



▶ ANNUAL REPORTS 2020-22





BIODIVERSITY CONSERVATION

THE MADAGASCAR FAUNA AND FLORA
GROUP PROTECTS THE RICH BIODIVERSITY
OF EASTERN MADAGASCAR THROUGH
CONSERVATION, RESEARCH, EDUCATION,
AND CAPACITY BUILDING.

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PARC IVOLOINA

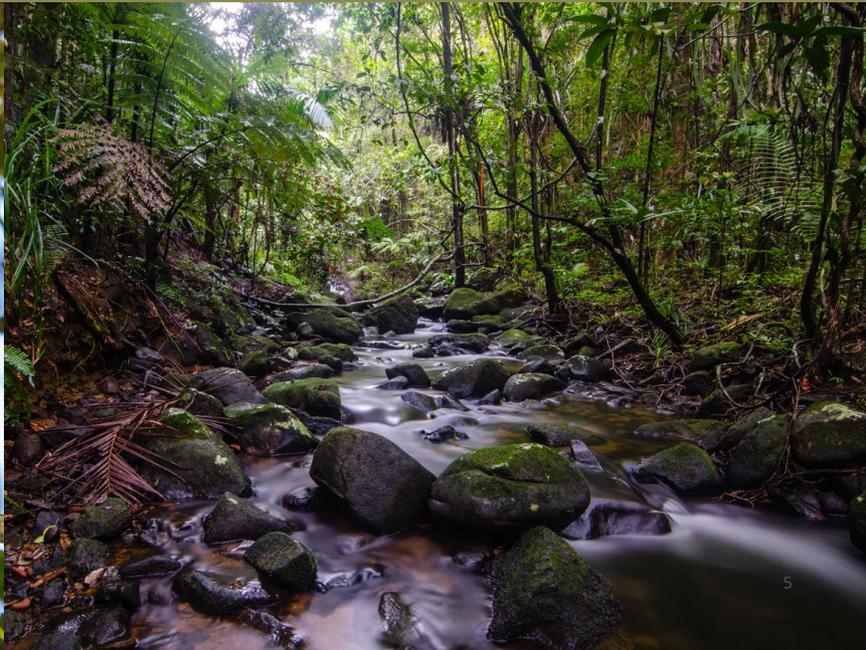
A ZOO WITHIN A RESEARCH SITE AND LIVING LABORATORY OPERATED BY THE MFG





BETAMPONA NATURAL RESERVE

MFG CONSERVATION AGENTS WORK WITHIN THIS 2,228 HECTARE LOWLAND RAINFOREST





OUR IMPACT

IN CONTRAST TO THE DECLINES
in forest cover across Madagascar,
BETAMPONA RESERVE AND ITS
ZONE OF PROTECTION

is one of a handful of protected
areas in Madagascar that has

INCREASED IN SIZE

in the last two decades!



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FROM THE CHAIR

If you want to go fast, go alone.
If you want to go far, go together.

The universal truth of this proverb has been borne out over the decades as our consortium has protected biodiversity through a host of profoundly challenging circumstances. Nearly one in three nonprofits don't survive the first ten years and even more stall without reaching any of their initial potential.

Which is why I am immensely proud of MFG's history and grateful for the combination of support and financial planning that allowed us to not just weather the diverse ravages of the pandemic while keeping our nearly 100 staff employed, but also to advance our mission.

To give just a few examples, MFG leveraged its longtime efforts on invasive plant control that protects lemur habitat by undertaking both mitigation research on the toxic Asian toad and eradication of highly damaging house crows from two port cities. To garner further support for invasive species action, the MFG partnered with the Malagasy government and international community on the successful passage of Resolution 100 at the IUCN World Conservation Congress 2020 in Marseille, France.

Further, the MFG also received its second highly competitive Darwin Initiative grant from the UK government to help local communities reduce both susceptibility to extreme climate events and pressure on remaining local forests. All these

efforts give native Malagasy wildlife a better chance to survive during these turbulent times – and all were championed for years by the MFG's Dr. Karen Freeman.

Experienced Leadership

Dr. Freeman needs little introduction to the MFG family as she began as MFG Program Manager in 2004 and then Research Director while also serving the absolutely critical role of interim Program Manager during leadership transitions.

Against the backdrop of these nationwide and international efforts, we began the lengthy process of careful evaluation of our work and involved outside experts - all of which reinforced the need to enlist an Executive Director to meet the growing challenges. Based on her experience and fierce advocacy for the people and wildlife of Madagascar, **Dr. Karen Freeman** was our top candidate and I was overjoyed when she accepted.



We also sought out a strong leader to advance MFG's efforts on the ground. I am more than

delighted to introduce **Jean Jacques Jaozandry** who joined us as our In-Country Director in 2021.

Mr. Jaozandry has more than twenty years' in the field of conservation including over a decade working for Wildlife Conservation Society and was a key leader in the creation and implementation of Makira-Masoala-Baie d'Antongil, a land and seascape of over one million hectares. Of great benefit to our mission, he has also held leadership positions in the Madagascar National Parks and the Ministry of the Environment and Sustainable Development (MEDD) including coordinating the implementation of Madagascar's national reforestation policy.



This division of labor allows the MFG to grow stronger and is yet another example of going together to go far. I'm honored to have both of them – and you – along on this journey.

Tim L. Tetzlaff
Tim L. Tetzlaff
tim@savethelémur.org





“Great things are done by a series
of small things brought together.”

Vincent Van Gogh

Since our founding in 1988, MFG’s successes are like a long journey made of single steps and our consortium of Members, Friends, and Advisors on five continents made each stride possible.

See our current members and key individuals at
www.madagascarfaunaflora.org.

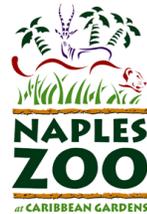
JOIN US! OUR MEMBERS ARE THE FOUNDATION OF MFG

Members of MFG's consortium of zoos, botanical gardens, aquariums, and universities make an even greater impact by working together. www.madagascarfaunaflora.org.

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Plus Darlene Benzon, Martin Reichard, David Schilling, Xander Schrijen, Jane Barthelme, and Anonymous Donors.

The above listing represents Members and Friends who supported the MFG any year between 2020 and 2022.

WEATHERING COVID-19

© Jo Macnaughton

The day that changed everything started like any other day.

Writing from this side of the worst of the pandemic, it's already difficult to recall the daily challenges presented to humanity. This recounting chronicles the resilience of our team and the MFG itself.

20 March 2020. Upon the discovery that several tourists who had flown into Antananarivo's airport tested positive for COVID-19, Madagascar's President ordered the closure of the country's borders and all its schools. By the 23rd, Antananarivo and Toamasina were placed under a State of Emergency when their combined number of cases rose to 17. Most government offices and non-essential businesses were ordered to close, and residents were required to stay home except to address essential needs. Masks were mandatory and manned roadblocks enforced internal travel restrictions. The prolonged shutdown led to food shortages, higher prices, misinformation, rumors, increased social unrest, and crime.

On May 16th 2020, Toamasina reported the country's first COVID-19 death, and with 83 cases,

it was considered the pandemic hotspot until mid-June when Antananarivo took over as Madagascar's COVID-19 epicenter. MFG complied with all COVID-related mandates. The MFG office and Parc Ivoloina Zoo were closed from March 22nd through October 26th, but essential workers, animal caretakers, and horticulturalists continued working. MFG provided the office staff and managers with internet connections so they could work at home.

Vero Ravolonarivo took on the task of ensuring that government mandated/recommended COVID-19 rules were in place for the opening of Parc Ivoloina. A station was set up to take the temperature of employees and visitors prior to entering the zoo, and posters written in Malagasy, French, and English listed the rules required to protect guests, employees, and the animals.

MFG's activities were once again disrupted for a period of six months when COVID's second wave hit Madagascar in April 2021. Most hard hit were activities that required a gathering of people. Madagascar's President, who had endorsed an herbal drink to prevent and treat COVID-19, and

had resisted joining the global COVID-19 vaccine program, relented in April as infections and deaths rose. When vaccines were available in Toamasina, MFG's HR Manager, Michella Nantenaina, collaborated with Toamasina's Director of Public Health, Mrs. Célestine Vavy, to hold two vaccination campaigns for MFG's employees.

The first campaign took place on September 22, 2021 at Parc Ivoloina's Conservation Training Center. Michella (in photo), Jean Jacques, and Bernard, the Ivoloina Zoo Manager, served as role models by being the first to be vaccinated, which was done to reassure staff members who harbored some misgivings. The second campaign was held in Ambodiriana on the 8th of October for the Betampona team. Follow up clinics were organized to give boosters as recommended.





Impact at Betampona

The pandemic also caused a number of research projects to be pushed back by a year, including a study through the Living Earth Collaborative (Washington University, Missouri Botanical Garden, and Saint Louis Zoo) comparing the behavior of diademed sifaka and black and white ruffed lemurs in Betampona to those inhabiting Vohibe Forest which remains connected to the much larger Ankeniheny-Zahamena forest corridor.

Also pushed back a year was a multi-year study led by Dr. Fidy Rasambainarivo on the impact of



Toxoplasma gondii, an introduced parasite, on the health of endemic carnivores. Fidy also leads the diademed sifaka capture missions; two missions scheduled for 2020 had to be cancelled.

With all but essential government workers ordered to stay home, Madagascar's reserves were particularly vulnerable to illegal activities. A project using camera traps to monitor domestic dog activity and uncollared diademed sifaka within Betampona resulted in additional revelations - people searching for and leaving with forest products including a dead white-fronted brown lemur (*Eulemur albifrons*).

In addition to having several camera traps stolen, in a few cases, the camera was left in place, but the memory card was removed. This may explain the man wearing a face-covering ski hat. These illegal activities were reported to Madagascar National Parks (MNP) and the Regional Director of the Environment and Sustainable Development (DREDD), the latter having authority to make arrests. Alarmed by the situation, MFG's conservation agents returned quickly to the village of Rendrirendry by the Reserve to maintain an ongoing presence. Due to ongoing government restrictions, however, it

was not feasible to carry out joint camping trips for many weeks, which meant it was impossible to patrol the more distant parts of the reserve. The experience reinforces our belief that the presence of MFG's agents and collaborating researchers in the forest does serve to decrease illegal activities. Golden et al (2014) noted that hunting increased by 1.3 times per km away from MFG's base at Rendrirendry.

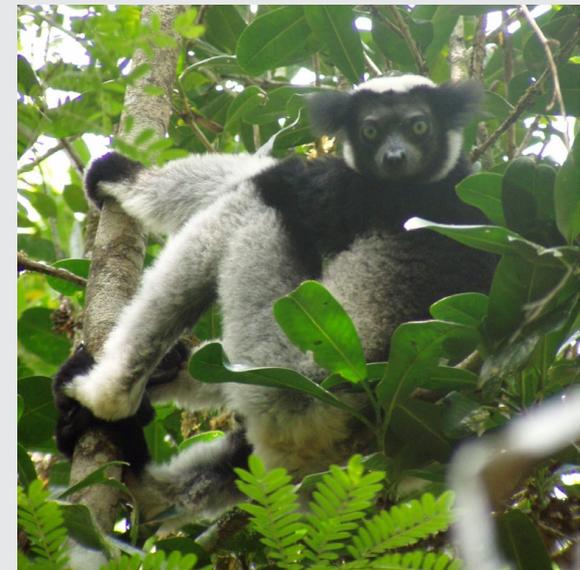
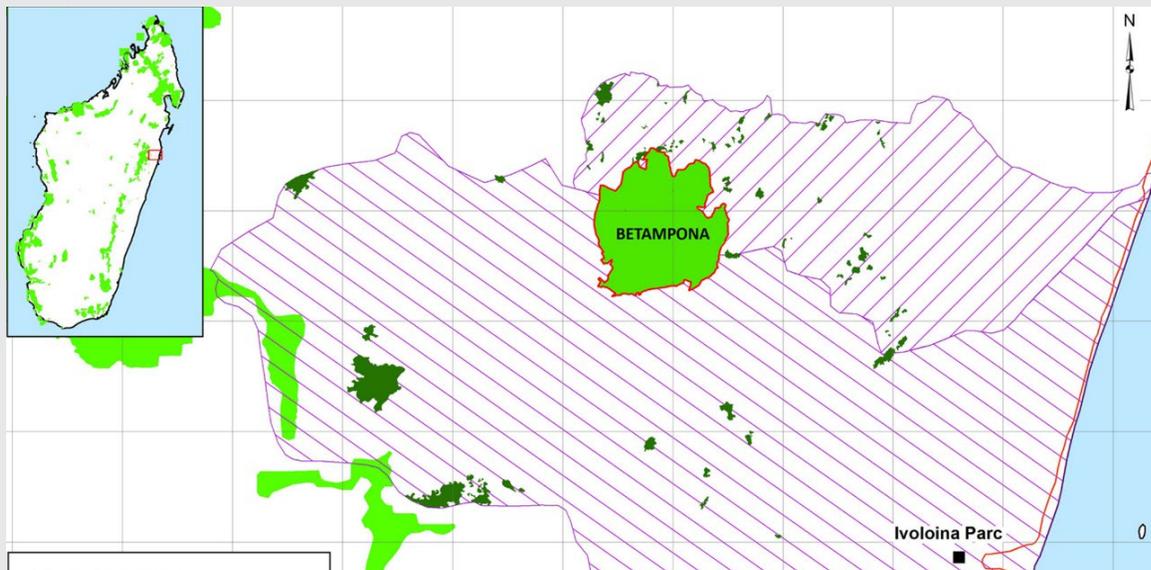


PROTECTING BETAMPONA

The MFG's mission "to preserve Madagascar's ecological systems, natural evolutionary processes, and endemic species diversity," conveys the complexity inherent in conserving ecosystems. Betampona's isolation combined with its proximity to expanding human settlements has exposed its stranded animal and plant

populations to a cocktail of anthropogenic threats. Fragmentation intensifies negative edge effects, and invasive plants play an outsized role in degrading Betampona's edge and primary forest. Restoring the integrity of Betampona's primary forest is fundamental to maintaining the reserve's rich biodiversity.

