Pest Management Plan

Date: 16/11/2023

CEPF Grant 113803

Grantee: Ebony Forest Ltd

Project Title: Restoring degraded forests in Mauritius

Project Location:
Vallée De L'Est (MUS-02)
Ebony Forest Chamarel (MUS-03)
Mauritius, Madagascar and Indian Ocean Islands

Grant Summary

1) **Grantee organization – Ebony Forest Ltd**
2) **Grant title – Restoring degraded forest in Mauritius**
3) **Grant number - 113803**
4) **Grant amount (US dollars) - $272,500**
5) **Proposed dates of grant – 12/1/2023 – 12/31/2026**
6) **Countries or territories where project will be undertaken - Mauritius**
7) **Summary of the project**

PROJECT RATIONALE

Climate change impacts on Mauritius

Mauritius is amongst the most vulnerable countries in the world to climate change. Tidal surges, cyclones, droughts, and floods will directly affect food security, human health, crop and livestock diseases and ultimately our daily lives. The greatest challenges identified in the National Climate Change Adaptation Policy Framework for the Republic of Mauritius are severe reduction in water supply, with projected demand outstripping supply; declines in agriculture production due to rainfall variability; loss of natural terrestrial and marine habitats; and the loss of natural assets such as beaches that are the pillar of the tourism industry. While climate change and climate variability will affect all Mauritian residents, it is and will continue to disproportionately impact those more disadvantaged.

Climate change impacts at the local scale

This application is to work at two sites that occur in the poorest areas of Mauritius: Vallée De L'Est in the Bambous Mountain Range (MUS-02) and Ebony Forest in the Chamarel-Le Morne KBA (MUS-03). Both forested sites are important water catchment areas and supply groundwater reserves. Ebony Forest is a feeder site for the proposed Chamarel dam, which could supply the dry west and south-west regions, where water shortages are common throughout the year.

In the last decade, the intensity and frequency of flash flooding has increased leading to damage to public and private infrastructure, loss of income and in some instances life. Flooding and landslides in both areas will be further exacerbated by the conversion of forested and agricultural land for development. Despite being an Environmentally Sensitive Area, forested land is being cleared to construct residential housing on the boundaries of Ebony Forest.

Agricultural land, mainly banana and sugar cane crops, in the Anse Jonchée valley, where Vallée De L'Est is found on the mountain top, is being abandoned due to low soil fertility, poor productivity and frequent crop loss due to flash flooding. Soil erosion due to overgrazing, the limited water retention and infiltration capacity of the above ground biomass, and poor soil fertility is increasing sea water turbidity in the Anse Jonchée bay and affecting marine habitats, fish populations and possible the aquaculture farm, Ferme Marine de Mahebourg, which provides fish for the local and international market. The majority of inhabitants around Anse Jonchée are fisherpeople and/or small planters, relying heavily on nature. Degradation of the terrestrial and marine ecosystems instantly affects their

livelihoods. The South Eastern Highway, a road project abandoned in 2005, is being re-discussed with proposed routes crossing the Bambous Mountain Range, close to Ferney Valley. The construction of this road and subsequent associated infrastructure and development would further stress this degraded landscape.

Conserving and restoring remnant endemic forest, such as at Ebony Forest and Vallée De L'Est, will contribute to mitigating some of the effects of climate change in the short and long term on the local people, simultaneously benefitting society and biodiversity. Biodiverse rich forests are more resilient to climate change, offering greater ecosystem services in terms of ecotourism value, soil fertility, reduced risk of soil erosion, water purification and replenishment of groundwater, and have greater above and below-ground carbon sequestration potential, which can help reduce global warming.

The need to control invasive alien plants and to plant natives

Threat: Invasive alien plants

Rapid deforestation following the arrival of humans around 400 years ago and the introduction of invasive alien plants has resulted in highly fragmented and degraded native forests (Virah-Sawmy et al. 2009, Baider & Florens, 2011). Today less than 2% (c. 2600 ha.) of reasonable quality native forest (i.e. that with more than 50 % native plant canopy cover) remains (Ministry of Agro-Industry and Food Security, 2017). Mauritius has the third most threatened flora in the World, with over 57% of plants threatened with extinction (Botanical Gardens Conservation International 2021). Controlling exotic plants in Mauritius improves native plant survivorship, growth and fruit and flower production (Baider & Florens 2011).

The control of invasive alien plants is a long-term commitment and is futile if maintenance weeding is not sustained. Following the removal of woody exotics such as guava or tecoma in the first or initial weeding process, regular maintenance weeding is needed to prevent infestations of fast growing light-loving herbaceous weeds and vines. Without maintenance weeding, the slow-growing natives, planted or natural regenerating, struggle to survive. Restoration of degraded sites typically requires maintenance weeding 3-5 times annually for the first couple of years to ensure natives grow and form a canopy. Thereafter, the frequency and intensity of maintenance weeding decreases to 2-3 times per annum. Even mature sites at Ebony Forest and Vallée De L'Est continue to be weeded once a year to remove exotic vines like *Hiptage benghalensis*. Our goal is to restore 50 ha. at Ebony Forest and at least 26 ha. at Vallée De L'Est. as large areas of native forest are needed to provide essential ecosystem services and support viable fauna and flora populations,

