Conservation Action Network (CAN)

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A habitat stronghold on the precipice: A call-to-action for supporting lemur conservation in NE Madagascar

From high-altitude forests with striking peaks, to beautiful sandy beaches lined by lush rainforest along a picturesque coast, northeast Madagascar is by most accounts, a tropical paradise. The applied research and conservation projects discussed in this Action Letter are seated within the SAVA and Analanjirofo regions, spanning the towns of Sambava in the north to Mananara farther south (https://arcg.is/1yyTbW). These regions contain the largest humid forest blocks remaining on this spectacularly diverse island (Goodman et al. 2018). Included are Masoala National Park and Makira Natural Park, both among the larger protected areas in Madagascar, as well as Anjanaharibe-Sud Special Reserve, Marojejy National Park, and the corridor that unites them, the COMATSA-Sud (Corridor Marojejy-Anjanaharibe Sud-Tsaratanana), formerly known as the Betaolana corridor. Also included is Nosy Mangabe Special Reserve, an island in Antongil Bay. Within the region, the forests of Makira are vital in maintaining long-term connectivity between the above-mentioned neighboring protected areas.



Protected areas within NE Madagascar

Regionally, there are currently 22 recognized lemur species (IUCN 2021; see Table 1). Of these, six species are listed as Critically Endangered (CR), seven are Endangered (EN), and eight are Vulnerable (VU). One species, *Microcebus jonahi*, was only just discovered last year (Schübler et al. 2020) and thus has not yet been assessed by the IUCN Red List. It is very likely that other still-undescribed species are hidden in these forests.

The mountainous rainforests of Marojejy NP and Anjanaharibe-Sud SR were some of the earliest established protected areas in the region (1952 and 1958, respectively) and are among the least disturbed. Masoala NP, renowned for rare littoral and lowland rainforest, and Marojejy NP form part of the Atsinanana World Heritage Site, so designated due to exceptional biodiversity. COMATSA-Sud and Makira are the most recently established protected areas (2015 and 2012, respectively).



Flagship lemur species for northeast Madagascar, all of which are Critically Endangered. From left to right: red ruffed lemur (Varecia rubra), silky sifaka (Propithecus candidus), and indri (Indri indri). Photo credits: N. Vasey (PSU), J. Gibbs, and E. Patel (LCF), respectively.

Table 1. Lemur species inhabiting northeast Madagascar

Family	Common name	Scientific name	Red List status
Lemuridae			
	Red ruffed lemur	Varecia rubra	CR
	White-belted ruffed lemur	Varecia variegata ssp. subcincta	CR
	White-fronted brown lemur	Eulemur albifrons	VU
	Red-bellied lemur	Eulemur rubriventer	VU
	Common brown lemur	Eulemur fulvus	VU
	Northern bamboo lemur	Hapalemur occidentalis	VU
Indriidae			
	Silky sifaka	Propithecus candidus	CR
	Indri	Indri indri	CR
	Moore's woolly lemur	Avahi mooreorum	EN
	Eastern woolly lemur	Avahi laniger	VU
Lepilemuridae			
	Scott's sportive lemur	Lepilemur scottorum	EN
	Seal's sportive lemur	Lepilemur seali	VU
	Holland's sportive lemur	Lepilemur hollandorum	CR
Cheirogaleidae			
	Hairy-eared dwarf lemur	Allocebus trichotis	EN
	Greater dwarf lemur	Cheirogaleus major	VU
	Crossley's dwarf lemur	Cheirogaleus crossleyi	VU
	Sibree's dwarf lemur	Cheirogaleus sibreei	CR
	Anjiahely mouse lemur	Microcebus macarthurii	EN
	Mittermeier's mouse lemur	Microcebus mittermeieri	EN
	Jonah's mouse lemur	Microcebus jonahi	NL
	Masoala fork-marked lemur	Phaner furcifer	EN
Daubentoniidae			
	Aye-aye	Daubentonia madagascariensis	EN

The northeastern region is one of the highest priority areas for conservation action in Madagascar due to its high species diversity and the continually increasing threats to its flora and fauna (Zaehringer et al. 2015, Herrera et al. 2017, Borgerson et al. 2021a, Vasey & Godfrey in press).