Additional conservation interventions are likely required for a number of species, such as Betampona's three critically endangered lemurs: diademed sifaka (*Propithecus diadema*), black and white ruffed lemur (*Varecia variegata*) and indri (*Indri indri*). The reserve is too small to maintain self-sustaining populations of these large-bodied





lemurs, and its isolation from other forests has limited the natural process of dispersal, which facilitates genetically diverse and healthy populations.

While we do not know when the reserve's isolation exceeded the dispersal capacity of these species, it's likely that there has been no meaningful gene flow since the 1950s.

Identifying Invasives

Foundational to lemur populations is a healthy habitat. The first time Dr. Karen Freeman stepped into Betampona in 2004, her experience in Mauritius made her acutely aware that the guava (*Psidium cattleianum*) patches within the reserve were a significant threat to Betampona's health – a threat that could not be ignored.

The use of herbicides to eradicate invasive flora was never considered as they have been shown to disrupt developmental, reproductive, and immunological processes of some amphibians, fish, and invertebrates. With over 83 recognized amphibian species in Betampona, the risk of

harm to this class of animals, yet alone the many others, was unacceptable.

Beginning in 2005, Karen recruited students from the Universities of Antananarivo and Toamasina to study the invasive dynamics of the reserve's three most damaging species: guava, Molucca raspberry (*Rubus moluccanus*) and Madagascar cardamom (*Aframomum angustifolium*), a native pioneer species that acts in a weed-like fashion under some circumstances.

These studies confirmed that colonization within the reserve's primary forest prevents the regeneration of its endemic trees. Thereafter, research focused on evaluating the most efficacious and least environmentally-damaging method of physically removing each of the three species.

Collaborative research with Dr. Vasisht Sagan of the Saint Louis University's Geospatial Institute found that it was possible to apply remote sensing methods to map and monitor the spatio-temporal distribution of these invasive species in Betampona.



GROWING STRONG



Dr. Chris Birkinshaw's internal alarm was growing louder. After decades of biologists warning about the imminent extinction of Madagascar's endemic flora, these extinctions were happening now. Bringing endangered species into *ex situ* conservation programs was an immediate step he and his colleagues could and should take. Propagating threatened plant species would prevent their extinction, and more importantly, make them available for a greater objective - forest restoration.



In 2006, Chris built on Missouri Botanical Garden's previous collaborations with MFG, and received a National Geographic Grant to construct nurseries at Parc Ivoloina dedicated solely to the propagation of threatened plant species endemic to Madagascar's eastern lowland rainforests. Jean François (above) who is now the Manager of Parc Ivoloina's Forestry Station, and Lala Randriatavy, had the horticultural experience to carry out the work. The project targeted 38 species of which 19 were successfully propagated and planted out in Parc Ivoloina. On six occasions, plants were used to reinforce wild populations.

Concurrently, Dr. Karen Freeman was working in collaboration with Madagascar National Parks (MNP) to improve the functionality of Betampona's 100-meter Zone of Protection (ZOP). Productive discussions with village leaders helped shape the logistics and incentives of the ZOP restoration program, e.g., individuals/families agreed to planting and nurturing the native saplings they were given at no cost. The objective was not only to increase tree density within the ZOP, but also in and around the participating villages.

Two nurseries were built in 2007, one in Ambodirafia, the other in Antananariva. Two people from each village were hired to run the nurseries. Experiences gained from propagating endemic species at Parc Ivoloina were shared with the ZOP nurserymen. MFG's Agroforestry Advisor, Dr. Christof den Biggelaar, provided additional training.

Other communities wanted to participate in the project so, in 2009, a third nursery was built in Fontsimavo and a fourth in Analamangahazo. Staff from Association Mitsinjo, who had significant nursery and restoration experience, came to Toamasina, and shared their knowledge with the eight nurserymen. Both endemic and commercial





trees were grown in the nurseries; endemics were primarily planted in the ZOP, and commercial trees were typically planted in residential areas close to the participants' homes.



Evaluating A Decade of Growth

In 2011, MFG entered into a rewarding collaboration with Dr. Vasisht Sagan at Saint Louis University's Geospatial Institute. Dr Sagan's research interest in remote sensing intersected with MFG's need to evaluate multiple restoration/reforestation programs in and around

Betampona. In a 2020 publication, Dr. Sagan, et al., compared land cover types in 2010 to 2019. The results showed that residents' 76% reduction of planting row crops within the ZOP concomitant with expanded tree planting activities increased evergreen forest by 59%, mixed forest by 28%, and reduced grassland by 80%. While encouraged by the 67% decrease of Molucca raspberry, the unchanged status of cardamom and 68% increase of guava, reaffirmed our plans for an aggressive invasive species management strategy. In addition, residential areas experienced a net increase in tree cover.

Many of the gains can be attributed to the ZOP program through which participants have planted more than 95,000 trees. Multiple agroforestry initiatives promoted by MFG/MNP, Conservation of Key Threatened Endemic and Economically Valuable Species (COKETES),



and other development organizations have contributed to this successful effort.

ZOP Reforestation 2010 - 2019

Percent Change in Land Categories

Land Type	2010	2019	Change
Mixed Forest	16.6	21.2	28%
Evergreen forest	16.8	26.8	59%
Shrubland	25.6	30.2	18%
Grassland	10.0	2.0	-80%
Row crops	11.3	2.7	-76%
Fallow	1.5	1.4	-5%
Residential	0.15	0.12	-18%
Guava	4.3	7.2	68%
Molucca Raspberry	8.4	2.7	-68%
Cardamom	5.3	5.3	-0.06%

RESCUING EVEN MORE FLORA

Given Madagascar's high level of endemism, each hectare of forest loss could be the last place on Earth for a species. Building on MFG's prior success creating assurance plant populations, MFG applied for a Darwin Initiative grant from the UK government to identify and rescue plants from doomed forest fragments like the one pictured here standing out from the smooth carpet of green deforested hillside.



Thanks to this funding, truly significant advances in *ex situ* conservation of eastern rainforest plants have been made over the past six years. Parc Ivoloïna's living populations of eastern rainforest plants has increased by over 260 species!

Careful attention was paid to developing and maintaining an excellent record-keeping system, which is an essential component of all *ex situ* conservation programs, just like studbooks for rare animals. All seed samples collected through the Darwin Initiative were assigned a unique number and accessioned into Missouri Botanical Garden's TROPICOS database including collection date, GIS location, habitat characteristics, and a photo of the mother tree. The field botanists also plucked a single leaf from the mother tree and took a photo of it before tearing off a small piece which they placed in a plastic bag with silica gel. The bag is labeled, barcoded, and added to MBG's DNA library. This information is particularly important for defining and optimizing the genetic diversity of the *ex-situ* population.

When the seeds are transferred to the nursery, so are the record keeping responsibilities. The nursery staff maintain records on germination rates, substrates, survival, transfers to different sized pots, and if all goes well, to the outplanting in the forestry station.

Darwin Initiative Evaluation

The first Darwin Initiative MFG-led project ended in 2019. The Darwin Initiative's expert panel awarded the MFG an "A" grade noting the design and execution as well as timeliness of the outputs. True to our collaborative ethic, they highlighted the benefits of our strong leadership and established partnership with MBG's Dr. Chris Birkinshaw, without whom this effort would not have been so profoundly successful. The MFG is extremely grateful for our relationship with such a dedicated and insightful partner and are proud to have him as an MFG Advisor.





Careful record keeping must be maintained from seed collection through storage and nursery planting as well as final outplanting.

Our thanks too to partners at Royal Botanical Gardens, Kew, Silo National des Graines Forestières (SNGF) and Parc Botanique et Zoologique de Tsimbazaza (PBZT). Of the 10 field botanists and horticulturalists trained through the project, 8 have gone on to find employment using skills developed through this project.

We are delighted that two of these, Platini and Philemonde, will continue to work at Parc Ivoloïna, funded by MBG, to carry on this critical ex-situ plant conservation work and that we will continue to benefit from the intensive training received by Sylvain, our Betampona Flora Conservation Agent. Our thanks again to Darwin Initiative for having made all this possible.





COKETES

CONSERVATION OF KEY ENDEMIC, THREATENED AND ECONOMICALLY VALUABLE SPECIES

COKETES, a United Nations Environmental Programme/Global Environment Fund funded program, introduced an initiative aimed at conserving 20 threatened, endemic, and economically valuable tree species by provisioning local communities with the materials and training that enable their sustainable use.

Communities with one or more of the 20 species were eligible to apply for a grant. Betampona

far exceeded that with 12 species. MFG and Madagascar National Parks were awarded COKETES grants and have worked collaboratively to maximize conservation benefits.

COKETES increased the number of MFG's community nurseries from four to six while also expanding the capacity of the existing four nurseries. The expansion was necessary to produce the number of saplings needed for

multiple ongoing conservation and development projects including Betampona's Zone of Protection (ZOP), home gardens, agroforestry plots, and the two-hectare invasive *Molucca* raspberry eradication/restoration plots in Betampona.

A key objective of COKETES is promoting the application of agroforestry methods, as it is a more sustainable method of farming.

Plants Produced in MFG's Six Community Betampona Nurseries

Restoration and COKETES Projects

Number of Target Species Produced

2020	15,519
2021	16,709
2022	15,243

Number of Associate Species Produced

2020	24,877
2021	25,065
2022	27,125

Total Number of Plants Produced

2020	40,369
2021	41,774
2022	42,368

Three Year Total of All

124,511 Plants

Malagasy farmers' traditional practice of "tavy" (slash and burn) was based on a rotational system that allowed farmed plots to remain fallow for 8-15 years before returning to that plot. Madagascar's population has long ago grown too large to practice tavy sustainably.

Today, farmers have less land on which to grow their crops, and growing the same crops on a smaller plot, year after year, left the soil depleted and reduced production.

In 2019, the COKETES team selected 287 people (172 men, 115 women) from the six communities where MFG's nurseries are located, for advanced training in agroforestry principles, including the benefits of incorporating trees in farmed land.

Trees improve soil fertility, and when farmers select several different species of fruit trees, they both diversify and improve their family's diet and/or income while also reducing the risk of a disease infecting all their trees.

Endemic trees provide timber, firewood, and annual contributions of organic matter that replenish the soil's fertility. All the participants were also given clove saplings, a reliable income generator, as a contribution to their diversification efforts.

RIGHT: Dr. Emérentienne Mametsa, MNP Director of Betampona Natural Reserve, presenting clove tree saplings to a participant in the COKETES initiative.





RESTORING BETAMPONA'S INTEGRITY

In April 2019, MFG submitted a report to MNP summarizing years of research documenting the characteristics, spread, species interactions and recommended methods to control the growth and incursion of three highly invasive species: guava, Molucca raspberry

and Madagascar cardamom. The report ended with a proposal to restore: 1) twenty hectares (ten hectares per year) of cardamom-dominated patches within Betampona's primary forest, which encompasses the home range of diademed sifaka groups, and 2) a

proposal to restore four hectares (two hectares per year) of Molucca raspberry- dominated patches along Betampona's southeastern edge.

Project implementation began shortly after its approval in mid-October 2020.

A PRIMARY FOCUS

RENDIRENDRY NURSERY'S PRIMARY FOCUS IS PRIMARY FOREST



Alex Mamisoa (above), whose exceptional knowledge and skills were responsible for much of the Darwin Initiative's success at propagating and planting out saplings in Parc Ivoloïna's forestry station, is leading the project's execution. Alex began by building a new and larger nursery at

Rendirendry following the same high standards used to build the Darwin Initiative's nurseries, including raised propagation tables, and the use of shade netting for the roof and walls. Multiple compost bins were built, and many days were spent collecting enough organic waste, fallen leaves, and grass clippings to produce the amount of potting soil needed for the project.

MFG follows the Kew protocol for the collection of seeds and seedlings, e.g., when selecting seedlings, the weaker individuals are collected because they have a better chance of survival when cared for in a nursery as opposed to competing with their robust siblings. One advantage of using seedlings is their time in the nursery is shortened to 1- 2 months instead of taking 6-12 months when propagated from seeds.

Local villagers were hired by MFG to assist in the collection of seeds and wildlings, and the manual removal of cardamom from designated plots. The two sites selected for restoration are within the home range of diademed sifaka groups MFG has been monitoring since 2019.





Two sites in the western part of Betampona that included the home range of diademed sifaka, and were overrun with cardamom, had been identified in MFG's proposal.

The next step was for Alex and his team to visit those sites and demarcate a series of 15 x 15 meter plots, which were then further subdivided with the objective of removing all cardamom plants from every other sub-plot in a checker board type arrangement. In this way the negative impacts on native fauna are reduced and the alternate sub-plots will be weeded 6 months after the initial treatments.

Later, a third site at Tolongoina was added in the

North of Betampona. The cardamom stems are cut to the ground and used for mulch, after which the entire root system must be completely dug up and removed. In Sahakoho the roots were particularly long and dense; the strength required to dig them out took a toll on the workers who sometimes needed additional days off to recover from the exertion. Once the plot is cleared of the cardamom, it is important to begin planting the cleared areas within two to four weeks with native plants.

Decisions on how many and which species to plant was based on the characteristics of each plot, e.g., slope and structure, existing species composition

and density. Planting began in May 2021 and at year's end 2022, the team had planted 14,097 saplings, representing 42 families and 115 genera in 344 cleared plots giving a total surface area of 7.6 ha. This is well on schedule to meet our 10-ha target for this particular project. Team members also began checking the first 27 plots they planted at Sahabefoza and the first 36 in Sahakoho, to evaluate their status and address problems.