Threat: lack of native plant recruitment

Conservation efforts have focused primarily only on weeding invaded forest. However, native plant recruitment is limited due to a lack of native seeds in the soil seed bank or a nearby stand of intact

native forest that can produce viable seed/material to be dispersed to a site suitable for germination and establishment, and the lack of effective seed dispersers. While some native plant species may return naturally to a site, overall the native species composition is skewed towards wind dispersed species. Large fleshy fruited species are invariably the most threatened species; they have lost their large seed dispersers, and their seeds are most at risk of predation from rats and monkeys. Exotic plants are more likely to establish following weeding as they are, in general, prolific seed producers, have high seed germination rates and probability, are faster-growers, dominate the soil seed bank in degraded areas, and produce wind-dispersed seeds. Planting native species helps to overcome their plant recruitment limitations and accelerates the restoration process, ultimately decreasing the costs associated with maintenance weeding.

The need to control invasive mammalian predators

Invasive mammalian predators, accidentally or intentionally introduced to Mauritius, are prevalent in forests. Rats, monkeys, deers, pigs and tenrecs limit plant recruitment by predating seeds, fruits and seedlings. Monkeys rip orchids from trees, and uproot young palms. Indirectly, rats, cats, mongoose, and monkeys affect plants by killing seed dispersers (Pink Pigeon, Echo Parakeet, Mauritius Bulbul) and pollinators (Mauritius White-eyes, Mauritius Fody, Phelsuma species) at their different life stages (egg, juvenile, adult). They also decrease fruit available for endemic frugivores such as the Mascarene flying fox. The control of these introduced mammalian predators is essentially to restore forest dynamics, resilience and conserve biodiversity, which will in turn help mitigate the impacts of climate change.

A 50 ha. predator control grid at Ebony Forest targeting rats, cats, monkeys, mongoose and tenrecs has significantly reduced the number of predators. There has been an observed increase in the number of seedlings, specifically of large-seeded species, and an increase in the population of endemic birds, notably the Mauritius Grey White-eye (Least Concern), Mauritius Paradise Flycatcher (not assessed), and Pink Pigeon (Vulnerable). Predator control is an integral part of forest restoration in Mauritius as endemic fauna are reliant on endemic forest. Simply restoring the flora is insufficient for bird, reptile populations, and their associated ecosystem functions, to naturally recover.

There is currently no predator control implemented at Vallée De L'Est and bird diversity and abundance is limited, even exotic avifauna. The control of predators at Vallée De L'Est will enable threatened bird species such as the Pink Pigeon, an important seed disperser, and Mauritian passerines (Mauritius Fody, Mauritius Olive White-eye, Mauritius Cuckoo-shrike) to be reintroduced, improving ecosystem resilience, seed dispersal and pollination functions. Besides the aforementioned benefits, the establishment of new bird subpopulations would reduce their risk of extinction.

The need for restoring ecosystem processes

Threat: missing species interactions

Prior to the arrival of humans in 1598, Mauritius, which was covered largely in native forest, had 53 native species of forest vertebrate. Today, 25 are extinct and the remaining fauna are found either on offshore islands or in small pockets of native forest. The resilience and resistance of Mauritius' forests to climate change has thus been significantly reduced due to the extinction and/or local extinction of pollinators, seed dispersers, nutrient cyclers and grazers. Introduced mammals and birds are poor substitutes, and in many cases introduced frugivores or grazers predate seeds, fruits, seedlings, flowers and plants.

Forest restoration projects must not solely focus on restoring the plant community, but include the reinstatement of missing ecosystem processes and functions to limit the need for future human intervention. Seven of nine of endemic bird species occur at Ebony Forest; four naturally occur (Mauritius Bulbul, Mauritius Paradise Flycatcher, Mauritius Grey White-eye, Mauritius Kestrel) and three have been reintroduced (Pink Pigeon, Echo Parakeet, Olive White-eye), with plans to reintroduced the Mauritius Fody and Cuckoo-shrike.

There are four endemic bird species at Vallée De L'Est, albeit in low numbers: Mauritius Kestrel, Echo Parakeet, Mauritius Grey White-eye, Mauritius Bulbul. Low avifauna diversity and abundance in the Bambous Mountain Range is attributed to heavy use of organochlorine pesticides in the 1970s, which wiped out many species (Safford & Jones 1997). The Mauritius Kestrel was the first species to be reintroduced to the Bambous Mountain Range in the 1990s, followed by Echo Parakeet in 2015 and Pink Pigeon in 2016, which were released at Ferney Valley. A few Echo Parakeet have naturally colonized Vallée De L'Est, but Pink Pigeon remain near the release site at Ferney Valley as the population has not grown significantly due to limited predator control. Fortunately, DDT exposure is no longer a threat to bird survival. Recognizing the importance of creating a stronghold for threatened bird species in the isolated Bambous Mountain Range, the National Parks & Conservation Service included the reintroduction of birds to Vallée De L'Est in an MOU with Ebony Forest as there will be long-term management of the species and habitat by an experienced organization. The reintroduction of Pink Pigeon, important seed dispersers of small-medium sized fleshy fruits, to the proposed 26 ha. predator control grid, encompassing one of the best-preserved upland humid forests in Mauritius, will restore this missing function.