Major Threats

The human population depends heavily on the rivers, reefs, seas, forests, and agricultural lands of the region, much of which is now within Madagascar's protected area network (Llopis et al. 2021). Farmers typically grow rice in irrigated lowlands, or use traditional shifting agriculture on hillsides in and around protected areas to grow rain-fed rice, tubers, and vegetables (Herrera et al. 2021). The rural communities hunt many species of wildlife, including endemic lemurs, tenrecs, bats, carnivorans, and birds, because of low food security, high malnutrition, and insufficient alternatives to animal-based foods (Borgerson et al. 2019, Brook et al. 2019, Golden et al. 2019. Spira et al. 2021, Randriamady et al. in press). Minimal forest monitoring and incomplete park boundary demarcation have exacerbated these drivers of endemic wildlife depletion (Patel, 2021). These factors, in addition to population growth, poverty, corruption, and unstable (often extreme) climate have led to increased deforestation for both subsistence (e.g., rice) and cash (e.g., clove) crops (Zaehringer et al. 2017, Martin et al. 2020).

While cash crops can provide a pathway out of poverty, market prices can be volatile and lead to food insecurity, crime, and habitat disturbance inside protected areas, such as the sharp rise in illegal vanilla plantations in Marojejy in recent years.

Many species of hardwood, not just precious hardwood species, have long supplied the region with timber for housing and furniture (Patel et al. 2007). Since the political crisis of 2009, however, this region has experienced a precipitous surge in illegal logging and export of precious hardwoods, such as rosewood (Dalbergia spp.) and ebony (Diospyros spp.). These pressures have continued at a steady pace over the last decade and have likely had a negative impact on many lemur species (Patel 2010, Waeber & Wilmé 2013). The Covid-19 pandemic brought tourism to a halt in late March 2020, and the ensuing economic crisis caused by lockdowns has seemingly accelerated many of these previous problems to the extent that many communities living adjacent to the region's protected areas are now increasingly dependent on local natural resources.



Illegal logging in Masoala National Park. Photo: SDZWA-Andriahavanana

Lastly, a major new threat is the paving of the 150-km road from Ambilobe to Vohemar, scheduled for completion next year (financed by the controversial Belt & Road Initiative; BRI 2021). Previously one of the world's least accessible regions (Rice et al. 2020), paved road access will bring economic benefits to SAVA, but also has the potential to bring problems such as increased population growth through immigration from other parts of the country and increased illegal exploitation of natural resources.

Conservation Goals and Actions

Two high-impact publications provide clear conservation actions for Madagascar as a whole. The Lemur Action Plan, a 197-page report by the IUCN SSC Primate Specialist Group (Schwitzer et al. 2013: https://portals.iucn.org/library/sites/library/files/documents/2013-020.pdf), recommends three major approaches to save lemurs in the wild: promoting eco-tourism, supporting community-managed protected areas, and expanding long-term research (Schwitzer et al. 2014). More recently, Jones et al. (2019) advocate that Madagascar's newly-elected President Rajoelina undertake five actions that would benefit people and nature: 1) tackle environmental crime, 2) invest in protected areas, 3) ensure infrastructure developments limit impacts on biodiversity, 4) strengthen local tenure rights over natural resources, and 5) address the growing fuelwood crisis.

Northeastern Madagascar is rife with conservation challenges given the large size and high border-to-interior ratios of its protected areas, relative inaccessibility, combined with a largely forest-dependent, poor, and malnourished human population. To ensure conservation of forest habitats and their fauna, including lemurs, it is imperative to support local human populations while maintaining the integrity of protected area borders. We advocate for conservation activities with focus on eight main areas: 1) empowering and partnering with local conservation actors, 2) ensuring native habitat is effectively protected, both within established protected areas and in community managed forests, 3) expanding reforestation efforts, 4) establishing and continuing long-term biological research and ecological monitoring, including lemur population monitoring, 5) reducing food insecurity through improved, diversified practices that include alternative protein initiatives and agroecological techniques, 6) supporting environmental education, 7) promoting livelihood opportunities that are either nature-positive or that do not rely on extractive use, and 8) expanding community health initiatives including population-health-environment (PHE) programs.

1) Empower local conservation actors

For conservation to be effective and sustainable long-term, Malagasy nationals, especially those from within the region, must assume stewardship of their natural heritage and resources.