Pioneer species were sprouting in the plots, but only those that were interfering with the growth or health of the saplings were removed. Many of the plants were growing well, including some that had already doubled in height.

Our thanks to the Living Earth Collaborative for supporting this critical project to restore primary forest in the heart of Betampona Reserve.



WRESTLING AGAINST RUBUS



COKETES Adopts the *Rubus moluccanus* Eradication Project

Patrick Rabeharison, MFG's COKETES Plant Project Manager and a botanist by training, oversees the nurseries and the Molucca raspberry eradication project. He worked with MNP and DREDD to select the 2-hectare site, which is close to Betampona's southeastern perimeter. Patrick met with mayors and fokontany presidents to explain the project's purpose, objectives, and that it was authorized by the authorities.

Workers were hired from COKETES-participating communities whose names were registered with MNP and DREDD.

Molucca raspberry (*Rubus moluccanus*) forms a sprawling, thorny and very unwelcoming barrier for most plant and animal species. COKETES adopted the Molucca raspberry control project due to the threat this invasive species poses to the health of Betampona's biodiversity including its endangered lemurs.

The team began by marking 60 plots that measured 15 x 15 meters and 20 plots that measured 20 x 20 meters.

Similar to the cardamom work, the first step entails cutting the vegetation to the ground and piling it along the borders of the plot. Thereafter, the roots have to be completely removed before planting native species.



DARWIN INITIATIVE II

DIVERSE AGROFORESTRY PROTECTS NATURAL CAPITAL AROUND BETAMPONA AND VOHIBE



Protecting the primary forest of Betampona not only relies on active conservation work to remove invasive plants and restore areas with native plants but it also requires pro-active steps to reduce forest loss through clearance for agriculture or illegal logging for either timber or firewood collection. An important part of that is the provision of regular patrols as a deterrent, and thanks to extra support from Saint Louis Zoo's Wildcare Institute, we were able to not

only maintain but increase our patrolling effort at Betampona during the difficult COVID-19 period when pressures were greater than ever on Malagasy forests due to racing inflation and economic hardship.

Another part of the puzzle is the continued encouragement and facilitation of more sustainable agricultural methods. In a country where the vast majority of people are subsistence

farmers, the population is booming, and most non-protected forest has already been cleared (not to mention a good proportion of the protected forest too), traditional slash and burn or "tavy" methods are no longer viable. MFG has long partnered with agroecology specialist, Prof Christof den Biggelaar, to promote agroforestry around Parc Ivoloina and Betampona, but never before have we had dedicated funding for this purpose.



As of July 2021, MFG and partners were awarded their second prestigious Darwin Initiative Award from the UK government's Department of the Environment, Food and Rural Affairs (DEFRA) to promote agroforestry around Betampona, Ampasina (a community-managed network of forests near Betampona) and MBG's site of Vohibe in the Ankeniheny-Zahamena forest corridor. The project also supports community management of forest fragments outside the main protected areas at these sites.

By working through already-existing local village associations, known in Malagasy as Vondron'Olona Ifotony (VOIs), the project seeks to create model villages to showcase the benefits of agroforestry for biodiversity protection and socio-economic development, producing a cascade effect throughout the wider community. The project is working with 100 households across the three sites and has got off to a flying start. Training has been offered to date by several of our inspiring and highly expert partners: Prof Christof den Biggelaar, the FJKM Church's Fruits, Vegetables and Environmental Education Program and Kew's Madagascar Conservation Centre in topics ranging from agroforestry basics to fruit tree grafting to yam cultivation.

The program has been extremely well received by the participants, who have received start up plants and tools as well as the all-important capacity building opportunities. As their part of the deal, the VOIs have committed to work with MFG and MNP to better conserve and monitor the community forests under their management.

Between the agroforestry promotion, our ongoing native forest restoration program and this new initiative to help conserve the remaining forest fragments around Betampona, we aim to gradually build an ever-increasing tapestry of tree cover around Betampona to buffer it further from severe storm damage, climate change impacts, encroachment by invasive species and slash and burn agriculture. In so doing we will also help protect vital ecosystem services for local communities. A win-win for all!





SOCIAL SIFAKAS

Population Dynamics

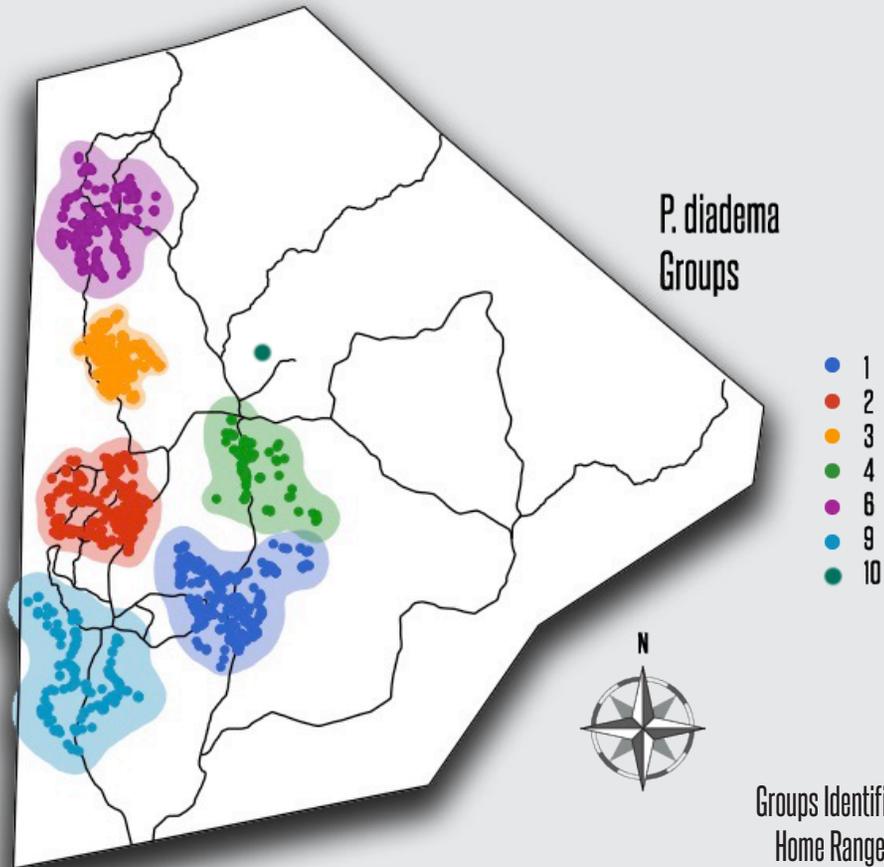
In 2018, MFG initiated research to collect demographic, genetic, health and home range data on Betampona's *Propithecus diadema* for the purpose of developing a conservation masterplan. Our objectives include placing radio collars on the entire adult population to enable systematic

evaluations of the population's sustainability and revise conservation strategies as needed.

At the end of 2019, 5 groups that included at least one radio-collared individual, were monitored. Groups 1 and 4 comprised a pair, Group 2 included a pair and their daughter, Groups 3 and 5 were single males. Our team identified three uncollared groups, including Group 6, a pair with an infant, and Groups 7 and 8 both comprised of adult pairs. The known population included

8 males, 7 females, and 1 infant for a total of 16 individuals.

The demographic changes that occurred over the succeeding three years are detailed on pages 32-33. They include 5 new individuals, 4 births, the deaths of 1 adult male, 3 adult females, and 5 infants/juveniles. At the end of 2022 the collared groups comprised 7 males, 5 females and 1 infant for a total of 13 individuals. The uncollared groups 7 and 8 were no longer observed; absent collars,



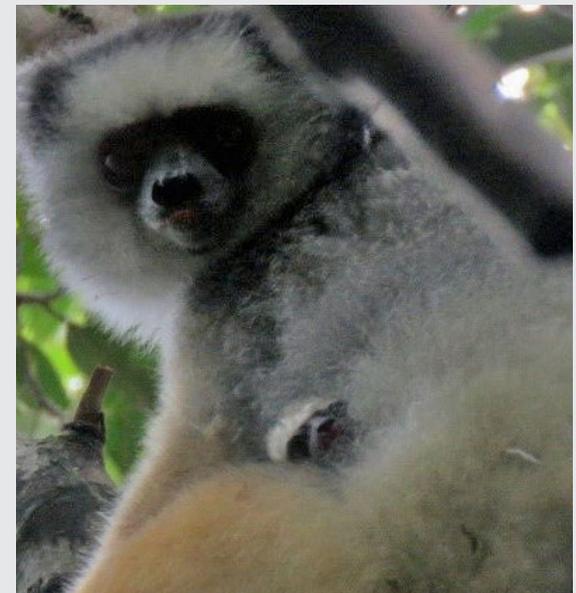
it is impossible to know what happened to these individuals. Some may have died or dispersed to different areas of the reserve. Some may be among the five newly identified individuals; an adult and adolescent female who joined the Group 3 single male, the male found with Ruby to form Group 9, or the newly discovered pair that comprise Group 10.

The data we have collected indicates a population undergoing extirpation. Especially concerning are the deaths of 3 adult females and the high infant/ juvenile mortality. Shockingly, Ruby is the only offspring to reach breeding-age, disperse from her natal group, and find a mate, only to die nine months later. Why the deaths of so many infants? None exhibited signs of weakness when observed, but that does not preclude a health related

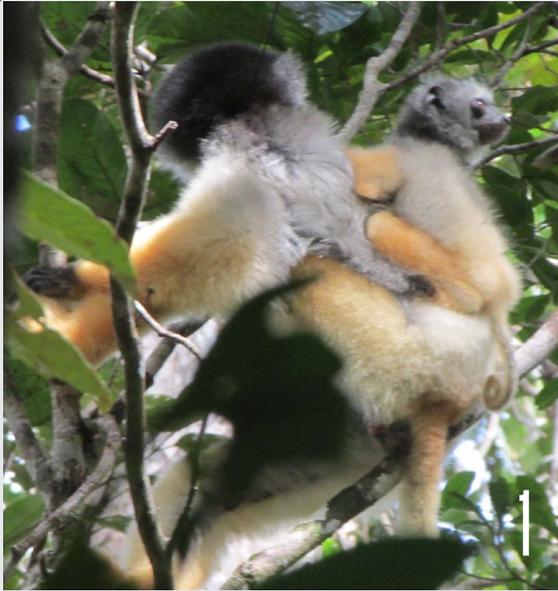
death. Predation by fosa is to be expected, and although illegal, hunting by humans and/or dogs does occur. Even unsuccessful hunts can have a negative impact on their victims via the stress of being chased and/or the decreased time spent feeding/resting. This may be especially true for breeding females.

Genetic analysis of samples from three *P. diadema* (reported on pages 34-35) shows limited allelic variation. We suspect reduced genetic diversity and inbreeding plays a role in its extirpation and have recommended translocating unrelated individuals as the best option to maintain the species in Betampona.

While difficult to read, this hard-won data by dedicated conservation agents provides crucial information for refining conservation action planning and interventions.



Group 3 female with newborn infant



GROUP 1

- Dec 2018 – Male* and female pair captured, female radio collared; male nylon collar.
- 2020 Mid-July: Birth of healthy infant.
- 2021 July: Birth of 2nd infant who dies mid-Sept
- 2022 August: 2 year old offspring died.
- 2022 Dec: Female died.

Group = 1 Male

*Male was first captured in 2012 as a subadult in a group with an adult pair and younger female sibling. Male dispersed from natal group in 2013, he is at least 13 years old

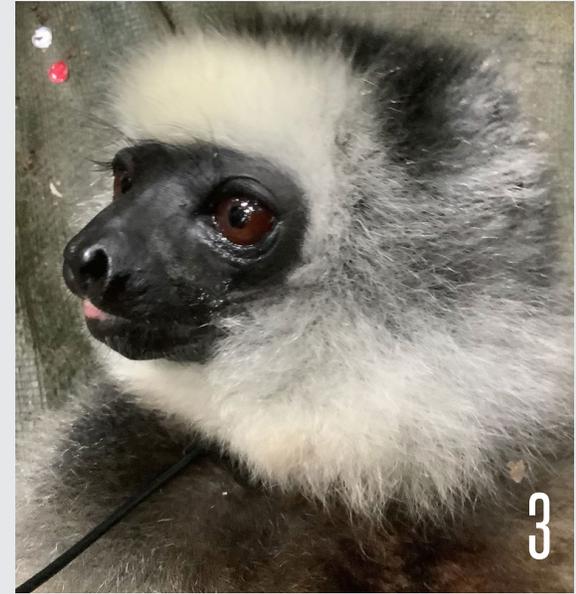


GROUP 2

- 2018 Dec: Group includes pair with juvenile daughter; all three were collared. Female (Ruth)* was lactating, indicating recent loss of her infant.
- 2019 October: Ruth gave birth.
- 2019 Dec 25: infant death.
- 2021 Sept: Ruth gave birth.
- 2021 Dec: Daughter Ruby disperses to form Group 9.
- 2022 Death of infant.
- 2022 Sept Ruth gives birth.

Group = Male, Female, Infant

Ruth: a microchip revealed Ruth was first captured in 2007. Researchers reported a birth in 2008 but the infant died. Another birth in 2009, research ended - infant's fate unknown. Ruth is at least 19 years old.



GROUP 3

- 2018 Dec – Single male radio collared.
- 2019: Male's home range overlapped with other groups; a behavior observed in single males.
- 2020 March: Male found with an adult and juvenile female; juvenile disappeared/died in September.
- 2021: late July female gave birth; infant died late September.
- 2022: Pair bred in Feb – no birth observed.

Group = Male, Female



GROUP 4

- 2018 Dec: Male and female pair observed; male captured and radio-collared.
- 2019 Dec: Female captured and radio-collared.
- 2020- no offspring.
- 2021 Feb 17: Female's radio collar found on ground; cut by knife; no body found, most likely killed for bushmeat.
- 2022 Dec: Male remains single.