Threat: missing seed dispersal functions

Large-seeded Mauritian plants, many of which are threatened with extinction, are reliant on large frugivores, and so have a limited repertoire of effective dispersers. Giant tortoises weighing up to 100 kg were the largest native frugivores on Mauritius; today, the title goes to a fruitbat weighing only 0.54 kg. Thus, the loss of the island giants—tortoises, lizards, and flightless birds such as the dodo, has left many large-seeded fruits anachronistic in relation to the current frugivore assemblages in defaunated and invaded Mauritian forests (Hansen & Galetti 2009).

Failure to restore frugivore assemblages or guilds results in fruits accumulating under maternal trees, increasing seed and seedling mortality and predation from herbivores and pathogens. Greater competition between siblings and with the parent tree also increases seedling mortality. Poor dispersal also limits the opportunity of offspring to find suitable habitats. Thus, the extinction and severe reduction in abundance and diversity of Mauritius' frugivores has resulted in poor recruitment, hindering restoration efforts (Griffiths et al. 2011). Ultimately, this has important implications for plant populations, species diversity and ecosystem resilience.

Opportunity: restore tortoise grazing functions

Introduced herbivores, such as deers and pigs, predate most native plants and should be excluded from restoration sites. Aldabra giant tortoises are used as ecological replacements for the two extinct giant tortoises on offshore Mauritian islands, Round Island and Ile aux Aigrettes, to cost-effectively control exotic vegetation (Griffiths et al. 2013). Giant tortoises avoid the foliage of most native species, many of which exhibit anti-herbivorous traits, favouring fast-growing exotic grasses, herbs and shrubs, reducing their above ground biomass and limiting exotic seed production. This "weeding" enables limited resources to be directed elsewhere. Furthermore, the consumption of large seeds, subsequent defecation in moist faeces on grazed areas i.e. limited competition, increases seed germination and seedling survivorship (Griffiths et al. 2011). Giant tortoises improve nutrient cycling, benefiting the soil microbiome and thus its carbon sequestration and water retention capacity. Aldabra giant tortoises will be released in Ebony Forest in 2023 to reinstate seed dispersal, grazing and nutrient cycling functions.

The need for greater awareness and public involvement

Threat: lack of public awareness and connection

Local awareness about the climate and biodiversity crises and what can be done by individuals and our nation is limited. Habitat destruction, the introduction of exotic species, species extinctions, overexploitation, pollution, and land use change continue to occur in Mauritius. High levels of urbanization have exacerbated the threats to native forests as the human population is disconnected from nature and lack experiences and an appreciation of the value of native biodiversity and how its health is intricately linked to ours. Expectations about what a healthy ecosystem looks like have shifted as each generation grows up with a more impoverished natural biodiversity. This is curtailing the ability of both the general public and political powers to identify problems and implement solutions at the scale needed to protect biodiversity and mitigate the impacts of climate change.

Local visitors to Ebony Forest are astounded by the variety of endemic biodiversity, many not having seen a black ebony tree, the commonest native hardwood, or a Pink Pigeon. More children and the public need to see, touch and partake in restoration activities as such experiences can have a profound impact on people's views.

Opportunities: strengthened management

This project provides an opportunity to build on work previously supported by the Critical Ecosystem Partnership Fund and Fondation Franklinia, among others, and which has been ongoing since 2004 at Vallée De L'Est and 2006 at Ebony Forest. Since 2006, Ebony Forest has weeded 25 ha. and planted over 152,000 native plants. 25 ha. remains to be weeded and restored. Ebony Forest is the best preserved semi-humid forest in Mauritius and is home to 197 indigenous flowering plant species, 2 reptile species, 2 mammals, and 8 bird species. Vallée De L'Est harbours one of the best upland humid forests in Mauritius and is home to a more than 170 indigenous plants, 2 reptile species, 2 mammal species, 8 bird species and 4 molluscs. Since 2004, 12 ha. have been weeded and over 52,000 plants planted in an effort to conserve biodiversity.

The directors of Ebony Forest Ltd are fully committed to conservation, education and supporting the local community and in 2021 the company was converted to a non-profit organisation. Permits to weed in the mountain reserve at both sites have already been obtained from the Forestry Service. Ebony Forest has a five year Memorandum of Understanding with the National Parks and Conservation Service to introduce fauna to both sites. There are no other authorities that influence the proposed project, nor are there any country laws or strategies in place specifically for either site.

The proposed project is in line with national policies such as the National Forest Policy 2006; National Climate Change Adaptation Policy Framework 2022; Strategic Plan 2016-2020 for the Food Crop, Livestock and Forestry Sectors and the Mauritius INDC (2015); National Biodiversity Strategy and Action Plan 2017-2025; National Invasive Alien Species Strategy and Action Plan 2010-2019, UNCCD, Land Degradation Neutrality Target Setting Programme 2018; Mauritius Vision 2030 and international targets such as the Sustainable Development Goals (climate action, gender equality, life on land); United Nations Framework Convention on Climate Change; Agenda 2063; United Nations Convention on Biological Diversity; United Nations Convention to Combat Desertification; FAO initiatives on Integrated Landscape Management & Sustainable Land Management; the Paris Agreement; to name a few. The project also contributes to Mauritius' Intended Nationally Determined Contributions under the Land Use, Land Use Change and Forestry, including social security, education and gender. As Ebony Forest and parts of Vallée De L'Est are private, there are no other stakeholders interested in undertaking the proposed project.