By supporting and partnering with local educational and conservation organizations, we promote a place-based approach with investment from local stakeholders. Northeastern Madagascar's sole undergraduate university, Centre Universitaire Région de la SAVA (CURSA), trains students in sustainable natural resource management and agronomy, preparing the next generation of scientists to work for the national park service and local ministries, or to become teachers and agro-entrepreneurs. By supporting CURSA's efforts to provide high quality education for local students, these students will have better opportunities to positively impact their communities. In partnership with CURSA, the Duke Lemur Center (DLC) and other organizations have created training and support opportunities for students and faculty. For example, DLC and CURSA co-hosted two workshops on scientific methods: one field workshop on ecological methods in Marojejy National Park, and one workshop on research design, statistics, and natural history collections. DLC also supports undergraduate research by providing small grants and internships in agroecology, reforestation, and fish farming. It is also critical to support development and training (including providing tools and legal know-how) for community forest managers who conserve over 100 forest sites around Makira and Masoala National Park. An increasing number of communities in the region are interested in receiving forest management tenure from the government of Madagascar. Near Marojejy, the Lemur Conservation Foundation (LCF) supports a growing number of private nature reserves (Antanetiambo, Agnolakely, Antohakalava, and Macolline) which were started by local

conservationists, and which now host tourists, students, and researchers. Similarly, San Diego Zoo Wildlife Alliance (SDZWA) and Portland State University (PSU) support the newly-formed Ravintsara, a communitymanaged forest adjacent to Masoala NP, by training members in forest and lemur monitoring methods. In collaboration with IMPACT Madagascar and the University of Antananarivo (UA), local NGOs Antongil Conservation and Fandroakandro have undertaken conservation of the Farankaraina and Rabondro Forests, respectively. These neighboring forests are the site of a red ruffed lemur reintroduction-translocation project.

2) Protect native habitats

Efforts must strengthen and reinforce the capacity of protected area managers to patrol forests and to effectively and systematically survey and monitor all sectors.

This should include supporting and training both individuals and institutions, e.g., local branches of the judicial system, to correctly interpret environmental laws and enforce penalties for those caught conducting illegal activities within protected areas. An insufficient number of park rangers has been reported for numerous protected areas in Madagascar (Schwitzer et al. 2013). Anjanaharibe-Sud SR, for example, has only five park rangers patrolling 269 km² of mountainous rainforest. Moreover, patrols should work with local communities to collaboratively survey the interior and exterior of protected areas, to identify current and potential threats, to monitor lemurs and other fauna, to monitor local ecology, and to improve community-park relations. LCF organizes monthly 5-day patrol missions in Marojejy with dozens of Comité Local du Parc and



WCS patrol removing lemur snare in Makira Natural Park. Photo: WCS-Paulson

park rangers. The Wildlife Conservation Society (WCS) has management delegation in Makira Natural Park, and uses SMART (<u>https://smartconservationtools.org/</u>) to monitor threats and wildlife during c. 600 collaborative patrols per year with local communities. Strengthened capacity to patrol, survey, and monitor in and around all northeastern protected areas will help minimize pressures and promote biodiversity conservation.

3) Reforest new and existing habitats

Forest restoration projects are of critical importance to restoring native habitat within the region. These efforts include forests in protected areas, their peripheral zones, and in corridors between forest fragments. Furthermore, taking a landscape restoration perspective (e.g., reforestation initiatives that integrate native utilitarian trees) could be beneficial for both biodiversity conservation and local people (Konersmann et al. 2021). This strategy of improving matrix habitat and promoting connectivity can also integrate lemur food trees to promote wildlife dispersal (Steffens 2020). Proof of this principle has been shown in northern Masoala through ruffed lemur seed dispersal (Martinez & Razafindratsima 2014). Natural forest regeneration efforts such as these can be an effective strategy for restoring landscapes at lower cost than active tree planting and should be promoted wherever possible. Both LCF and WCS currently support tree nurseries and reforestation. In 2021, 30,000 seedlings were grown and planted around Marojejy and Anjanaharibe-Sud and 552,000 were grown and planted around Marojejy and Anjanaharibe-Sud and 552,000 were grown and planted around Makira. The DLC supports reforestation in the SAVA region, including five community reforestation projects in which over 59,000 seedlings were planted in 2021 on approximately 20 hectares. By partnering with local stakeholders, including farmers, government, and even military, DLC provides technical and financial support for Malagasy staff, collaborators, and partners at CURSA.