Group = 1 Male

GROUP 5

- 2019 May: Single male radio-collared.
- 2020: Large home range overlapped with 2 northern groups.
- 2021 – Last observed in March; radio collar, body never found; presumed dead.

Group = 0



GROUP 6

- 2019: Adult male, female and infant daughter first observed. Attempts to capture failed.
- 2021 August : Male radio collared.
- 2022 July: Daughter radio collared.
- 2022 Sept: Adult female gives birth.

Group = Male, 2 Females, 1 Infant



GROUP 9

- 2021 Dec: Group 2 daughter "Ruby" dispersed and was found with an unknown male south of her natal home range.
- 2022 Sept: Ruby died.

Group = 1 Male



GROUP 10

- 2022: MFG team observed a new pair;
- 2022 July: Male radio-collared.

Group = 1 Male, 1 Female



GENETIC DIVERSITY CHALLENGE

Betampona's diademed sifaka have likely been isolated for at least seven generations, and with such a small population, an erosion of genetic diversity is inevitable. MFG partnered with Dr. Emily Wroblewski, anthropological geneticist at Washington University, to assess the population's genetic diversity. She began by using three samples to do an initial validation and optimization of genotyping methods from Ramarokoto et al. (2008) which you can see in the chart on the following page.

The three samples are from BET 18.01, Group 1 female, BET 18.08, Group 2 female Ruth, and BET 19.01, Group 5 single male. The three sifaka had identical genotypes at three loci (light green). Homozygous genotypes are indicated in bold green. Blue highlights indicate that at two loci, two individuals shared identical genotypes.

The number of alleles detected for each locus of the three Betampona individual (BNR = Betampona Natural Reserve) is compared to

those of ten individuals from Mantadia and 10 individuals from Maromizaha (MM) (total 20 individuals genotyped, Ramorokoto et al. 2008). We do not observe a high frequency of homozygosity at these other sites, with homozygosity observed at just one of six loci. However, we observe highly similar genotypes whereby all three animals from Betampona have identical genotypes at three of six loci (50%).



Most critically, we observe that BNR has a significantly lower average allele number across all loci compared to that detected for MM (BNR mean = 2.33, MM mean = 7.5, $p < 0.0001$), suggesting that there is limited allelic variation within BNR. Samples from ten additional sifaka will be genotyped in 2023.

Infant mortality is known to be high in several *Propithecus* species. Researchers studying *P. edwardsi* at Ranomafana reported that 29 infants of 56 observed *P. edwardsi* births died within their first year, long term studies of *P. verreauxi* found similar results. In contrast, of 76 observed *P. diadema* births in fragmented and intact forests of Tsinjoarivo, the survival rate to one year was 91%.

The authors go on to say “after 15 years of collecting data from several groups, infant deaths were unexpectedly few”. A study of infant behavior in *P. diadema* inhabiting Maromizaha Reserve, seven of the eight infants survived to at least two years when observation ended.

Animal ID	64HDZ74		64HDZ86		64HDZ281		64HDZ265		64HDZ289		64HDZ305	
	Allele 1	Allele 2										
BET18.01	241	245	202	206	170	174	168	170	101	168	147	147
BET 18.08	241	245	204	206	170	174	168	172	101	168	147	147
BET 19.01	241	245	204	206	170	174	168	170	101	168	141	147
N alleles (BNR)	2		3		2		3		2		2	
N alleles (MM)	6		9		8		7		9		6	

AMPASINA

A MODEL FOR WORKING WITH THE LOCAL COMMUNITY BY ROBERT LONG

It took me a while to understand the essence of this project. Its Malagasy acronym - VOI Lovasoa - loosely translates as "Local Community Initiative". It is managed by MFG and financed by the Darwin Initiative, one of the UK's recently rebranded Biodiversity Challenge Funds (BDFs).

Located deep in the Ivoloina Valley, this project aims to conserve a cluster of forest fragments via the local community. It falls under MFG's core objectives: conservation action, capacity-building and environmental education.



I was lucky enough to be part of two training initiatives in October and November, 2022:
- How yams can help to promote food security and increase local community revenue, while protecting the forest - Agroforestry techniques to improve local welfare while protecting forests and biodiversity.

Ampasina is clearly less high-profile than MFG's role in protecting lemurs, managing the exclusive Betampona natural reserve, and operating the region's flagship tourist attraction: Parc Ivoloina. However, I believe the VOI project holds some of the keys for long-term flora and fauna protection in Madagascar: involvement of the local community in project management, protection of their livelihoods and the creation of a legal entity (the VOI) which ensures these efforts are recognised and protected under Malagasy law.

In short, it is a model for sustainable biodiversity and conservation efforts. Well done to Alice Heliarisoa and her team!

Note on the Author

Robert Long (60) is an Irish citizen living in Belgium. Following a career in European affairs, Robert became an English teacher at secondary school in Brussels. In both 2021 and 2022 he spent a few months as a volunteer with MFG, while teaching English at schools in Toamasina. The team have been extremely grateful for his English lessons, which have been continued by Courtney Meek, a long term MFG volunteer.



GREAT DAY FOR MFG AND FOR OUR LONG TERM “TEMPORARY WORKERS”



The MFG permanent team has grown over the past years as our remit and activities broaden and increase. Beyond these dedicated permanent employees MFG has benefited from very loyal support from a number of “temporary workers” – some of whom have been with MFG for 15 years! They perform roles ranging from guiding at Betampona to helping Vero keep the Ivoloia Conservation Training Centre functioning.

The temporary workers do not benefit from the same advantages that full time permanent staff receive such as pension and healthcare contributions. Although this is both legal and common practice, the MFG felt compelled to change this situation. Many of these individuals have contributed a huge amount to MFG over the years with tireless dedication and hard work despite not having permanent contracts and it was only right that their long-term efforts were recognised in this way.

All prospective candidates for a permanent position were interviewed and a prioritization was done based on merit, motivation and longevity. While it was not possible to employ all potential candidates in one go, it was made very clear to anyone not selected that it was not a one-off



assessment, but would be an ongoing process to provide further motivation for future efforts.

Despite the terrible timing with severely reduced income due to COVID-19 related issues, the MFG made the decision to shift thirteen of these long-serving staff to full-time employees in May 2022. It was a joyous couple of days as first the Ivoloia “temporary” staff were awarded their permanent contracts – and then those at Betampona. MFG’s Executive Director, Karen Freeman, shed more than a few tears.

Obviously, it is an ever-growing responsibility for MFG to maintain salaries for our growing number of permanent staff: as of the end 2022 MFG had 61 core permanent staff and a further 26 full time employees working on grant-funded projects.



As we have always maintained, it is the MFG membership dues which are utterly critical to providing a stable basis of funding to keep these salaries being paid year in and year out.

MFG is the sum of its parts and so our team is really the body, heart and soul of MFG. It has been a desperate struggle the past couple of years to avoid COVID-19 related redundancies within MFG, so our sincere thanks go to the MFG Board who have worked miracles to keep us afloat and to all our amazing MFG members and friends who have stood by us despite suffering extremely hard financial times themselves. The team have asked us to transmit their heartfelt thanks to you all.

SMALL POPULATIONS CAN'T AFFORD RISKS

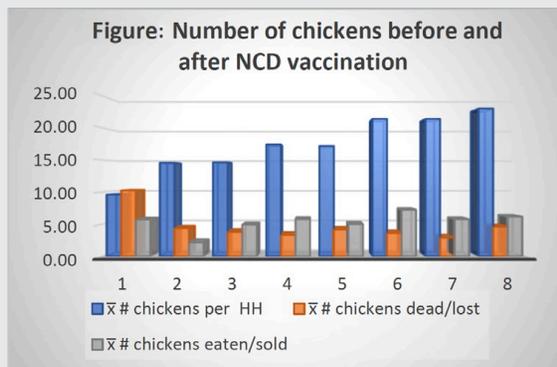
In demographic terms, the most consequential loss is a reproductive-aged female from a small, isolated population. Females are the critical limiting factor to growing the population. It took four years and five months to replace female BET 19.1. While bushmeat hunting within Betampona is relatively low, the consequences for this critically endangered population of a critically endangered species are not.

Reducing the nutritional and economic drivers of bushmeat hunting has been proposed as a conservation strategy to reduce bushmeat hunting. MFG applied for an IUCN Save-Our-Species Lemurs grant to initiate a vaccination program against Newcastle Disease (NCD), a significant cause of high chicken mortality. NCD vaccines are very effective in preventing

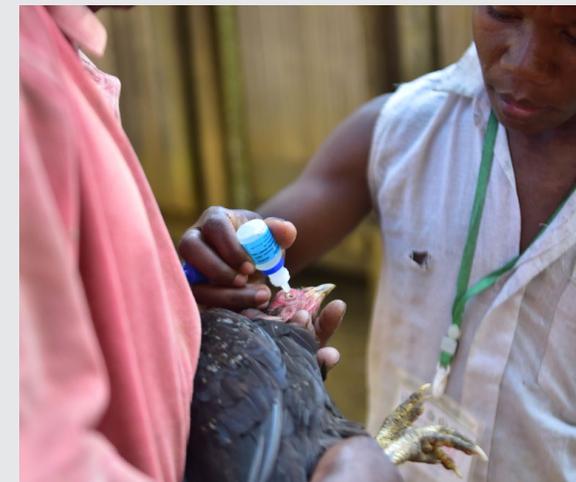
outbreaks, but it was not until a thermotolerant NCD vaccine was produced in Madagascar that it was practical to immunize chickens in rural areas. MFG was awarded an IUCN Save-Our-Species grant to: 1) show families that vaccinating their chickens against NCD would increase their chicken production, 2) demonstrate that the financial benefits of increased production are greater than the cost of vaccinating their flock, and 3) distribute fuel-efficient stoves to reduce pressure on lemur habitat.

MFG collected baseline data on flock demographics in May 2018, prior to beginning the first round of vaccinations in July. The trained vaccinators took vaccine orders and collected demographic data two months before the next triannual vaccination. The figure at left presents data from households (HHs) that vaccinated their chickens every four months regardless of when they joined the program.

At the end, 341 Vax HHs and 233 NoVax HHs were interviewed. We found no substantive difference between Vax and NoVax HHs' chicken husbandry practices. The majority of HHs allow their chickens to free-range during the day, 67% bring all their chickens, or their most valuable chickens into a coop or their house at night, and 84% feed them daily. Asked the maximum number of chickens they can manage; the average response was 51 for NoVax HHs and 57 for Vax HHs. The average number of chickens that Vax HHs produced in 2020 was 33; we did not ask whether they were trying to reach their maximum flock size, or what they would need to reach it.

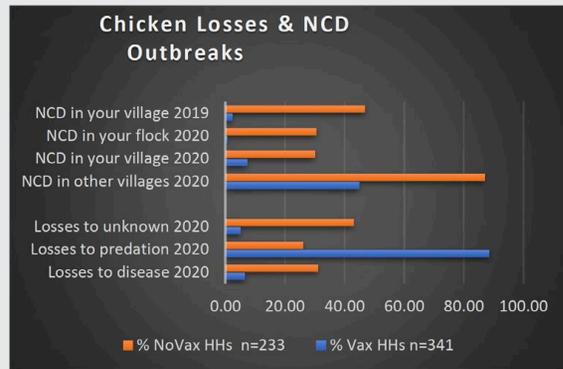


In addition to the information generated by the chicken population data, the MFG developed a survey to compare chicken health and husbandry practices of HHs that participated in the NCD vaccination program with HHs that did not. Two recent ISSEDD graduates were hired to carry out the survey which was planned for mid-2020, but due to COVID-19 precautions, it was delayed until January 2021 and ran through March.



CHICKEN LOSSES & PERCEPTIONS OF GAINS

There are no clinical symptoms that are unique to NCD, a chicken's death cannot be definitively attributed to NCD without lab diagnostics to identify the virus (e.g., PCR tests). However, the multiple symptoms and timing of outbreaks of the disease residents refer to as "bomoa" is likely NCD (Golden, et.al. 2014). In 2020, 30.5% NoVax HHs (n= 71) reported at least one outbreak of NCD in their flock, in contrast to only 0.6% Vax HHs (n=2); $p < 0.001$, Odds Ratio = 73.7). These HHs reported that NCD disease occurred mainly in the fourth trimester of 2020 (October-November-December) which is consistent with the NCD reported by Maminaiina et al. (2007) and Bagnol & Alders (2011, unpub. report Makira Protected Area Bushmeat Initiative).



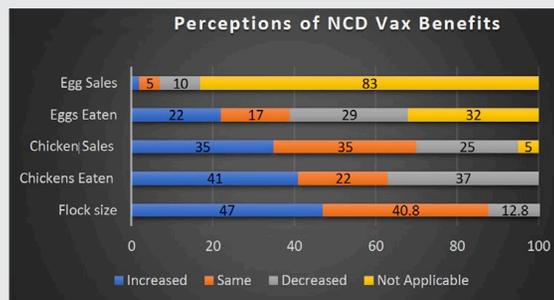
Vax HHs that missed 1 or 2 vaccination campaigns were not more likely to report experiencing a NCD outbreak in their flock than HHs that had not missed any vaccination campaigns, (potentially the number of HHs vaccinating their chickens provided

some herd immunity). While recognizing the survey reports of NCD are not definitive, the demographic data collected throughout this project along with the results of this survey suggest Vax HHs have been protected from contracting NCD.

Our results show that NCD vaccinations have led to substantial increases in flock size. It was therefore surprising that less than half of the Vax HHs thought their flock had grown in size. There could be any number of reasons for this perception. The results we see are presented as average increases, which means there are HHs with higher, and with lower than-average gains.