PROJECT APPROACH

Threat: Invasive alien plants

Four men and four women will be recruited at each site and trained in restoration activities by the Site Supervisor at Vallée De L'Est (Helene Bertille), team leaders at Ebony Forest (Bryan Quint, Marie-France Leopold) and Conservation Manager (Nicolas Zuël). The Conservation Manager and the conservation team (Jevika Atwaroo; Helene Bertille; Olivier Brunneau; Estelle De Sornay; Christelle Ferriere; Naomie Lagesse; Elisa Laverdant; Denis Li; Adisha Sewydal) will demarcate sites for restoration and develop a weeding and planting plan.

The men's teams will weed 3.5 ha. per annum per site using machetes and chainsaws to remove large woody exotics such as guava, tecoma and bois d'oiseaux, while the women will do the maintenance weeding using sickles to prevent reinvasion. Maintenance weeding by the women's teams will be done 2-5 times per annum, depending on the level of site degradation, to control exotic vegetation and enable the slower-growing native plants to compete. Initial and maintenance weeding will occur throughout the year.

The Conservation Manager and the Site Supervisor will communicate monthly to the team leaders at Ebony Forest and Vallée De L'Est, respectively, which sites to weed and the expected time taken to complete each site. Progress is monitored monthly.

Threat: lack of native plant recruitment

Following finalization of the weeding plan, the Ebony Forest Nursery Officer (Jevika Atwaroo), Vallée De L'Est (VDL) Site Supervisor, Plant Coordinator (Adisha Sewydal) and Conservation Manager will plan which species to plant at each restoration site based on the site characteristics and plant survivorship data of adjacent sites. Restoration sites will be planted with a mix of pioneer and hardwood species at the same time. Planting will be done during the rainy season, with efforts to plant the maximum at the start of the rainy season to increase survivorship.

The VDL Site Supervisor and the Nursery Officer at Ebony Forest will be responsible for propagating the species needed for the upcoming planting season. Plant material (seeds, seedlings, cuttings) will be sourced from onsite, neighbouring areas, the Forestry Services or other partners. The plants will be grown in the native plant propagation nurseries at Ebony Forest and Vallée De L'Est until they are healthy and around 30 cm in height, then hardened by increasing sun exposure and reducing water prior to planting to acclimatize them to the harsher field conditions.

The restoration teams at each site, together with the conservation team, and when possible volunteers, school children, corporates, will plant 300-600 plants per day depending on the site characteristics (accessibility, surface area, slope). Planting will be only done in sites that have <70 percent native cover. Holes will be dug around 1.5 m apart or more depending on the species that will be planted. Planting at higher densities leads to competition and tree death, whereas when planted at lower densities, a native canopy takes longer to form and necessitates more maintenance weeding, increasing weeding costs. Once planted, woodchip mulch, generated from the weeding process, will be placed around the base of the seedlings to increase humidity and reduce competition from weeds. The only post-planting aftercare will be maintenance weeding.

The conservation team will monitor plant survivorship at each restoration site 6 months and 1 year after planting. The Nursery Officer and VDL Site Supervisor will write monthly and annual reports, with the assistance of the Plant Coordinator. The planting season is reviewed annually by the Nursery Officer, VDL Site Supervisor, Plant Coordinator and Conservation Manager to identify lessons learnt and plan for the subsequent season.

Threat: invasive mammalian predators

A Conservation Staff will be employed and trained to oversee the predator control grid and the bird work. Self-setting and species-specific kill traps, which are more costly, will be used as they reduce the amount of time spent by staff and hence are more cost-effective and enable a larger area to be maintained predator-free. The grid will be established in a fenced area of high-quality native forest. The A24 traps will be located 25 m apart and the A18 every 50 m in a grid to intercept rats and mongoose respectively. The Timm's traps will be placed every 75 m to target cats, tenrecs and mongoose. The set up of the grid will be done by the VDL Conservation Staff with the assistance of the Ebony Forest conservation team. Thereafter the monitoring of the grid will be done by the Conservation staff.

The effectiveness of the grid will be measured every 2 weeks by comparing the grid's predator index to an area where there is no predator management, the control. Chew cubes, a mix of wax and cocoa, and camera traps will be used to detect rats, and cats and mongooses, respectively. The Conservation Staff will send a monthly report to the Predator Control Supervisor and Conservation Manager so adaptive management can be taken if needed. Volunteers and other staff will be trained to assist in the management of the grid, which will be done indefinitely.