4) Establish long-term biological research and ecological monitoring programs



McAntonin Andriahavanana (UA masters student, right) and Geraldo (local field asst., left) collecting vital lemur data at Andranobe, Masoala National Park. Photo: SDZWA-Eppley

Paramount for protecting lemurs from extinction is conservation-driven scientific research that factors in the context of protected areas as well as the needs of wildlife.

Establishing and continuing collaborative research and monitoring programs is an effective strategy for acquiring baseline data on flora and fauna, allowing local communities, park managers, and researchers to evaluate temporal patterns of anthropogenic pressure and climate change. Andranobe Forest in Masoala NP is home to the longest, continuously-run biological research station in northeast Madagascar (established 1993). Broad biological monitoring occurred at Andranobe prior to establishment of the park whereas long-term studies focus predominantly on red ruffed lemurs (Vasey et al. in press and refs. therein). The site has been a training ground for university students from Madagascar and the USA with recent studies examining forest and lemur responses to cyclonic weather and seasonality (Andriamahaihavana 2020, Mogilewsky 2020). Since 2017, SDZWA has partnered with PSU and the UA to continue work at Andranobe, conducting comprehensive population monitoring of red ruffed lemurs begun in 2007. Ruffed lemurs are indicator, umbrella, and flagship species, and addressing their survival requirements thereby reins in the survival of myriad other plant and animal species. Ruffed lemurs rely on a multitude of exceptionally large trees to nest and stash their young in the canopy, so even selective logging likely causes ubiquitous local extirpations by impeding successful reproduction (Vasey et al. 2018). The conservation directive is clear; however many tree seedlings we plant, we must also do our utmost to protect mature native forests. Long-term monitoring has also been established by IMPACT Madagascar and UA researchers in the Farankaraina and Rabondro Forests in order to carry out post-release behavioral ecology assessments of reintroduced-translocated red ruffed lemurs. The DLC has recently begun a collaboration with CURSA and World Wide Fund for Nature (WWF) to engage students and faculty in ecological monitoring in the COMATSA protected area. A team of CURSA scientists are partnering with local forest managers to study lemurs and their habitats at nine sites around the COMATSA. The team also conducts sociological research with communities bordering the forest to understand natural resource extraction in the area.

5) Reduce food insecurity

Unsustainable hunting of wildlife depletes targeted species and potentially causes local extirpations, particularly of lemurs. Food security is a serious challenge for smallholder farmers. In two studies in the SAVA region, up to 76% of farmers reported they had insufficient food during the previous years (Andriamparany et al. 2021; Herrera et al. 2021).

Conservationists have promoted alternative agricultural methods such as regenerative agriculture, and alternative protein programs to both curb unsustainable hunting and improve food security.

Examples include those pioneered by the NGO Madagascar Health and Environmental Research (MAHERY). This has included work on the Masoala Peninsula promoting a native edible insect called "sakondry" (*Zanna tenebrosa*), to improve protein and iron intake and decrease pressure on wildlife (Borgerson et al. 2021b). Efforts led by Dr. Christopher Golden, the Wildlife Health Network, and IMVAVET (Madagascar's Veterinary Vaccine Institute) developed a thermostable vaccine to address Newcastle disease and improve poultry husbandry (Annapragada et al. 2019).

On the edge of Makira Natural Park, WCS is also working with Centre de Cooperation Internationale en Recherche Agronomique pour le Développement (CIRAD) to screen for zoonotic diseases and to support farmer-to-farmer field schools for improved livestock husbandry techniques that reduce reliance on wild meat. LCF has supported numerous fish farming trainings and maintains a model freshwater fish pond with a locally endemic cichlid fish, *Paratilapia polleni*. The DLC also



Edible insect farming has been a success in villages adjacent to Masoala National Park. Photo: MSU-Borgerson

facilitates a demonstration fish pond from which harvested fish are shared with members of the school parentteacher association, who are encouraged to make their own ponds.