Sick chickens are often eaten, and thereby still provide a benefit. Chickens remain vulnerable to other diseases, and free-ranging chickens are always vulnerable to predation. We look at numbers and graphs and see substantial gains, whereas HHs may adjust quickly to the new norm of fewer losses. What does make a BIG impression is the loss of most or all of their chickens. Indeed, these huge losses are what families reported in three previous surveys, and this was the barrier we set out to remove so HHs could achieve their goals.

The vaccinators did explain when the free vaccinations were set to end. Despite additional funding to lower the costs and thereby ease the



transition HH participation dropped significantly. The pandemic led to significant economic hardships, especially for the rural poor.

We believe this issue requires one or more skilled and empathetic people who can carry out meaningful conversations with HH that participated in the program. A deeper understanding of the bigger picture could help in developing a path forward.



AMAZING RECOGNITION FOR UNSUNG HEROES

The fruits of one of our best long-term MFG research partnerships are now being seen as multiple new species of endemic Malagasy frogs are gradually being described from Betampona, Parc Ivoloïna and other sites. The achievement is the result of decades of hard work by Betampona staff and an incredible partnership of international herpetology experts including Dr Angelica Crottini (Research Centre in Biodiversity and Genetic Resources (CIBIO) at Porto University), Dr Franco Andreone (Turin Natural History Museum) and Dr Gonçalo Rosa.

Dozens of Species

Thanks to their work and observations by our own team at least 36 new putative species have been identified. The process of describing those new species can be extremely long and laborious, often involving multi-partner taxonomic revisions that can take years to complete. Our incredible collaborators and their colleagues have stuck with it and in recent years a host of new taxonomic revisions and new species descriptions have been published.

Saint Louis Zoo Support

We are very grateful to Saint Louis Zoo's WildCare Institute, whose Field Research Conservation grants have made the majority of the work at Betampona possible. Given the 16 new formal species descriptions and the 20 Betampona-related peer-reviewed publications to date from between our collaborators, these grants have truly been the gifts that keep on giving.

Our colleagues are always very quick to appreciate and recognize the vital contribution made by MFG's Conservation Agents and guides in the data collection and field observation aspects of the work and many of our agents have been included as co-authors on multiple peer-reviewed papers (see the 2020-2022 publication list at the end of this report for some examples).

In 2014 and 2017 respectively MFG's Karen Freeman and Jean Noel's contributions were further recognized when each had a new species of Betampona frog named after them: *Platypelis karenae* and *Stumpffia jeannoeli*.

New Species Named in Their Honor

We are delighted that this great honor has now been bestowed upon two of MFG's unsung heroes: Ingrid Porton and Georges (Betampona): *Gephyromantis portonae* and *Mantidactylus georgei*.

Georges

Georges has worked for MFG for over two decades, joining the team in 2001 to initially help with the black and white ruffed lemur releases. Georges is a diligent but quiet member of the team so has probably not received the recognition he is due for his years of loyalty and hard work.

We are thrilled that he now receives one of the greatest honors a biologist can have; having a species named after them.



MANTIDACTYLUS GEORGEI PHOTO: GONÇALO ROSA

As the authors note in the publication “We dedicate this species, which occurs, among other sites along Madagascar’s east coast, in Betampona Strict Nature Reserve, to Georges, our guide on numerous field expeditions in Betampona, in recognition of his dedication to the study of the herpetofauna of Betampona.”

Ingrid Porton

Our other honored huge unsung hero is Ingrid Porton, MFG’s Vice Chair of Conservation and Research. Ingrid is part of the very fabric of MFG and has been involved since its creation in 1988.

On top of this, Ingrid has held one of the most integral behind-the-scenes support roles since 2004 when Saint Louis Zoo became the official headquarters of MFG. She has maintained this



GEPHYROMANTIS PORTONAE PHOTO: ANGELICA CROTTINIA

crucial role to this day even though the MFG is now headquartered at Naples Zoo.

Ingrid always makes sure she is as far away from the limelight as possible, but MFG would simply not function without all she does and we are beyond grateful for her recognition in this permanent manner.

Our massive thanks again to our amazing herpetological collaborators who have become lifelong friends of MFG for the incredible work they do and also to Georges and Ingrid.

Misaotra betsaka!

INVASIVES: NOT JUST PLANTS

Analalava Special Reserve

On July 7, 2020 MBG's Chris Birkinshaw forwarded a photo he had just received from staff at Analalava to MFG's Asian Toad Team. Could someone confirm that, what looked to be an Asian toad, was indeed an Asian toad? And, if yes, could the toad field team assess its population status in and around Analalava Reserve, and then suggest a control strategy MBG staff could enact? Roderic Mahasoa, MFG Toad Project Field Leader, responded and when travel restrictions were lifted in mid-August, he drove to Analalava with a team of experienced ISSEDD students. They met with MBG staff and laid out a survey plan.

The team found 39 adults, 28 subadults, 22 juveniles and over 500 tadpoles. The existence of this isolated satellite population, approximately 57 km from the toad's likely entry point via a shipping container just south of Toamasina, suggests a human-mediated introduction.

A Year of Infamy

In early January Roderic was notified that a juvenile Asian toad had been discovered in Parc Ivoloïna. Alarmed, Roderic jumped into action and organized nine teams of eco-volunteers to survey areas within and outside of Ivoloïna's

eastern border. Outside the border they found 2 pregnant females, a small stagnate pool with eggs, and residents of three nearby villages who reported seeing or killing toads. Scattered within Parc Ivoloïna, they found 3 adults, 27 young toads and a subadult. The toads invaded Parc Ivoloïna in January; two months later COVID-19 invaded Madagascar; 2020 was indeed a year of infamy many of us will never forget.

COVID-19 Delays and Disruptions

Drs. Ben Muller and Noeli Ramamonjisoa lived and worked in other countries when they were selected to lead the Asian Toad Control and Mitigation Program and both would be free to move to Madagascar by mid- 2020. Then the world changed, and like millions of other people, their plans were stymied by the pandemic. Noeli was able to return to his home country in mid-November when the Malagasy Government scheduled a limited number of flights to repatriate citizens.

Ben's move to Madagascar took another year due to the closing of the Malagasy border. However, like so many people in the age of COVID-19, Ben used Zoom and emails to communicate with project staff and attend meetings held in



Building Madagascar's Capacity to Counter the Threat from Invasive Species
The motion confers international recognition of the threat invasive species pose to Madagascar's biodiversity



AND

The urgent need to develop a coordinated national detection and eradication program when populations are still small enough for this to be a feasible, less costly, and more humane option.

Adopted by IUCN October 2020

Invasive Species Information Network

In December 2020 MFG, DREDD and ISSEDD organized a workshop attended by 42 fokontany (village) presidents to raise awareness of the ecological and socioeconomic damage caused by Invasive Alien Species, (IAS), and get feedback on what would an effective communication network, within and between fokontany, look like? Participants were divided into three working groups, each group was assigned a topic and asked to address their topic within the framework of

identifying: 1) the main problems/challenges, 2) actions to be taken, and 3) the stakeholders. The topics were: 1) how to prevent the entry of IAS into Toamasina, 2) how to establish an IAS surveillance and reporting network, and 3) how to eradicate IAS.

Networking



- There was unanimous agreement that a community-based surveillance network was required to prevent the spread of IAS,
- Participants were willing to collaborate within and between fokontany to develop this network.
- They recommended that sightings of IAS should be reported through the fokontany's existing administrative structure, the Vaomiera (Malagasy for committee).
- The Vaomiera would report sightings to the fokontany President, who would inform the MFG.
- MFG would assume the responsibility to inform the relevant authorities.

In August 2021 the team held a second two-day workshop to introduce and expand participation in the community-based invasive species surveillance network. In total 198 influential village leaders, primarily the Presidents and/or the Tangalamena (wise elders), representing 99 fokontany attended the workshop. As in the previous workshop, there was an emphasis on the Asian toad and house crow, but examples of invasive plants, such as Molucca raspberry and guava, were also discussed. Results of pre- and post-workshop presentations showed that 61% of the participants had a better understanding of invasive species' negative impacts, and 93% of respondents strongly supported awareness raising and interventions at the community level. Their support was confirmed through the creation of 99 new Vaomiera that were added to the network.



The project was supported by the Critical Ecosystem Partnership Fund.

ASIAN TOAD CONTROL & MITIGATION PROGRAM



Raising awareness that humans help toads expand their range by hitching a ride inside a comfortable sack or food basket is a message that needs to outpace the toad's expansion.

Madagascar's Asian toad population is estimated to be over twenty million and growing. The eradication of this invasive species from Madagascar is considered unattainable with the currently available methods. There is, however, an urgency to identify isolated satellite populations that can still be eradicated. Dr. Ben Muller, in collaboration with Ministry of the Environment and Sustainable Development (MEDD), and the project's technical advisory group, comprising of national and international experts, has outlined the current scope of this program which aims to mitigate the Asian toad's harmful impacts on Madagascar's biodiversity and its citizens.



It was therefore important to carry out surveys to monitor the invasion front and identify where toads have invaded areas of high biodiversity (referred to as High Value Areas). To date, four High Value Areas have been identified: Parc Ivoloïna, Analalava Reserve, Analabe and Vohibola Forests.

More systematic surveys were carried out in the four High Value Areas to map the toad's distribution and identify spawning sites to assess the extent of the population and develop an eradication plan. The team also carries out inventories of the native fauna to identify the

species that will likely be harmed by the toad's presence. MBG staff at Analalava Reserve have initiated the next step and, in consultation with MFG's toad team, developed a project to capture and remove Asian toads from the forest.



Eradicating satellite populations before they get too large needs the united vigilance of the thousands of people who, as they go about their day, might encounter a toad.

SEARCHING FOR TOADS AND SPREADING THE WORD



As staff and ISSEDD students initiated toad surveys focused on areas 10-15 km from the last documented location of the toad invasion front, they had two objectives to: 1) carry out day and night-time searches, and ask residents they met if they had seen Asian toads, and 2) take the opportunity to provide residents with basic information on the toad, their negative impacts and toxicity, and the need to report all toad sightings.



Posters were distributed in locations where most people would see them. Workshops were held in some villages, providing opportunities for more in depth communication on both sides – answering questions and listening to concerns, observations, and feedback. Above left photo: Ben Muller at a community workshop.



Can You Hear Me Calling?

Because early detection is vital to managing the spread of Asian toads, Ben developed an acoustic monitoring program. Ben's experience with applying vocalizations as a lure to capture cane toads, an invasive species in Australia, into traps was key. Through a collaboration with researchers at the Western Australia Department of Primary Industries and Regional Development (WADPRI), University of Adelaide, and Centre for Invasive Species Solutions (CISS), they trained computer software to automatically recognize Asian toad calls. Using automatic call recognition will allow the team to detect toads when they first arrive into new areas at very low densities, even if the technicians are unable to physically survey the site for toads.



SUCCESSFUL HOUSE CROW ERADICATION IN TOAMASINA AND FORT DAUPHIN- A FIRST FOR MADAGASCAR!

Eradication specialist Peter Haverson (InGrip Consulting) left Madagascar late 2019 after he had reduced Toamasina's crow population from approximately 28 to 17. Upon his return in February 2020, the known population had grown to 32. Over the next 40 days he had shot all but one crow and had planned to return in April for the remaining crow and the three known individuals in Fort Dauphin. The pandemic thwarted that plan, and due to other commitments, Peter would be unable to return for several years.

MFG needed an in-country shooter and selected Betampona conservation agent, Jean Honoré Velo for his experience with rifles and observing house

crows. COVID-19 and complications related to obtaining insurance and permits took up much of 2020.

All the while, Project Coordinator Herison Ralaimaro, continued monitoring the crow population. For months he only observed the singleton, but on June 29 he observed two new individuals. In November he discovered a nest with three fledglings, and in December 2020 one of the six crows had disappeared. In 2021 Jean Honoré successfully shot three of the five crows. The last two crows disappeared, and there was reason to believe a local business owner was paying young men to kill them with rock catapults. Herison and his assistant



relocated to Fort Dauphin in mid-October to obtain the necessary permits, and observe the crows. The population had thankfully not grown from three, leading to the speculation that the three were likely a single sex group. Jean Honoré and Herison arrived mid-November, and spent some time becoming familiar with the crows and the surroundings. By mid-December when the team had to leave, two of the three crows had been removed.

At the end of September 2021, and in coordination with the Asian toad team, Herison organized a five-day survey for house crows and Asian toads. Project staff and 10 ISSEDD students divided into two teams; one team covered sites up to 59 km north of Toamasina, the other covered sites up to 65 km south of Toamasina along the Pangalanes Canal. The surveys included direct searches for both species and interviews with residents of each village they visited. Asian toads were found in Vohidotra to the North of Toamasina (the known northern front of the main invasion incursion) and to the South as far as



Ankarefo and Ambodisaina. No crows were found. Jean Honoré returned on his own in April 2022 and was successful in completing his mission to

shoot the last house crow in Fort Dauphin. Given the extremely challenging weather conditions with continuous strong coastal winds, his relative inexperience and using just an air rifle, this was a remarkable achievement. Follow up surveys revealed no further house crows in Fort Dauphin.

The house crow eradications in Toamasina and Fort Dauphin are very significant for the protection of Madagascar's biodiversity from this highly invasive bird and, as far as we know, are a first for Madagascar. The success of the project to achieve the eradications themselves and the creation of an active community-based surveillance and communication network was only possible due to the strong partnerships built between the various project members: MEDD, DREDD, ISSEDD, MFG, InGrip Consulting, Association Vahatra and Island Endemics Foundation. The fact that these highly specialist eradications were completed by Malagasy nationals is a further testament to the success of the project and the capacity building offered by the eradication specialists at InGrip Consulting.

