suffer increased density-dependent mortality. Large animals are responsible for the dispersal of the largest seeded plant species which are often associated with large trees and high wood density. Consequently, extirpation of large vertebrates may alter the composition and spatial structure of plant communities and impair ecosystem functions like carbon storage. At the northern edge of the Congo Basin rainforest, the CAR rainforests are known to shelter a high density of mature ebony trees. Up to 4.4 ebony trees >10 cm in diameter ha^{-1} have been observed at Mbaïki experimental station, CAR. This is an order of magnitude above the 0.5 trees ha^{-1} that we observed in 1,200 ha of forest in the Dja, Cameroon. The forest of Dzanga-Sangha reserve, in the SW corner of CAR, constitutes an extreme in the gradient of elephant density, with a population of 0.10 elephants km^{-2} in 2016, to be compared with the 0.04 elephants km^{-2} in 2018 in the Dja reserve (WWF data). The ebony population in CAR is an ideal benchmark to evaluate the loss of regeneration in hunted forest of Cameroon.

Managing Operations

In the past three years the project has made effective improvements to its management and operations, but Cameroon remains a challenging environment to operate in. We have come to understand that certain risks cannot be avoided, or even mitigated, and we need to set realistic expectations for ourselves, our communities, and our supporters about working the region.

Growing the Team

In 2017, the project set a goal to increase the number of young Cameroonians working on the project, and by 2018 began earmarking funds and identifying qualified research assistants. As a result, in 2019 the project was able to hire three new student workers. It is anticipated that starting

in 2020 this increased capacity will ease the process of expanding to new villages and give senior project staff more time to focus on other issues, for example, publishing research findings in peer-reviewed scientific publications.

Investing in young Cameroonian staff meets two immediate needs. First, it increases our capacity to work effectively with communities and to conduct research. Second, it helps trains the next generation of Cameroonian scientists on skills ranging from the scientific method to budget and time management, thus contributing to CBIs larger mission to build local capacity.

Managing Team Members

The Congo Basin Institute (CBI) manages The Ebony Project as a collaboration between three organizations: The University of California Los Angeles (UCLA), the International Institute for Tropical Agriculture (IITA), and the Higher Institute for Environmental Studies (HIES). UCLA, is the project lead and provides ecology expertise. IITA is the in-country host for UCLA's work and has led the effort to regenerate ebony through tissue culture, and HIES is a Cameroonian university that leads the community engagement and agroforestry. Taylor Guitars, Madinter and Crelicam staff also play an important in-kind role.

The following management changes are planned for 2020:

Pausing tissue culture efforts while we search for additional technical expertise

The project has made progress over its first three years advancing tissue culture, a notoriously difficult proposition for tropical hardwood species. By 2019, the project had successfully transitioned a few dozen ebony plants produced via tissue culture into a greenhouse setting, but many technical questions remain unanswered. Survival rates remain low and saplings continue to predominantly grow laterally rather than horizontally, preventing consistent output of viable saplings. Efforts to find technical assistance, mainly through a US Department of State program, have proven unsuccessful.

As a result, the Project will suspend tissue culture work in 2020 but will continue funding into the New Year allowing the project time to document and archive everything learned to date, and further permit the graduate student to finish her PhD based on her three years of hands-on lab experience as part of The Ebony Project team. It is hoped that appropriate technical expertise, and with adequate funds, this work will resume at some point in the future.

Introducing more structure into our collaboration with local partners

Earlier in this progress report, we noted our shortcoming with respect to fruit tree production, and listed our technical approaches to addressing the shortage. We will also be making some management improvements to address the issue. Specifically, in 2020 we will trial a more structured relationship with HIES tying funding to specific technical milestones. Rather than providing funds in an annual lump sum, HIES will receive funds on a trimester basis once they have

demonstrated meeting the defined deliverables for the previous period. This approach will be supported by monthly management meetings with HIES.

In 2019 the UCLA Institute for the Environment and Sustainability (IoES) completed its third annual Senior Practicum course with a project focused on the Taylor Guitars Ebony Project. Each year, five to six undergraduate students in IoES have been selected to work on the project for three quarters, conducting research and writing reports.