6) Support environmental education

Exposure to basic levels of earth and environmental science education can encourage a deeper understanding of the value of nature and the services it provides. Understanding the diverse role of trees in the landscape helps link the need for reforestation with the services trees provide (e.g., flood and drought resilience, clean air, and erosion control). Yet educational opportunities are often limited for rural communities, because only primary schools are accessible.

To improve the awareness and appreciation of ecosystem services, it is crucial to incorporate environmental education into the lesson plans of remote communities living adjacent to forests.



LCF-organized field trip to Marojejy National Park for local Malagasy students. Photo: LCF-Patel

The DLC has trained over 2,600 teachers in the fundamentals of environmental sciences (including photosynthesis, the water cycle, and food webs) to empower teachers and communities to promote a greater appreciation for the endemic species in their own 'backyard.' DLC has also developed a lemur awareness program led by a local education specialist, in which the educator visits schools and delivers an interactive lesson plan focusing on the diversity of lemurs from the SAVA region, explaining that lemurs are not to be kept as pets or eaten, and why lemurs are important for

the ecosystem. WCS also runs the Open Classroom Program in Maroantsetra, which organizes educational sessions and trips for local environmental clubs. Assessments are needed to determine program effectiveness. A quantitative assessment by LCF found positive impacts of student fieldtrips to Marojejy and highlights the importance of "place-based" environmental education programs (Sorenson et al. 2021).

7) Promote nature-positive livelihood opportunities

Community revenue-generating projects that encourage wildlife conservation and sustainable resource use are needed to reduce economic dependence on land and forest resources (e.g. ecotourism initiatives, healthcare and industry training, and certified forest-friendly cash crops). WCS developed the first farmer cooperatives in the Maroantsetra region, training farmers in agroforestry and cash crop production, including integrating cacao with food crops and native forest flora. Farmers are now exporting cacao to Switzerland, providing diversified revenue and encouraging others to adopt these agroforestry techniques. Eco-tourism, a key strategy of



Cacao and agroforestry demonstration site near Makira Natural Park. Photo: WCS-Kirkby

the Lemur Action Plan, often has a revenue generating cascade effect. However, this region of Madagascar remains one of the least visited. Improved infrastructure could draw tourists to these incredible protected areas (Ormsby & Mannle 2006).

Makira Natural Park communities manage an ecotourism site in collaboration with WCS, using their annual tourism revenue for community development, including running a health clinic and subsidizing teacher salaries.

LCF created Camp Indri in Anjanaharibe-Sud, the only site with infrastructure for visiting tourists and reseachers. More recently, Camp Mantella and Camp Marojejia in Marojejy, the most visited sites in the region, have also been completely rebuilt after being closed due to cyclone damage. A new tourist-friendly website for Marojejy has also been created: <u>https://explorewildmadagascar.com/marojejy-national-park/</u>

8) Expand community health programs

Rural communites living near protected areas in this region often have unmet basic healthcare needs. Only a handful of hospitals exist, and it can take several days to reach the closest medical clinic.

Community health programs can contribute to forest conservation not only by building trust, but also by breaking cycles of poverty and disease.



Left: WCS-organized school vaccination campaign near Makira Natural Park. Photo-Zafinandrasana. Right: LCF supported family planning services with nurses from Marie Stopes Intl. Photo-Patel.

Duke University's Global Health Institute has studied many aspects of human health in this region with some surprising findings, such as high rates of hypertension (Manus et al. 2018). Population-Health-Environment (PHE) programs have expanded greatly across Madagascar in recent years (Mohan & Shellard 2014). DLC, LCF, and WCS have partnered with nurses from Marie Stopes International to provide voluntary family planning services, including contraceptive implants. Through DLC's collaboration with Marie Stopes Intl., over 1,500 women from 23 villages received reproductive health care services within SAVA. Through LCF and WCS's efforts, 2,100 women in 63 villages near Marojejy and 6,000 families in 50 villages around Makira have received reproductive health care services are held regularly, and the first annual PHE Day meeting took place in March, 2021 in Sambava.

Drawing on diverse training and common goals, we focused on eight areas that can improve the co-existence and optimal health of the environment, people, and lemurs. *We are all in this together!* Here are some ways that you can help...

TAKE ACTION TO SUPPORT LEMUR CONSERVATION!