The house crow is an extremely difficult species to control due to its high intelligence and to date, to the best of our knowledge, only one other eradication has been successful (also carried out by InGrip consulting in Socatra, Yemen). This species remains a huge threat in at least 24 countries outside its natural range. Sadly, reports were received during 2022 of a population of house crows in Mahajanga, a city in northwest Madagascar. As yet we have not been able to confirm the numbers present. This prevents us from being able to claim a country-wide eradication of this species, but the two local eradications achieved through this project remain highly significant for local biodiversity, the local

economy and human health at both sites.

The surveillance network is also a first for Madagascar and already there is interest to replicate it in other parts of the country. With this, MFG's extensive Asian toad program and the successful completion of the 2020 IUCN World Conservation Congress Resolution #100, MFG is showing real leadership in Madagascar on the issue of invasive species control, mitigation and biosecurity promotion. There is a very long road ahead to keep these critical issues on the national agenda and keep pushing for positive change.



In June 2022 the value of the invasive species surveillance network was reinforced when MFG received news of a new pair of house crows at the Toamasina port. This was always expected as this species is known to use boats to disperse but we had hoped it would not happen quite so soon! Thanks to quick work by Herison confirming their presence, we were able to quickly deploy Jean Honoré to shoot one of the two individuals, thereby achieving a further functional eradication. This ongoing surveillance and control will be essential to ensure that this species does not reestablish in Toamasina. Hence, MFG's commitment to continue to support the invasive species surveillance network is vital.

▶ IMPACT ON ENDEMIC

The 2014 discovery that the Asian toad had invaded Madagascar was met with widespread concern; Madagascar's fauna evolved in the absence of cryptic species with weaponized poison glands. Marshall, et al. (2018) found that almost none of Madagascar's predators were resistant to the toad's bufotoxins. It was not long after the toads invaded Ivoloïna that staff were finding dead snakes, often on their back, sometime with a nearby deceased toad.

In 2021 Ben recruited ISSEDD students to begin systematic nocturnal surveys aimed at assessing the impact of Asian toads on Parc Ivoloïna's predators. The fifteen 150-meter transects were surveyed weekly from April through June (total 12 surveys). In total, the team observed seven amphibian and four reptile species. *Ptychadena mascareniensis*, the Mascarene grass frog, was the most observed amphibian (309/45.5%), but the second most abundant was the Asian toad (211, 31.1%). Four reptile species were observed with *Madagascarophis colubrinus*, the cat-eyed snake, by far the most abundant (43/86%). Seven of the 43 cat-eyed snakes were dead when found. This

corresponds with Fulvio Licata's experience (Licata et al. 2021) studying Asian toads in Analabe, a 17 ha patch of lowland rainforest. He found, on average, two dead cat-eyed snakes per month, similar to the 2.3 dead snakes/month at Parc Ivoloïna. Fulvio calculated that, if this continued, it could result in the extirpation of this abundant snake from Analabe in a relatively short time. Parc Ivoloïna is larger than Analabe and surveys are being carried out to calculate the cat-eyed snake population, but preliminary results show that the similarity is sobering.

Ironically, the invasive Asian toad is proving to be a serious threat to the cat-eyed snake, a species that is providing beneficial services to farmers, shop owners, and others by preying on invasive

black and Norway rats. Herpetologists report that research on Malagasy snakes is limited because they are especially difficult to find in forests. Data on population size and demographics is rare, all of which will make it more difficult to assess the Asian toad's impact on these reptiles.

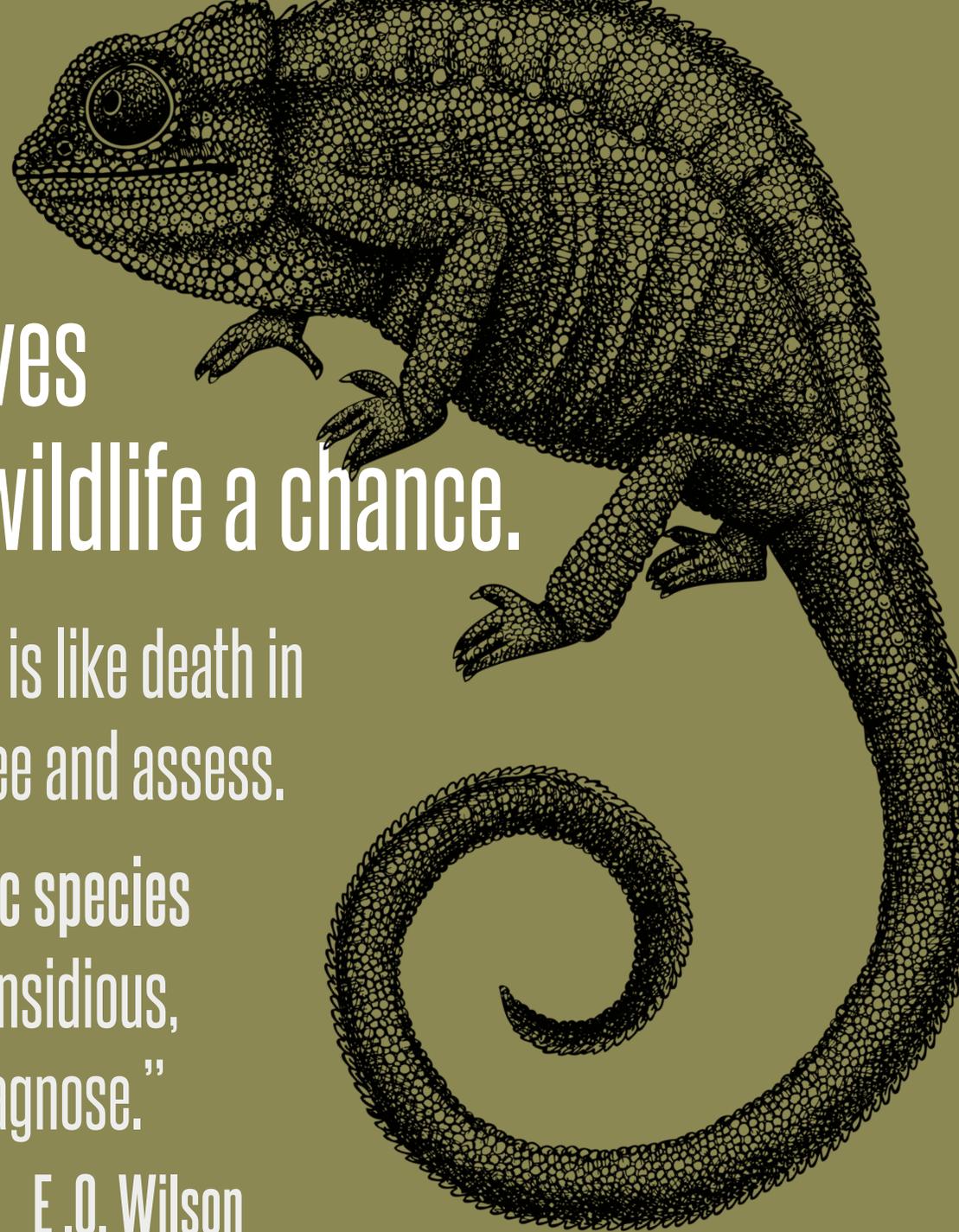


Mitigating the impact of invasive species gives Madagascar's native wildlife a chance.

“Extinction by habitat destruction is like death in an automobile accident: easy to see and assess.

Extinction by the invasion of exotic species is like death by disease: gradual, insidious, requiring scientific methods to diagnose.”

E.O. Wilson



IVOLOINA: EX-SITU PLANT CONSERVATION

“Certainly, this is the most comprehensive collection of Malagasy palms anywhere in Madagascar and perhaps anywhere in the world.”

When the highly successful Darwin Initiative I Project came to an end, Missouri Botanical Garden (MBG) continued to support the vital ex-situ conservation work being carried out at Ivoloina with funding from Chester Zoo, the Association of Zoological Horticulture, National Geographic, and other MBG funds. From the single doomed forest fragment of Ambatobiribiry, seed from at least 56 species has been collected and brought to Ivoloina including 8 Endangered and 2 Vulnerable species as classified by the IUCN’s Red Data List. Of the 56 species, seed from at least 41 species has so far germinated successfully and we expect that number to increase as time goes on for some species that are slow to germinate.

PARC IVOLOINA: A REFUGE FOR MADAGASCAR’S RARE PALMS

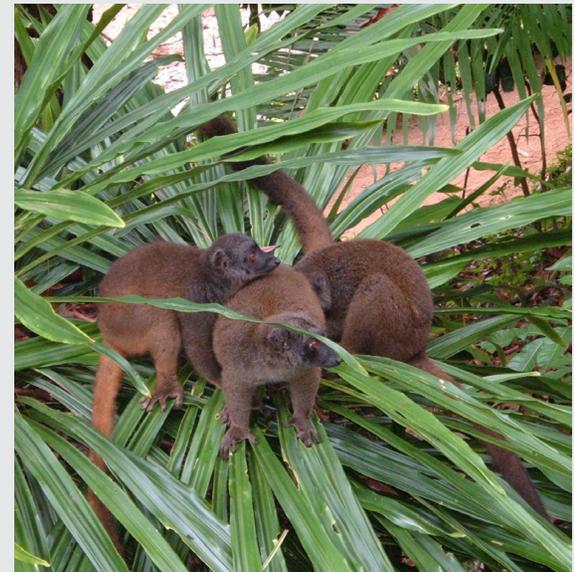
by Dr. Chris Birkinshaw, MBG

In an ideal World the animals and plants with which we share this planet would be free to live in the wild where they belong. However, the World is not ideal, and humans, powerful and selfish, have left no room for many species of fauna and flora. For these the only alternative to extinction is preservation ex-situ in zoos, botanical gardens and seed banks. This is undeniably a pathetic outcome but worthwhile nevertheless because it offers a strand of hope that someday, come more enlightened times, these collections can provide

the opportunity for disenfranchised species to be reintroduced back into the wild.

We are all familiar with the important role that the Madagascar Fauna and Flora Group plays in the ex-situ conservation of lemurs – most notably *Prolemur simus* and *Eulemur flavifrons*, but Parc Ivoloina is doing its bit for plants too, and especially notable is the Parc’s living collection of Malagasy palms.

Palms are among the most distinctive and charismatic of plants. Their neat sculptural forms are much loved by garden designers as is their association with luxury and exoticism. One Tamatave-based horticulturalist makes a good-living by renting-out large potted palms, by the day, for prestigious functions.





However, in general, in Madagascar, the role of palms is more utilitarian since they provide a wealth of products for rural communities including planks, fibers, thatch, materials to make woven products and food.

While the “hearts” of some palms are commonly eaten, in more remote communities palms are also cut and their trunks used as the substrate to grow huge palm weevil maggots for consumption. In addition to serving us humans so generously,



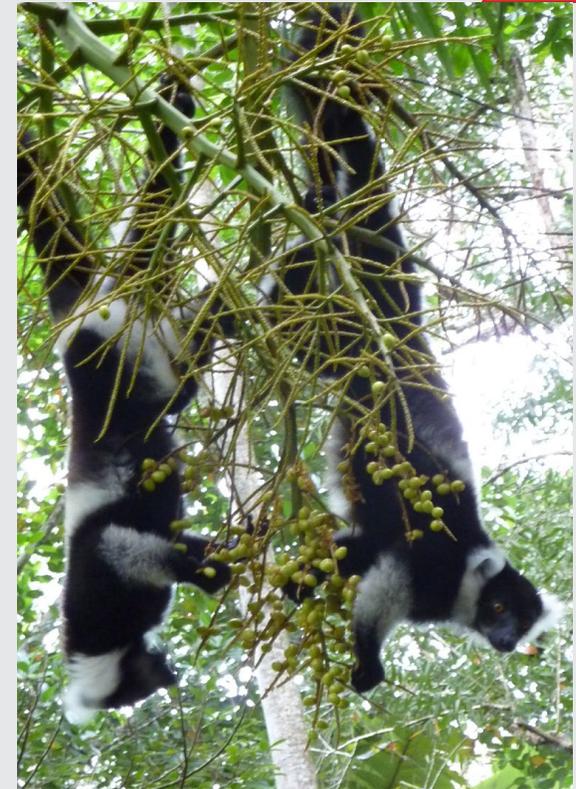
most Malagasy palms also provide fleshy fruits that are an important source of nourishment for frugivorous lemurs and birds.

Madagascar has more than its fair share of the World’s palms: 208 species in Madagascar compared to just 68 species in the whole of continental Africa. They range from tiny but exquisite forest floor palms like *Dypsis poivreana* less than 2 m high to showstoppers like *Ravenea rivularis* surging up to 25 m high.

While palms can be found in all vegetation types, from humid forest to sub-arid thicket, and from the beach to mountain tops, this group is most diverse in Madagascar’s humid forests. Sadly 82% of Madagascar’s palm species are classified as threatened with the most important threats being habitat loss due to shifting cultivation and selective exploitation. Some species such as *Dypsis ambositrae* and *Voanioala gerardii* are now known from less than 50 individuals in the wild and sadly *Dypsis robusta* is now known only in cultivation.

Over the last three decades MFG staff and the staff of several partner organisations including Zoo Zürich, the Royal Botanic Garden Kew, and Missouri Botanical Garden have collected seeds from wild palms and sent samples to Parc Ivoloina for propagation and out-planting into the Parc.

Together these disparate actions have created a significant collection of Malagasy palms numbering 38 named species and 7 collections that have not yet been identified to species. Certainly, this is the most comprehensive collection of Malagasy palms anywhere in



Madagascar and perhaps anywhere in the world. Most significant in this collection are the nine Critically Endangered species and ten Endangered species.

While we hope to continue building this collection, we must make sure that it is better sign-posted in the future, and ultimately, let’s hope, that some of species now taking refuge in the Parc will one day contribute to restoring Madagascar’s lost natural ecosystems.