Threat: missing seed dispersal and grazing functions

Reinstate seed dispersal functions by reintroducing Pink Pigeon to Vallée De L'Est

An MOU with the Ministry of Agro-Industry and Food Security was signed for the establishment of 50 Pink Pigeon at Vallée De L'Est in April 2022. The Conservation and General Managers and the conservation team will meet with the National Parks & Conservation Service, the division responsible of the aforementioned Ministry, to approve source of the Pink Pigeon and to finalise the translocation protocol.

In year 2, a four compartment aviary will be constructed for the release of 30 Pink Pigeon, in batches of ten, to increase translocation success. The number translocated subsequent years will depend on the number of birds that establish. Pink Pigeon fledglings will be collected from the source populations in the Black River Gorges National Park during the peak breeding period between October and March, and translocated to the Vallée De L'Est aviary, where they will remain for around one month to monitor their health and allow them to acclimatize and anchor to their new location. While in the aviary, they will be provided daily with freshly chopped fruit, maize in a feeding hopper to habituate them to the supplementary feeder, and fresh water. Following release of the 10 birds, one compartment will remain open and the other three will be disinfected and prepared for the next batch of ten birds. The above process will be repeated until the desired number of Pink Pigeon is released per season.

The VDL Conservation Staff will monitor the released birds daily and continue to provide supplementary food.

Reinstate nutrient cycling, grazing and seed dispersal functions by introducing Aldabra giant tortoises to Vallée De L'Est

Ten juvenile (c. 20 kg +) Aldabra giant tortoises will be released in Vallée De L'Est with gps locators and their movement, behaviour, diet and impact on the vegetation monitored.

Threat: lack of public awareness and connection

Awareness activities will be implemented at Ebony Forest where there is a Visitor Centre and trained guides and conservation staff. VDL is a 30 minute jeep drive inland and is not readily accessible to the public.

The Conservation Manager will develop a short course to train seven Ebony Forest guides and eleven conservation staff about the consequences of the climate and biodiversity crises, their connection and the importance of ecosystem-based adaptation approaches such as forest restoration, so that the staff can then communicate to the public, school children and corporate partners about the importance of restoring the degraded watershed. To reinforce the verbal message communicated during guided tours, a graphic highlighting the importance of forests for biodiversity and as nature based solutions will be printed on a signboard erected along the most popular hiking trail and on 500 posters that will be distributed to visiting schools and corporates over the three years. The conservation team will train 5-10 international and local volunteers per annum in forest restoration activities and raise awareness about the link between climate change and forests.

The Operations & Marketing Coordinator will be responsible to communicate to schools that children can plant a native tree at Ebony Forest during the rainy season, with the aim of school children planting 500 natives over the three years. The General Manager and Operations & Marketing Coordinator will contact private sector companies to encourage them to visit and participate in the restoration activities (weeding, planting, plant propagation). A member of the conservation team will give a 15 minute presentation about ecosystem-based adaptation to explain the importance of their contribution and the urgency for action to mitigate further biodiversity and climate disasters.

The Conservation Manager will organise three webinars about ecosystem-based adaptation approaches in Mauritius to tackle climate change and the consequences of a business as usual approach. The General Manager will write 20 social media posts (Facebook, Instagram) per annum and 1 blog per annum about the climate crisis and how healthy forests can mitigate global warming impacts with the aim of raising awareness among the public.

Sustainability

To ensure financial sustainability the reoccurring costs of the different activities will be budgeted and a financial sustainability plan developed by the General Manager. A minimum of USD30,000 will be sought from local and international grants and local partners. The General Manager will continue to liaise with the Forestry Services to obtain a Special Lease for the long-term management of the state forest at Vallée De L'Est as currently this does not exist.

8) Date of preparation of this document

12th April 2023, reviewed 16th November 2023

Pest Management Approach: This section should describe your understanding of the problem, your experience with pest management issues, and your proposed actions during the project. Specifically, what do you intend to do and how will you do it? The information presented should include methods of application, e.g. by hand or via aerial spraying.

9) Current and anticipated pest problems relevant to the project.

Invasive alien plants are the greatest threat to the preservation of Mauritius' remnant forest. At Chamarel, the commonest exotic tree is tecoma (*Tabebuia pallida*), which forms dense monotypic stands and suppresses other species, whereas at Vallée De L'Est, *Psidium cattleianum* or chinese guava is the commonest invasive alien tree. Other exotic species, common to both sites and listed among the 100 worst invasive species by the Invasive Species Specialist Group are Hiptage benghalensis, Schinus terebenthifolius, Ligustrum robustum var. walkeri), *Mikania micrantha, Lantana camara, Chromolaena odorata, Psidium cattleianum, Clidemia hirta,* and *Leucaena leucocephala*.

In open restoration sites (areas of low quality native forest), emerging weeds such as *Mikania micrantha, Clidemia hirta* and *Chromolaena odorata*, are fast-growing light loving species with short generation times. Regular maintenance weeding is needed to control such species.

Rats, monkeys, deers, pigs and tenrecs limit plant recruitment by predating seeds, fruits and seedlings. Monkeys rip orchids from trees, and uproot young palms. Indirectly, rats, cats, mongoose, and monkeys affect plants by killing seed dispersers (Pink Pigeon, Echo Parakeet, Mauritius Bulbul) and pollinators (Mauritius White-eyes, Mauritius Fody, Phelsuma species) at their different life stages (egg, juvenile, adult). They also decrease fruit available for endemic frugivores such as the Mascarene flying fox.