In 2019, UCLA refined its approach to the Ebony Project Practicum, providing selected students with a list of research topic to choose from that more directly mirrored real-world issues confronted by The Ebony Project. Core members of the Ebony Project team itself also took a more hands on role than in previous years. While the ability of undergraduates to contribute to such a complex project is limited, we hope having students focus on more pragmatic, real-time questions ultimately provided a more meaningful overall experience.

The 2019 class proved more productive with technological and scientific research projects than previous classes were with larger, less defined economic, social science, or management topics. 2019-2020 will be the fourth year for the project, and we're hoping to apply lessons we've learned from past Practicum's to make this one both beneficial to the project and enriching for the students. This collaboration with IoES is also an important opportunity to increase public awareness about the project, and to give American students an opportunity to understand and work on a complex environmental issue.

Future Potential

The Ebony Project is funded exclusively by Bob Taylor and is capable of supporting plant propagation and planting activities in four to five villages at a time, in addition to supporting all ongoing ecological research activities that unpins the community level restoration work. As discussed above, the project cycle design has participating villages "graduate" out of the project after five years allowing new villages to enter. In this way the project can expand over time under existing funds. The Ebony Project was always envisioned as a "demonstration project" with the hope that, if it worked, it would be expanded or otherwise replicated.

As per the 2018 Progress report, Taylor Guitars signed a Public-Private-Partnership agreement with the Government of Cameroon at the Bonn Climate Convention Conference of the Parties in 2017. This agreement called for a Scale-up Feasibility study to "conduct a technical analysis of the feasibility, opportunities and obstacles of expanding the current Ebony Project into additional forest communities, agroforestry projects, and restoration project areas." The study, a collaboration between UCLA, IITA, HIES and Taylor Guitars, was completed in 2019 and provides a roadmap for project expansion.

In 2019, several possible new funders emerged expressing interest in the project, including: Fondation Franklinia, the Global Environmental Facility (GEF), and the University of California carbon offsets office, driving the project team to consider various expansion scenarios beyond previously forecasted capacity. In looking forward, it is also clear that the project's objectives fit well with broader global priorities such as carbon sequestration and reforestation efforts such as the UN Decade of Ecosystem Restoration (2021-2030) and the African Forest Landscape Restoration Initiative (AFR100), which seeks to restore 100 million hectares of African land by 2030. As we consider expansion scenarios for 2020 and beyond, there are several key issues that need to be discussed.

- Team Roles and Growth: Our diverse team brings together business, research scientists, and communities. Ensuring that new potential donors respect this operating model will be critical to any expansion plans.
    - *Staffing*: What is the appropriate staff structure for the project under several growth scenarios, and how do we find qualified staff?
    - *Partnership structure*: With possible additional partners joining the project, how do we maintain the integrity and functionality of the original partnership that we feel works so well?
    - *Communities*: How do we maintain a close and productive relationship with communities as we grow? Substantial modelling in the Feasibility Study provides a strong foundation for this issue.
- Size and Pace of Expansion: The Project Team has agreed to modest, thoughtful expansion, erring on the side of small and successful over large and mediocre. We will leverage existing project sites and historical working relationships with communities to expand organically. In 2020, we will draft a staged expansion plan that includes modest expansion in 2020-2021 followed by potentially larger expansion in 2021-2022. New anticipated grants from Fondation Franklinia and the UC Carbon Offsets program will fund the modest expansion in 2020-2021.
- Connecting The Ebony Project to Global Priorities In 2020, we hope to connect the project more concretely to these global priorities.
    - *Carbon sequestration potential*: The Ebony Project has the potential to contribute to the pressing global need to sequester carbon. Carbon sequestration and carbon markets are complex, and in the coming year the project hopes to conduct additional research to better understand The Ebony Project's potential contribution to meeting global carbon reduction goals

- *Reforestation*: As the world continues to destroy and degrade forests, reforestation has become an increasingly urgent priority, and the Ebony Project may provide a durable such model in tropical regions. Continuing ecological research that clarifies the conservation value of land reforested by The Ebony Project is critical to linking it to larger restoration goals.