MORE ON MADAGASCAR'S PALMS

The palm family, Arecaceae, includes 202 genera and over 2,600 species, of which 17 genera and 208 species are found in Madagascar. Habitat loss has had a such a devastating impact on Madagascar's palm species that 66 are classified as Critically Endangered and 43 as Endangered. MFG's experience with propagating palms began in 2003 when Royal Botanic Garden, Kew sought to advance plant conservation by strengthening ties with Malagasy institutions. Between 2003-2006 Kew botanists searched for threatened palm species to assess their status and collect seeds. After locating a critically endangered population of *Beccariophoenix*, Kew funded university student, Mijoro Rakotoarinivo, to study it. Over a period of three years, seeds from 12 palm species had been dispatched to Parc Ivoloina, where Jean François, newly hired through the grant, would manage the nursery.

Dr. Mijoro Rakotoarinivo, now a lecturer at the University of Antananarivo, continues his work to conserve Madagascar's palms. Through the SEP2D (Sud Expert Plantes Développement Durable), he took a leading role in organizing the development of The Strategy for the Conservation and Sustainable Use of the Palms of Madagascar published in 2020 (see: www.sep2d.org). In 2021 Dr. Rakotoarinivo contacted the MFG to offer seeds from 17 palm species, including 13 species new to Parc Ivoloina, to advance Target 6 of the conservation strategy: At least 50% of threatened species are conserved ex-situ."

Target 6 also includes: "To promote the use of endemic palms in reforestation and in public

places and schools in order to raise public awareness about the diversity and value of endemic species", which is what the MFG already does at Parc Ivoloina.



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ABOVE: *Dypsis poivreana*, ENDANGERED
TOP RIGHT: *Tahina spectabilis*, CRITICALLY ENDANGERED
RIGHT: *Dypsis carlsmithii*, CRITICALLY ENDANGERED



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FLORAL AND FAUNAL RELATIONSHIPS



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In 2008, Dr Franco Andreone, et al.*, discovered a new frog species in Betampona, *Blommersia angolafa*, whose reproductive cycle from eggs, to tadpoles, to froglets to adult frogs took place in a microenvironment created by a fallen leaf stalk containing water. However, the stalk was restricted to one of only three *Dypsis* species: *D. lastelliana*, *D. tsaravoasira*, and *D. hovomantsina*. The latter two are critically endangered. *Gonçalo Rosa, Jean Noël, Angelica Crottini, Miguel Vences, Christopher Raxworthy

Continual Fire Threat

It was 9:00 pm January 2021 when a fire broke out in the Forestry Station. Jean François, the guards and 30 people from neighboring communities were finally able to get the fire under control at around 1am. Several members of the fire fighting team stayed all night in case unseen cinders sparked another fire. The burned area was approximately 1,700m² of primarily exotic trees but also included several native species. The next day, MFG staff searched the area for clues as to the origin of the

fire. They found dried ravenala leaves with burn marks and several dead bees, suggesting that a honey thief was trying to smoke out bees. Through further investigations, Jean François identified the person responsible for the fire, an 18-year old who admitted to committing the offense. The information was passed on to DREDD, who investigated and confirmed Jean François' conclusion; his punishment was to work in DREDD's nursery for 30 days. Jean François attends meetings with neighboring villages to promote collaborative and agreed upon actions on how to reduce accidental fires, and best practices

to extinguish them. Rapid community response to battling fires has reduced the amount of damage; preventing fires altogether is a more challenging objective.



RESTORATION WORK IN PARC IVOLOINA CONTINUES APACE

As well as the amazing ex-situ plant conservation work at Ivoloina, our ongoing habitat restoration efforts continue. Led by Jean François, the Ivoloina Forestry Station Manager, 22,201 trees were planted from 2020 to 2022.

MFG staff select the sites and prepare the ground but much of the planting is done by various associations and partners from the town of Toamasina such as the Rotary Club, the port authorities (SPAT), the Scouts and many more. Unlike in previous years, we now ask these various partners to contribute not only for the costs of the land preparation but also for some long term follow up to try to ensure that the planted trees have the best chance of survival through periodic clearing of competing (often exotic) vegetation

until the trees have reached a suitable height to no longer be at risk of smothering.

This has always been MFG's approach but in previous years we have covered these costs through the general MFG budget. The more areas we restore, the higher these ongoing maintenance costs become so in order to become more financially sustainable but also to educate people on the critical need for post-planting care (an element sadly missing in many of Madagascar's and indeed the World's restoration attempts), we now request a contribution to these ongoing costs at the time of planting.

Given the increasing threat to Parc Ivoloina and its very valuable collection of endemic plant

species in recent years from higher numbers of wildfires, a large effort was made by the whole MFG team to renew and increase the fire breaks around the Forestry Station, particularly in areas that have experienced greater threats from fires. Funds have been extremely limited for MFG since the inevitable COVID-related funding cuts but our new Programme Manager, Jean Jacques Jaozandry had the brilliant inspiration to organize MFG employees into a taskforce to carry out key tasks such as a big clean-up of the zoo and also this firebreak clearing effort at the end of 2022 as team-building experiences. The team has thrown themselves fully into the tasks and had a great time while doing it.



THE ZOO GETS A FACELIFT!



Thanks to extra support from Saint Louis Zoo and Jacksonville Zoo, Ivoloina Zoo was able to have a much-needed facelift during 2022. Although work is ongoing (and is a continuous process as all zoo people will appreciate!), zoo manager Bernard and MFG Programme Manager, Jean Jacques, oversaw the complete rebuilds of several lemur habitats that had got into bad repair due to the severe cyclone season in early 2022 and general wear and tear. Renovations had been put on hold during the COVID-19 pandemic and the zoo was looking more than a little tired.

A shiny new sheltered seating area for zoo visitors, which had also been damaged in an earlier cyclone was finally able to be rebuilt in 2022.



LOCAL VET SUPPORT FOR THE ZOO

MFG has been extremely lucky to have received a lot of veterinary advice over the years from Saint Louis Zoo, Duke Lemur Center and our very own Dr Fidy Rasambainarivo amongst others. While this remote advice for the zoo has been critical to support the zoo manager and the team of keepers with animal health issues, we have all recognized the need for in-person assistance in times or medical emergencies.

We are delighted to announce that Bernard and Jean Jacques have been able to organize a collaboration with local vet, Dr Christine Hanjarahivelo, who runs a small-animal vet clinic in Toamasina with her husband, to provide in-person vet support for Ivoloina. With the help of our long-term colleagues, Andrea Katz, Cathy Williams and Fidy, we have been able to establish a network of veterinary advisors for MFG that will be able to support Dr Christine with specialist lemur veterinary knowledge. It is a great relief to all of us to have this important on-hand support.

PARC IVOLOINA FORESTRY STATION

MBG botanist, Patrice Antilahimena, returned to the unprotected forests of the Ivoloina and Ifontsy River valleys in 2020 to collect seeds from several target species that were not in fruit during previous searches. He rehired one of the men from the nearby community who had proven to be an interested and reliable field assistant. The plan was for Patrice and his field assistant to 1) relocate five of the targeted species and search the surrounding area for additional individuals with the hope of expanding the gene pool, and 2) train his assistant to monitor the phenology of the flagged plants, collect seed samples from fruit that is sufficiently mature, clean the extracted seeds, and place them in cotton bags for transport to Parc Ivoloina.

They found one of the targeted species before COVID-19 disrupted everything, and Patrice was forced to stop and return to Antananarivo. After much discussion, MBG made the decision to suspend all field work. They felt that even the

chance that botanists from Antananarivo, with rising COVID-19 cases, could spread the virus into remote rural communities, was an unacceptable risk. On 15th May 2020, Platini, who continues the propagation program at the Darwin Nursery received the first package of seeds; since then, seeds from five of the target species have been propagated.

Stepping Up to Maximize Conservation Benefits

The Darwin Initiative grant has been a game-changer in driving the transformation of Parc Ivoloina's Forestry Station to an Ex-Situ Conservation Center for the flora of Madagascar's eastern rainforests. It enabled MBG/MFG to work out the logistics, establish record-keeping and propagation protocols, and train additional horticulturalists in this important vocation. It is often the case that, when a grant comes to an end, there is more that could be accomplished but financial constraints prevent pursuing them.



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Exemplifying the spirit of collaboration, both the American Association of Zoological Horticulture (AAZH), and the Chester Zoo awarded the additional funds that did indeed maximize conservation outcomes.

We would be remiss if we neglected to also thank all of our Members whose support is foundational to MFG's conservation program, which includes the measured transformation of Parc Ivoloina's Forestry Station to a center for the ex-situ conservation of Madagascar's threatened plants.



POLYSCIAS SP 2 DFGSF



MELANOPHYLLA DIANAEA



DRYPETES THOUARSIANA

TRANSFORMING PARC IVOLOINA FORESTRY STATION



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As Parc Ivoloïna's role in ex-situ propagation of threatened eastern rainforest plants has increased, so have Jean François' responsibilities. Every year he and his team collect seeds from native tree species in or around Parc Ivoloïna.

For example, in 2020 they collected 17,235 seeds from 19 mother trees, of which 16,370 were sown in the nursery, and 6,995 (42.7%) successfully germinated. The seedlings typically remain in the nursery for 12 months, thus the seeds collected one year produce the saplings that are planted the following year. In 2020, 5,803 saplings from 33 species were planted in the Forestry Station; in 2021 the total was 5,997; and in 2022 it was 8,200 plants composed of 38 species. This totals 20,000 trees over the 3 years in addition to 2,201 trees out planted at Ivoloïna for MBG's ex-situ plant conservation work over this same period so 22,101 native trees planted out in the Forestry Station from 2020 to 2022.

The majority of the saplings are typically planted by MFG staff, but every year local organizations, clubs and school groups contribute their time to planting trees. Jean François also fells the number of exotic trees that are required to repair or replace infrastructure such as steps, tables, and sign posts. Through this gradual process, the forest will decrease its population of exotic trees and increase the diversity and number of native and endemic species.

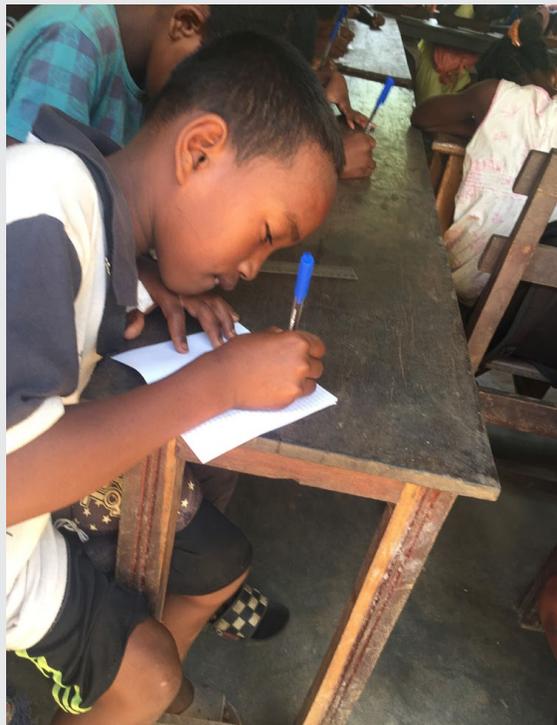
The restoration plots are weeded annually, removing invasives and plants that are interfering with the growth of young trees. The weeded area rose from 101,143 m² in 2020 to 158,782 m² in 2021 and up to 194,492m² in 2022.

This foliage is gathered into piles that help suppress the growth of some invasive species, provide cover for invertebrates and small vertebrates, and in some cases produce mulch over time.



EDUCATION DISRUPTED – AGAIN AND AGAIN

The CEE team undertook their normal preparations for the upcoming 2019/2020 school year. They hosted the annual gathering of all the Saturday School teachers and administrators to review and update the curricula needed. They were particularly pleased that Ivoloïna’s Saturday School Parents’ Club, initiated in 2017 to enable parents to take a more active role in their children’s education, was expanded to the three rural Saturday Schools in the Betampona region. They hoped parental involvement would reduce absentee rates as it had for Ivoloïna’s Saturday



School. Classes began December 3rd, 2019 and was off to a good start with low absentee rates and no dropouts.

All that came to an end in March. When the President declared a state of emergency because of the COVID-19 pandemic, he closed Madagascar’s borders and ordered the closing of all schools. The government rushed to develop a number of initiatives (TV and radio programs, a book with lesson reviews) that were meant to help children continue their education at home. Although well-intended, producing materials that would meet the widely divergent abilities of students within and across different grade levels was optimistic at best.

The government ordered the reopening of schools at the end of July 2020 but only for 5th, 9th, and 12th grade students for the specific purpose of preparing them for their certificate of graduation exams. The CEPE exam was set for 1 September. Tsiry Harison, CEE Manager, explained that normally all 5th graders are given the same standardized exam. But due to the pandemic, the Ministry allowed each school district to modify the exam based on where they were at in the curriculum when their school shut down. At the end of 12 weeks, the three rural schools had completed 25% and Ivoloïna had completed 18% of the curricula. Ivoloïna’s Saturday School children were behind because they attend different schools, and the teaching pace is dictated by the fifth-grade class that is furthest behind. The 2020/2021 school year was delayed by a month, and the CEE team noted the curricula of all

public elementary schools were behind the entire school year. Educators use the term “learning forgone” to refer to learning that would normally occur but did not. Sadly, this cohort of children have experienced educational disruptions over multiple years prior to COVID-19. Some of these children may have been impacted by the measles outbreak and heavy flooding that occurred in the first months of 2019. The 2017/2018 school year was delayed due to a serious outbreak of pneumonic plague, followed by cyclone Ava which wreaked havoc on the local landscape and infrastructure. A 3-month teachers’ strike further upended their education. Then two years of COVID-19 disruptions. As one of four African countries at high risk of cyclones, too many Malagasy children will experience multiple disruptions throughout their school years.