10) Current and proposed pest management practices.

Our current and proposed practices include the following methods depending on the species to be controlled:

- Herbaceous species, namely vines, herbs and grasses: uprooted (no herbicide) when they compete for resources with native plants. This is generally only done within a 0.5m diameter around small native plants. Grasses are encouraged between, but not encroaching, planted seedlings as they help stabilize soil, act as a natural weed mat and keep soil humidity. Herbaceous weeds, excluding vines, which do not compete with young plants, are left if not in close proximity. Once a closed canopy forms and a dense leaf litter develops, light-loving weeds are less problematic.

- Trees: cut close to the base using either a machete or chainsaw and herbicide applied directly to the cut stump.

Cutting woody weeds without the application of herbicides is an ineffective use of labour and finances as the cut stumps of most woody species simply resprout producing multiple stems and in some instances larger root systems. Subsequent control is thus harder. Herbicides reduce costs by extending maintenance cycles, limit soil erosion, and enable difficult to control species to be targeted. Uprooting woody stumps is not advisable at Ebony Forest as the slopes are steep and the soil fragile.

As fast-growing weeds are the greatest threat to open restoration sites, we use woodchip mulch to create a weed mat and prevent weeds emerging. Once a closed native canopy has developed, lower light levels and leaf litter minimize the number of light loving weeds.

Removal of cut or uprooted material is important and some species can readily regenerate (e.g. *Mikania micrantha, Furcraea foetida, Hiptage benghalensis, Cassytha filiformis, Kalanchoe pinnata*).

Rats will be controlled using self-resetting A24 traps located 25 m apart, rats and mongoose controlled using A18 Goodnature traps every 50 m apart, and cats, tenrecs and mongoose controlled using Timm's traps placed every 75 m apart in a grid. Currently there is a 50 ha. predator control grid in operation at Ebony Forest. This project will support the establishment, operation and monitoring of a 26 ha. predator control grid at Vallée De L'Est. The grid will be extended by 10 ha. thanks to funding from Fondation Segré.

11) Relevant integrated pest management experience within the project area, country or region.

Ebony Forest Ltd has been using and monitoring the effects of herbicide for over 17 years to control invasive alien plants in Mauritius. Various herbicides have been trialled and tested to assess their efficiency and the application technique.

Ebony Forest has been operating predator control grids since 2017 and the Conservation Manager has over 20 year's of experience controlling predators.

12) Assessment of proposed or current pest management approach and recommendations for adjustment where necessary.

The proposed and current pest management approaches are built on advice, experience and trials from multiple partners, including our own trials and expertise. We have evolved our weed management strategy in accordance with community ecology theory to address why particular species proliferate and how we can adapt our techniques to ensure they are safe and cost-effective. Our predator management approach is closely monitored to assess it's effectiveness and safety. We are constantly looking for new traps that can limit intervention, e.g. self-resetting traps.

Pesticide Selection and Use

This section should provide a comprehensive understanding of the pesticide that will be selected, why it was selected and what efforts were made to assess risks to human health. Note that this

section should also present information on the potential impacts that the selected pesticide(s) will have on natural ecosystems and non-target species.

13) Description of present, proposed and/or envisaged pesticide use and assessment of whether such use is in line with international good practice.

Garlon 4 (active ingredient: triclopyr).

The only broad spectrum systematic herbicides that targets broad leaf weeds and woody species that are readily available in Mauritius from reputable companies are Garlon 4 and Tordon 101. Garlon 4 is classified as class II (moderately hazardous), whereas Tordon 101 is deemed unlikely to present acute hazard to normal use by the WHO Recommended Classification of Pesticides by Hazard (2019). Previously the WHO and US EPA classified Tordon as less safe due to its volatility and longer decomposition rate. In Mauritius, use of Tordon 101 has stopped as it is believed to have greater non-target effects on indigenous plants. Garlon 4 is applied only to cut stumps and ring-barked trunks so the risks of affecting non-target organisms are minimal. As application is directed and there is no foliar spraying, there is little chance of herbicide seeping into the groundwater.

No pesticide or herbicide is used in the predator control grid or its monitoring. A powdered rooting hormone, Seradix, is used to promote early and vigorous roots on cuttings during plant propagation at the Ebony Forest nursery. The active ingredient is indolebutyric acid (IBA), which is a synthetic rooting chemical that is widely used because it promotes root development in a wide variety of plants without being toxic to the plant. It is considered to be a low toxicity product, but may cause irritation to the skin and eyes. IBA is registered as a biochemical pesticide with U.S. EPA

14) Indication of the type and quantity of pesticides to be financed by the CEPF grant (in volume and dollar value) and/or assessment of increase in pesticide use resulting from the project.

Funding from CEPF is not being sought to cover the costs of herbicide.

15) Chemical, trade and common names of pesticide(s) to be used.

Triclopyr, trichlopyr: 3,5,6-trichloro-2-pyridinyloxyacetric acid butoxethyl ester 61.6 %, Garlon 4
Indolebutyric acid, Indole-3-Butyric acid, Dynaroot rooting hormone

16) Form(s) in which pesticide(s) will be used (e.g., pellet, block, spray).