Durability: The project team adopted this term for the lasting value of restoration efforts—i.e. do the trees that are planted stay planted or is the forest quickly degraded again? We want to compare the Ebony Project's integrative, community-based, mixed-use approach to more traditional large scale tree planting initiatives, and determine if one results in more effective, long-term, outcomes.

- *Indigenous communities and local land management*: Expansion gives us an opportunity to think bigger programmatically. For example, we would like to leverage the participation of indigenous communities in the Ebony Project into a larger effort to allow indigenous communities to manage their own land.

Measuring and communicating project outcomes: To successfully connect with these global priorities, we will need to improve our ability to measure and communicate project impact. There are very few proven approaches to simultaneously. If The Ebony Project can demonstrate its success improving biodiversity and carbon sequestration *and* advancing human development indicators like food security and household financial stability, it would have a significant impact on conservation.

- Value chains and species: The Ebony Project exists because Taylor Guitars invested in it. The Ebony Project has thrived because Taylor Guitars has been a meaningful and constructive partner. But the market for ebony is relatively small and stagnant, leading to limited commercial demand. In 2020, the project will need to grapple with the question, should The Ebony Project consider moving beyond ebony?

ANNEX I: 2019 MEDIA COVERAGE

- National Geographic - Cameroon's embattled ebony trees get a lifeline—from guitar maker
- Reuters - U.S. guitar firm tunes business to protect Cameroon ebony
- BBC - How To Stop Killing Ebony
- Forbes - Sustainable Guitars - Giving Back To The Trees And Communities That Helped Create Music
- EuroNews TV - The Ebony Project
- Eco Africa - Cameroon and Taylor Guitars team up to replant ebony trees
- San Diego Times Union Tribune - Taylor Guitars' 'Ebony Project' continues to save trees in Africa
- CleanTechnica - Taylor Guitars Announces Planting Of 1,500 Ebony Trees In Cameroon
- Guitar Player - Another Green World
- Premier Guitar - TAYLOR GUITARS MAKES HISTORY WITH LARGEST RECORDED PLANTING OF WEST AFRICAN EBONY TREES IN CAMEROON'S CONGO BASIN
- Fretboard Journal - Putting Back: Taylor Plants 1500 West African Ebony Trees in the Congo
- Guitar World - Taylor Guitars Makes History with Largest Recorded Planting of West African Ebony Trees
- American Songwriter - Taylor Guitars Makes History With Largest Recorded Planting Of West African Ebony Trees In Cameroon's Congo Basin
- Acoustic Guitar - The Ebony Project: Taylor Guitars Plants Trees in Cameroon to Preserve This Vulnerable Tonewood
- Performer Mag - Taylor Guitars makes history with largest planting of Ebony trees in Congo Basin
- Peghead Nation - An Earth Day Message From Bob Taylor
- Guitar Girl Mag - Taylor Guitars Makes History with Largest Recorded Planting of West African Ebony Trees in Cameroon's Congo Basin
- Music Players - SAVING EBONY - TAYLOR GUITARS MAKES HISTORY WITH LARGEST RECORDED PLANTING OF EBONY TREES IN CAMEROON'S CONGO BASIN
- Jazz Guitar Today - Protecting the Future of Guitars – One Plant at a Time
- Guitar - TAYLOR EXPANDS THE EBONY PROJECT WITH 1,500 NEW TREES IN CAMEROON
- MMR - Taylor Guitars Makes History with Largest Recorded Planting of West African Ebony Trees in Cameroon's Congo Basin
- Music Trades - Taylor Preserves Vital Raw Material With Ebony Project
- Music Inc. - Taylor Plants 1,500 Trees
- Music & Sound Retailer - Taylor Guitars Makes A Big Difference In Cameroon
- Business in Cameroon - US Taylor Guitars planted 1,500 ebony trees in Cameroon
- Africazine - Taylor Guitars makes history with largest planting of Ebony trees in Congo Basin
- Africain - The Ebony Project: Taylor Guitars Plants Trees in Cameroon to Preserve This Vulnerable Tonewood
- The Good Men Project - Is There Such Thing as an Eco-Friendly Acoustic Guitar?