GREEN AMBASSADORS CAMP

The Green Ambassadors Camp had to be cancelled in 2020 due to COVID-19, but was held in 2021 from December 26-30 at Parc Ivoloïna. Five girls and five boys in their last year of Secondary School from four communities around Betampona (Ambodiriana, Sahandahatra, Antetezambaro, Sahambala) and 20 students in their second year of High School in Toamasina and 20 from the recently operational High School in Ambodiriana. The practical work focused on the propagation and care of plants in a nursery and the importance of compost.



WORLD ENVIRONMENT DAY CELEBRATION

COVID-19 restrictions prevented MFG from hosting a community-wide event. Instead, they celebrated the 2020 theme, “Time for Nature”, with MNP’s Director of Betampona Reserve, Emérentienne Mametsa, and her staff, the fokontany presidents of Andratambe and Ambodirafia, MFG’s nurserymen, and Betampona conservation agents by planting 258 endemic trees in the Zone of Protection. Likewise, 2021 saw a very low profile event due to ongoing COVID-19 restrictions with further small-scale MFG team tree-planting activities, which was fitting for the year’s theme of “Ecosystem Restoration” along with a dedicated radio programme on the same theme. 2022 saw a return to more usual level celebrations with a full day’s celebration at Parc Ivoloïna attended by the Mayor of Antetezambaro, a representative of the Chef District of Toamasina II and from the Ministry of the Environment and Sustainable Development (MEDD). It was a fun day of competitions, traditional Malagasy vakodrazana folklore dances and speeches on the theme of “Only One Earth”.

GIRLS LEADERSHIP CAMP

The 2019 Camp girls fulfilled their commitment to share what they learned with their classmates. Their teachers were very supportive and set aside a day for this special event. The girls performed skits on topics such as societal norms that limit girls’ opportunities to complete their schooling, pursue a vocation, and wait to marry, the problem of violence against girls, and unwanted pregnancy. Afterwards, they led a discussion with the 150 people, mostly students but also teachers and parents.

Because dates for the Girls’ Camps are flexible, Vero was able to schedule camps for 4th year girls attending secondary schools near Betampona, and 1st/2nd year girls attending high school in Toamasina. The high school girls met and heard from women who have careers in science-related



fields. Following the talks, the girls break up into groups, select a topic to present and debate. Vero put together a very special camp for the secondary school girls, most of whom have spent little time in Toamasina. Over the two days, they visited a museum, spent time with staff of SAF FJKM, an NGO dedicated to assisting people in need on issues of health, clean water, food, and nutrition, and to a Radio Station. At each location they met men and, most importantly, women employees.

NOTABLE PUBLICATIONS 2020 – 2022 (in order of publication)

The MFG continues to contribute to the wider scientific community through contributions like these.

Dubos, N., Morel, L., Crottini, A., Freeman, K., Honoré, J., Lava, H., Noël, J., Porton, I., Rendriendry, G., Rosa, G.M., Andreone, F. 2020. **High interannual variability of a climate-driven amphibian community in a seasonal rainforest.** *Biodiversity Conservation* 29, 893–912 (2020). <https://doi.org/10.1007/s10531-019-01916-3>

Glaw, F., Scherz, M.D., Rakotoarison, A., Crottini, A., Raselimanana, A.P., Andreone, F., Köhler, J., Vences, M. 2020. **Genetic variability and partial integrative revision of *Platypelis* frogs (*Microhylidae*) with red flash marks from eastern Madagascar.** *Vertebrate Zoology* 70(2)

Lam, B., Noël, J., Crottini, A., Andreone, F., Rosa, G. M., 2020. **Report of agonistic interaction in Malagasy frogs of the genus *Gephyromantis* (*Anura*, *Mantellidae*).** *Arxius de Miscel·lània Zoològica*, 18: 27–32

Licata, F., Andreone, F., Freeman, K., Rabesihanaka, S., Robsomanitrondrasana E., Reardon, J.T., Crottini, A. 2020. **The Asian Toad (*Duttaphrynus melanostictus*) in Madagascar: A Report of an Ongoing Invasion.** F. M. Angelici, L. Rossi (eds.), *Problematic Wildlife II*, p 617-638.

DeSisto, C.M.M., Park, D.S., Davis, C.C. et al. 2020. **An invasive species spread by threatened diurnal lemurs impacts rainforest structure in Madagascar.** *Biological Invasions*. <https://doi.org/10.1007/s10530-020-02293-7>

Porcel, X, Dubos, N., Rosa, G.M., Miralles, A., Noël, J., Lava, H., Velo, J.H., Georges, Andreone, F., and Crottini, A. 2021. **The kiwi of all skinks: an unusual egg size in a species of *Madascincus* (*Squamata: Scincidae*) from eastern Madagascar.** *Herpetology Notes*, volume 14: 365-369

Santos B, Bletz M, Sabino-Pinto J, Cocca W, Fidy JF, Freeman KLM, Kuenzel S, Ndriantsoa S, Noel J, Rakotonanahary T, Vences M, Crottini A . 2021. **Characterization of the microbiome of the invasive Asian toad in Madagascar across the expansion range and comparison with a native co-occurring species.** *PeerJ* 9:e11532 <http://doi.org/10.7717/peerj.1153>

Cota, G.; Sagan, V.; Maimaitijiang, M.; Freeman, K. **Forest Conservation with Deep Learning: A Deeper Understanding of Human Geography around the Betampona Nature Reserve, Madagascar.** *Remote Sens.* 2021, 13, 3495. <https://doi.org/10.3390/rs13173495>

Licata F, Andreone F, Crottini A, Harison R F, Ficetola G F, 2021. **Does spatial sorting occur in the invasive Asian toad in Madagascar? Insights into the invasion unveiled by morphological analyses.** *J Zool Syst Evol Res.*00:1–9

Licata, Fulvio & Andreone, Franco & Ficetola, Gentile Francesco & Crottini, Angelica. (2022). **Toad invasion of Malagasy forests triggers severe mortality of a predatory snake.** *Biological Invasions* <https://doi.org/10.1007/s10530-021-02708-z>

Porcel, Xavier & Dubos, Nicolas & Noël, Jean & Lava, Honoré & Velo, Jean & Georges, & Melo, Martim & Rosa, Gonçalo & Andreone, Franco & Crottini, Angelica. (2022). **Male parental care in Malagasy stream-dwelling frogs of the *Mantidactylus femoralis* group (*Anura: Mantellidae: Ochthomantis*).** *Herpetology Notes*. 15. 55-61. <https://www.biotaxa.org/hn/article/view/70431>



Scherz, Mark & Crottini, Angelica & Hutter, Carl & Hildenbrand, Andrea & Andreone, Franco & Fulgence, Thio & Köhler, Gunther & Ndriantsoa, Serge & Ohler, Annemarie & Preick, Michaela & Rakotoarison, Andolalao & Rancilhac, Loïs & Raselimanana, Achille & Riemann, Jana & Rödel, Mark-Oliver & Rosa, Gonçalo & Streicher, Jeffrey & Vieites, David & Köhler, Jörn & Vences, Miguel. (2022). **An inordinate fondness for inconspicuous brown frogs- integration of phylogenomics, archival DNA analysis, morphology, and bioacoustics yields 24 new taxa in the subgenus *Brygoomantis* (genus *Mantidactylus*) from Madagascar.** *Megataxa*. 7. 113–311. [10.11646/megataxa.7.2.1](https://doi.org/10.11646/megataxa.7.2.1).

Vences, Miguel & Köhler, Jörn & Crottini, Angelica & Hofreiter, Michael & Hutter, Carl & Preez, Louis & Preick, Michaela & Rakotoarison, Andolalao & Rancilhac, Loïs & Raselimanana, Achille Philippe & Rosa, Gonçalo & Scherz, Mark & Glaw, Frank. (2022). **An integrative taxonomic revision and redefinition of *Gephyromantis* (*Laurentomantis*) malagasius based on archival DNA analysis reveals four new mantellid frog species from Madagascar.** *Vertebrate Zoology*. 72. 271-309. [10.3897/vz.72.e78830](https://doi.org/10.3897/vz.72.e78830).

Licata, Fulvio & Mohanty, Nitya & Crottini, Angelica & Andreone, Franco & Harison, R & Randriamoria, T & Freeman, K & Muller, Benjamin & Birkinshaw, C & Tilahimena, A & Ficetola, Gentile Francesco. (2022). **Using public surveys to rapidly profile biological invasions in hard-to-monitor areas.** *Animal Conservation*. [10.1111/acv.12835](https://doi.org/10.1111/acv.12835).

**MFG Statement
Revenue & Expenditure**

31 December 2020 (in USD)

Revenue 2020

Membership dues	147,337.92
Donations	14,446.41
Madagascar in-country income	17,806.16
Grants	589,720.16

Total Revenue **769,310.65**

Expenditure 2020

Personnel	185,404.77
Operations	328,137.57
Other	3,167.11
Foreign currency gain/loss	3,101.32

Total Expenditure **519,810.76**

Net Surplus/Deficit **249,499.89***

Assets 2020

Bank Accounts (Madagascar)	368,824.29
Bank Account (USA)	397,613.34
Cash on Hand (Madagascar)	5,347.31

Total Assets **771,784.94**

Restricted Funds

Restricted Funds (Grants)*	362,930.57
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Total Restricted Funds **362,930.57**

*Surplus comprised of restricted grant funds received in advance during 2020, particularly for Asian toad project.

**MFG Statement
Revenue & Expenditure**

31 December 2021 (in USD)

Revenue 2020

Membership dues	167,162.14
Donations	11,759.53
Madagascar in-country income	4,235.91
Grants	649,904.36
Other	3,041.49

Total Revenue **836,103.43**

Expenditure 2021

Personnel	202,008.61
Operations	560,371.40
Other	6,168.89

Total Expenditure **768,548.90**

Net Surplus/Deficit **67,554.53**

Assets 2021

Bank Accounts (Madagascar)	497,685.86
Bank Account (USA)	337,183.73
Cash on Hand (Madagascar)	4,469.89

Total Assets **839,339.48**

Restricted Funds

Restricted Funds (Grants)*	571,113.66
----------------------------	------------

Total Restricted Funds **571,113.66**

**MFG Statement
Revenue & Expenditure**

31 December 2022 (in USD)

Revenue 2022

Membership dues	181,951.89
Donations	21,459.83
Madagascar in-country income	7,159.73
Grants	429,729.24
Other	19,396.84

Total Revenue **659,697.53**

Expenditure 2022

Personnel	427,394.10
Operations	450,385.81
Other	0.00

Total Expenditure **877,779.91**

Net Surplus/Deficit **-218,082.38**

Assets 2022

Bank Accounts (Madagascar)	304,510.15
Bank Account (USA)	312,209.11
Cash on Hand (Madagascar)	4,537.85

Total Assets **621,257.11**

Restricted Funds

Restricted Funds (Grants)*	357,285.50
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Total Restricted Funds **357,285.50**

GRATITUDE

As an extensive collaborator, the MFG is grateful to our many partners and funders. While our praise and thanks is written across this report to many of them, the following deserve special note for their commitment and sacrifices proportionate to their capacity. There are many others worthy of this and regret that all cannot be mentioned.



Saint Louis Zoo

Our profoundest thanks to the Saint Louis Zoo WildCare Institute and Dr. Lisa Kelley. The impact of their enormously generous support over the years through the present time simply cannot be overstated given how much of our effort is funded by their Center for Conservation in Madagascar.



Zoo Zürich

The exceptional generosity of our Swiss colleagues provided both additional operational support as well as funded critically needed equipment well above their Membership commitments. This is in addition to many years of support and sage guidance on the MFG Board of Directors.



Chester Zoo

In addition to being an MFG Member, Chester Zoo has advanced numerous successful programs by providing much needed funding and expertise from helping to protect Parc Ivoloina from the encroaching toxic Asian toads to securing a future for unprotected and newly discovered plant species.





GUST UND LYN GUHL-STIFTUNG FOUNDATION

This foundation has been the long-term backbone to our Saturday School Program. Because of their support, the MFG has made a true difference for so many children in the rural villages in which we work. We gladly recognize the great debt we owe to the Gust und Lyn Guhl-Stiftung Foundation!

Wildheart Animal Sanctuary

Ryan Randall and many keepers along with former Education and Conservation Manager, Tracy Dove, organized and led a fundraiser to meet their membership commitment to MFG.



Missouri Botanical Garden

This long-standing MFG Member helped bring the “flora” into our name and has been an essential partner in many of our efforts for endangered plant species. We are proud to partner one of the world’s leading botanical gardens focused on research and conservation in Madagascar.



Duke Lemur Center

From the founding of the MFG until now, DLC has been an integral part of our existence from providing the original leadership of the program and a decades-long history of professional expertise including providing on-site animal care staff to enhance the well-being of the animals at Parc Ivoloina.

Dr. & Mrs. Clinton W. Kelly, III

We are most grateful for their \$10,000 donation for MFG’s Renewable Energy Installation Project. The funds bring electrification to the MFG’s Environmental Education Center to reality.

American Association of Zoo Keepers

We honor keepers for their dedication to the welfare of the animals in their direct care as well as species in the wild including AAZK chapters at the Little Rock Zoo, Milwaukee Zoo, and Zoo Atlanta!



Darlene Benzon

This long-time advocate for Madagascar went well above and beyond to support the MFG during tough times by providing an institutional level of support as an individual!

FARMER ⇄ YOU

Our sincere thanks to Transit General Office Co. in Japan for funding coming from the sale of specialty Ice Cream Puffs using fair trade Malagasy vanilla beans grown exclusively in agroforestry operated farms. These funds support MFG’s agricultural initiatives and beyond!





Madagascar Fauna and Flora Group

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