The herbicide is used in liquid form in hand sprayers whereby it is sprayed onto cut stumps or ring-barked areas.

The rooting hormone is in powder form.

17) Specific geographic description of where the pesticide(s) will be applied: province, district, municipality, landowners [do not give names of individual persons], and map coordinates (if available); and the total area (hectares) to which the pesticide(s) will be applied.

Two sites in Mauritius: Ebony Forest Reserve (57.371881, -20.437149), Chamarel, District Riviere Noire & Vallée De L'Est (57.727748, -20.334647), District Grand Port. An area of 10.5 ha. will be weeded using Garlon 4 at each site.

18) Assessment of environmental, occupational and public health risks associated with the transport, storage, handling and use of the proposed products under local circumstances, and the disposal of empty containers.

Garlon 4 is classified as class II (moderately hazardous) by the WHO Recommended Classification of Pesticides by Hazard (2019). Garlon 4 is applied only to cut stumps or ring-barked trunks so the risks of affecting non-target organisms are minimal. As application is directed and there is no foliar spraying using a backpack sprayer (i.e. onto the leaves of plants which have a large surface area and is less targeted), there is little chance of herbicide seeping into the groundwater. There is a low risk of herbicide contaminating waterways at Ebony Forest as there are no rivers or streams on site, only natural drains which are dry except following heavy rainfall. The application of herbicide is not done during rainfall or if there is a threat of rainfall to avoid it being leached into the soil, affecting non-target organisms and because this water-soluble herbicide would be less effective.

IBA is registered as a biochemical pesticide with U.S. EPA. It is regarded as having low toxicity due to its use in ultra low quantities-and as it does not persist long in the environment

19) Description of plans and results for tracking of damage to natural ecosystems and/or harm to non-target species prior to pesticide application and subsequent to pesticide application.

Damages to non-target species are monitored by regularly visiting the site post-herbicide application. As herbicide does not immediately affect plants, it is possible to monitor impacts once weeding has been done. This is also easier due to lower tree density. Any impacted plants can be readily identified by loss of leaves, wilting, bark damage and tree death.

20) Prerequisites and/or measures required to reduce specific risks associated with envisaged pesticide use under the project (e.g., protective gear, training, upgrading of storage facilities, etc.).

As with all chemicals, there are risks to human health arising from intentional or unintentional direct consumption, improper application resulting in the herbicide coming into direct contact with people or wildlife, inhalation of aerial sprays, or following food consumption. The risks are deemed minimal because of the following.

- Application procedure: directed, no foliar or aerial spraying.
- Rapid absorption of herbicide in through the plant cuticle, becoming completely rainfast within 2 hours.
- Low toxicity to humans. The US Environmental Protection Agency classifies it as Category D – “meaning there is no evidence it causes cancer in humans”.
- Follow manufacturer’s recommendations in terms of health and safety and application rates.
- Use of Bazasol blue, a colourant dye, to indicate where the herbicide has been applied, prevent unintended double applications, and to safeguard the staff as the dye can be detected if it comes into contact with skin or clothing. Dye markers allow for greater precision and accuracy as spray patterns can be easily identified, giving early indications of drift to non-target areas. Colourants also help reveal any faults in nozzles, applicators or safety clothing, and so can help to reduce operator contamination. Broken or poorly functioning equipment is replaced and only good quality applicators are purchased.
- Bi-annual staff training and evaluation about the risks of herbicide use and how to apply and handle herbicide safely both for the environment and staff well-being.
- Provision of vinyl gloves, gardening gloves and masks to reduce contact with the skin and inhalation, as well as long-sleeved tops and trousers.

- Labeling of containers used for the application of herbicides and storage in a locked cupboard in an area only accessible by authorized personnel.
- A first aid kit is carried by personnel and one is kept in the staff mess room at all times. There are trained first aiders on site and there is a protocol to follow should staff require additional medical treatment. All staffs have access to the company doctor, an allowance of sick leave and medical insurance. Activities are always performed in teams.
- A Material Safety Data Sheet for Garlon 4 is kept with the chemical, with instructions on what to do should the product be ingested.
- Participation in weeding activities by the general public will be restricted to handpulling to avoid the use of herbicides as well as potentially dangerous tools.
- If herbicide application is needed in an area frequented by the general public, then this work will be done before the arrival of visitors. Visitors will be requested to remain on the paths and be explained that herbicides have been applied.

21) Basis of selection of pesticide(s) authorized for procurement under the project, taking into consideration the risks identified under Section 19, and the availability of newer and less hazardous products and techniques (e.g. bio-pesticides, traps).

Garlon 4 is chosen as it is rapidly absorbed through the plant cuticle, becoming completely rainfast within 2 hours and is regarded as having low toxicity to humans. The US Environmental Protection Agency classifies it as Category D – "meaning there is no evidence it causes cancer in humans".

22) Name and address of source of selected pesticides [do not give names of individual persons].

Dow AgroSciences LLC
9330 Zionsville Road
Indianapolis, IN 46268

23) Name and address of vendor of selected pesticides [do not give names of individual persons].