• Save, protect, and care for lemurs and other endangered African wildlife when you give to the <u>San Diego Zoo</u> <u>Wildlife Alliance (SDZWA)</u> African Forest conservation hub. Your generosity will support field-based conservation projects—including long-term lemur population monitoring and extensive lemur and habitat monitoring expeditions—and provide training and capacity-building opportunities to community forest managers, forest patrols, and university students. Thank you for being an ally for wildlife!

• Support Dr. Cortni Borgerson (<u>Montclair State University</u>) by making a donation to help support continued interventions which improve food security and reduce the unsustainable hunting of threatened lemurs.

• Support conservation efforts by donating to <u>Lemur Conservation Foundation (LCF)</u>. Donations help fund ecotourism infrastructure, forest patrol missions, fuel-efficient stoves to reduce pressure on forests, reforestation, providing access to medical and family planning health care, and environmental education programs.

• Support the <u>Duke Lemur Center SAVA Conservation Program</u>, including empowering farmers to diversify crops and promote regenerative agroecology techniques, landscape restoration, environmental education, fuel-efficient stoves, women's reproductive health, and supporting local university students to become the next generation of conservation scientists.

• Support the <u>Wildlife Conservation Society (WCS)</u>, MaMaBay Landscape, including management of Makira Natural Park, forest patrols, improved farming techniques including agroforestry with cash crops, rice intensification and small livestock husbandry, improving community access to health care and education, forest restoration, and developing and training community forest managers.

• Support the <u>Madagascar Health and Environmental Research (MAHERY)</u> team to finance three primary efforts: 1) training and mentoring Malagasy researchers in planetary health research; 2) scale and disseminate vaccinations to support poultry production to reduce wildlife hunting; and 3) provide human health monitoring of local communities to understand the multifold benefits of conservation activities and the potential risks of environmental change.

• Support **IMPACT Madagascar** and the red ruffed lemur reintroduction and translocation project in Farankaraina. Donations help to support post-release ecological monitoring of the lemurs, training of local guides, and supporting university student research.

• Support lemur conservation through **Portland State University**. PSU supports long-term lemur population monitoring and applied research, provides training and employment to Malagasy partners and staff, and helps prepare university students for environmental careers. To donate, contact Dr. Natalie Vasey at <u>nvasey@pdx.edu</u>.

Other equally important actions individuals can take:

- \rightarrow Support products that are independently certified as sustainable.
- → Support (through financial donations or volunteering) community-based conservation projects.
- → Avoid purchasing non-certified tropical timber by checking labels and the origins of any wood products.
- → Researchers should engage with and empower local communities.
- → Visit and promote community managed ecotourism sites that support forest conservation initiatives.

Northeastern Madagascar in the News

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<u>Authors</u>

Timothy M. Eppley, San Diego Zoo Wildlife Alliance, USA (teppley@sdzwa.org)
Cortni Borgerson, Montclair State University, USA (borgersonc@montclair.edu)
Erik R. Patel, Lemur Conservation Foundation, USA (patel.erik@gmail.com)
James P. Herrera, Duke Lemur Center, USA (james.herrera@duke.edu)
Andrew E. Kirkby, Wildlife Conservation Society, Madagascar (akirkby@wcs.org)
Christopher D. Golden, Harvard T.H. Chan School of Public Health, USA (golden@hsph.harvard.edu)
McAntonin Andriahavanana, University of Antananarivo, Madagascar (andryantonin@yahoo.fr)
Lanto Andrianandrasana, Duke Lemur Center, Madagascar (lha3@duke.edu)
Louis Joxe Jaofeno, Lemur Conservation Foundation, Madagascar (joart29@hotmail.fr)
Claudin Delaïd Rasamisoa, San Diego Zoo Wildlife Alliance, Madagascar (claudinrasamisoa@yahoo.fr)
Josia Razafindramanana, University of Antananarivo, Madagascar (josia.razafi@gmail.com)
Charlotte Spira, Wildlife Conservation Society, Madagascar (cspira@wcs.org)
Dean Gibson, San Diego Zoo Wildlife Alliance, USA (dgibson@sdzwa.org)
Charles Welch, Duke Lemur Center, USA (charles.welch@duke.edu)
Natalie Vasey, Portland State University, USA (nvasey@pdx.edu)

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