Blychem Ltd
Industrial Zone
IBL Complex
Rice Terre
Tel: 203-9355/2039350/2039360

24) Name and address of facility where pesticides will be stored.

Ebony Forest Reserve
7 Coloured Earth
Chamarel

Vallée De L'Est
Anse Jonchée

Herbicide is stored in a locked cupboard at each site, with limited access except for authorized personnel.

Policy and regulatory framework, and institutional capacity:

This section should describe the institutional and legal framework under which the pesticide(s) will be applied, with reference to the documentation and standards required under local and national law and international good practice. Where a particular pesticide is not regulated at the target site,

you must identify similar pesticides and the applicable regulation in neighboring countries that could apply, and international good practice. You must also explain why this particular pesticide is necessary, even in the absence of national laws.

25) **Policies on plant/animal protection, integrated pest management, and humane treatment of animals.**

Animal Welfare Act 2013
The Use of Pesticides Act 2018
The Dangerous Chemical Control Act 2004
The Plant Protection Act 2006

26) **Description and assessment of national capacity to develop and implement ecologically based invasive alien species control [where relevant].**

Mauritius has been controlling and tackling invasive alien plants for more than three decades. Actively involved in the control of invasive plants are the National Parks and Conservation Services, Forestry Services and private sector companies.

27) **Description and assessment of the country's regulatory framework and institutional capacity for control of the distribution and use of pesticides.**

The Local Government Act 2011 necessitates that all vendors in pesticides are regulated and have relevant licences. Under the Dangerous Chemical Control Act 2004 an import permit is required for the sale of herbicides. This is issued and enforced by the Ministry of Health & Quality of Life. The Ministry of Agro-Industry & Food Security have published a Pesticide Code of Practice for the Republic of Mauritius.

28) **Proposed project activities to train personnel and strengthen capacity [list the number of people and what they are being trained in].**

All staff (16 restoration labourers) involved in the use, transport and storage of herbicides will be trained bi-annually in weeding, health and safety, chainsaw use, planting techniques, nursery management and plant propagation. Training will be done by the Conservation Manager, Vallee de L'Est Site Supervisor and team leaders. All staff will be trained how to safely and effectively place and monitor traps, and dispose of carcasses to reduce the risk to personnel and the environment.

29) **Confirmation that the appropriate authorities were approached and that the appropriate licenses and permissions were obtained by the project.**

The Ministry of Agro-Industry and Food Security has granted permission to Ebony Forest Ltd to weed in the mountain reserves and restore forest throughout the site.

Participatory preparation:

This section aims to outline the range of informed consultations that you have had both with experts to optimize the potential for success, and with stakeholders, particularly local communities, who are potentially affected by the use of pesticides (due to, for instance, proximity, use of certain areas for free-ranging livestock or non-timber forest product collection, etc.).

30) Dates, and results of expert consultations, if necessary.

Garlon 4 is regularly used in restoration activities in Mauritius and is accepted as the most effective and safe herbicide when used as per manufactuerer's instructions.

31) Dates, and results of consultations with local communities.

The land where the herbicide will be used is private and the surrounding land is private deer ranching land. The nearest local communities are at least 2 km away.

Monitoring and evaluation:

This section aims to outline the steps you will take to monitor and evaluate the purchase, storage, application and effects of the pesticide(s) in the target area.

32) Description of activities related to pest management that require monitoring during implementation.

Purchase, storage and use of herbicide will be monitored. The amount purchased and the use of herbicide will be compared as part of stock take procedures and also in relation to the area weeded.

33) Monitoring and supervision plan, implementation responsibilities, required expertise and cost coverage.

Purchase monitoring: all items are signed for and sales are summarized annually providing a record of how much product is purchased.

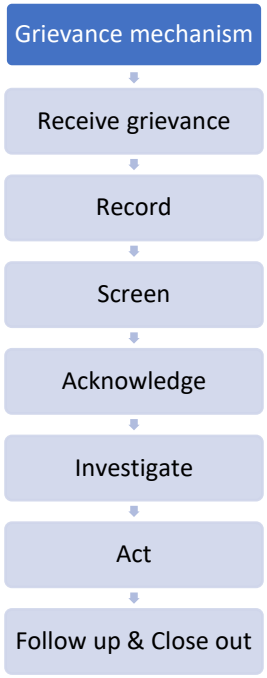
Access to herbicide is controlled by the Conservation Manager, who distributes the herbicide upon request and in relation to the amount of restoration work implemented. Herbicide is provided in small quantities of 1-5L depending on the site. The Conservation Manager knows the estimated amount of herbicide needed per site.

34) Disclosure:

CEPF requires that pest management plans are disclosed to affected local communities and other stakeholders prior to project implementation. Please describe the efforts you have taken to disclose this plan.

Four laminated A4 posters will be erected on site explaining the work and use of herbicides. The information will be communicated in English, French and Creole text or via an infographic. Each poster will be accompanied by explanation of the grievance mechanism policy.

In summary, the following mechanism will be used:


Grievance mechanism
Receive grievance
Record
Screen
Acknowledge
Investigate
Act
Follow up & Close out