Association Vahatra

Annual report for 2023




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A MESSAGE FROM THE PRESIDENT OF VAHATRA, ACHILLE P. RASELIMANANA, PROFESSEUR TITULAIRE

First off, on the behalf of Association Vahatra, I wish to send our best wishes to you and yours for 2024. Good health to all and the best of success with your important projects.

In the year 2021, Vahatra embarked in a new direction concerning applied scientific work associated with an ecological restoration project at the Ambohitantely Special Reserve in the Central Highlands. We were driven in this new direction by the desire to contribute to the preservation of one of the last vestiges of montane humid forest in the Central Highlands. It was and remains both a considerable challenge and an ambitious adventure for a group of scientists that have worked for decades exploring the forests of Madagascar to document its untold biodiversity, as well as pedagogic activities in the fields of biodiversity, ecology, and conservation biology for the general public, conservation workers, and students in the national university systems. Indeed, Association Vahatra, thanks to the various scientific books and articles that it has published and made accessible to a range of different users, has become an essential national and international reference for most questions concerning aspects of the island's terrestrial biodiversity. However, our long years of experience concerning Malagasy wildlife, their ecological requirements, and the dynamics of ecosystems, and most importantly watching these wonders disappear before us, convinced the scientific members of the association to take on a new and important role in applied conservation and contribute to the preservation of a vestige forest habitat that was once broadly distributed and today threatened. Hence, this new, captivating, and very stimulating venture.

Thus, 2023 was both a period of reinforcing the ecological restoration activities initiated in 2021 at Ambohitantely and a year to test and evaluate the ability of the association to pursue this new direction with innovative approaches. The efforts made to follow this ambition have borne fruit, the results are conclusive, and we are delighted to present them in this annual report. We hope that our humble contribution will help preserve the remaining forests of the Ambohitantely Special Reserve and the innovations concerning ecological restoration will be considered by other projects and duplicated elsewhere as needed.

Furthermore, the biological station constructed by Vahatra at Ambohitantely in the middle of the countryside of the Central Highlands, is now operational and includes permanent electricity and pumped water via solar power. We continue to get new equipment for the station to serve different users. This is the fruit of our collaboration with Madagascar National Parks, the protected area manager, and the financial aid of Save the Rainforest (Sweden) and Madagascar Classic Collection, a tour operator in Antananarivo.

The challenges are multiple and the ambitions are daring, but according to the Malagasy saying "Lokanga tsy atao no maha lehibe ny voatavo", which literally translates as "Transformation into something useful is not easy with large pumpkins" and figuratively "Do not look for excuses to advance difficult tasks and do what is needed", and "Tsy misy mafy tsy laitry ny zoto", which literally translates as "There is nothing hard without diligence" or figuratively, "Conviction with forward motion and success is the manner to proceed". Hence, with your support, we will reach the goal and achieve the set objectives.

Achille P. Raselimanana

LONG-TERM GOALS

The long-term goals of Association Vahatra are to advance Malagasy scientists, in particular graduate students within the university system, as well as other members of the national conservation biology community, make substantial advances in understanding the island's unique biota, and to disseminate this information. Our sincere intent is to put in place an organization with a long-term future and broad vision. A critical aspect to mention is that we have created this vision largely based on the scientists and students working with the association, and, hence, distinctly Malagasy in prospective. This is in comparison, for example, to large international organizations that might not necessarily have the interests of Madagascar as their principal point of perspective. This aspect is fundamental for the long-term strength of the association, since members are engaged and committed by conviction with respect to the study and conservation of their natural heritage.

The seed was planted for Association Vahatra over three decades ago in the context of a project organized by WWF-Madagascar, put in place by Olivier Langrand, Sheila O'Connor, and the late Martin Nicoll, and known as The Ecology Training Program (ETP). Steve Goodman and Achille Raselimanana were the coordinators of the project for well over a decade, during which several generations of Malagasy graduate students finished their higher degrees within the national university system in animal and conservation biology. Many of these people are among the major actors in the current Malagasy conservation community within different sectors. For example, some of these individuals are now responsible for the advancement of new generations of national field biologists in at least three different capacities: 1) lecturers and professors within the national university system, as well as private universities, 2) active scientific members of the Vahatra staff or eminent researchers, and 3) playing important roles and holding key positions in the non-governmental and governmental sectors. Association Vahatra places strong emphasis on capacity building and continues this tradition and the body of well-trained nationals continues to grow, and regularly advancing the dissemination of information to the scientific community and the Malagasy public in general.

VAHATRA – PERMANENT STAFF

1. Professor Achille P. Raselimanana (raselimananaachille@gmail.com) – President of Vahatra and Professor, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo. Founding member. Achille was in the first generation of ETP graduates (see above under Long-term Goals) and did his DEA and Ph.D. in the context of this program. In 2011, he presented his "Habilitation à Diriger des Recherches" (HDR) at the Université de La Réunion, which is the highest scientific degree in the French university system. Achille is a herpetologist with considerable experience in aspects ranging from field studies, classical taxonomy to molecular systematics. Before the creation of Association Vahatra, he held for nearly a decade the position of Biodiversity Program Officer for WWF-Madagascar. In 2018, Achille was named "Professeur titulaire" by the Ministère de l'Enseignement Supérieur et de la Recherche Scientifique.
2. Dr. Marie Jeanne Raherilalao (jraherilalao@gmail.com) – Co-editor of the journal *Malagasy Nature* and books published by Vahatra and Professor, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo. Founding member and General Secretary of Vahatra. Marie Jeanne did her Ph.D. associated with the ETP (see above text under Long-term

Goals) and presented her HDR in 2021 at the Université d'Antananarivo. She works on bird ecology, biogeography, and systematics.

3. Dr. Voahangy Soarimalala (voahangysoarimalala@gmail.com) – Scientific Coordinator of Vahatra; Head Museum Curator, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo; and Professor, Université de Fianarantsoa. Founding member. Voahangy did her DEA and Ph.D. in association with the ETP (see above text under Long-term Goals). Voahangy is a mammalogist with a particular interest in rodents and tenrecs.
4. Dr. Jacquis T. Andonahary (andonahary@yahoo.fr) – Botanist, Geographic Information Specialist, Geometician (discipline concerned with the collection, distribution, analysis, processing, presentation of geographic data), and responsible for the ecological restoration project at Ambohitantely. Jacquis co-presented his Ph.D. at Université d'Antananarivo and Université de Genève (Switzerland) in late 2016. He is the principal coordinator of the Ambohitantely restoration project (see below). Since 2011, Jacquis has joined the Vahatra field team on numerous field expeditions and recently has become a core member of the association.
5. Professor Steven M. Goodman (sgoodman@fieldmuseum.org) – Scientific Advisor and Vice President of Vahatra; co-editor of the journal *Malagasy Nature* and books produced by Vahatra; and Docteur Honoris Causa, Université d'Antananarivo. Founding member. Steve works on both mammals and birds. Steve play a major role in the sales of books from Association Vahatra publications, including national distribution. He holds the post of MacArthur Field Biologist, Field Museum of Natural History, Chicago, and since several decades lives in Madagascar most of the year.
6. Mrs. Sabrina Raharinirina (msraharinirina@gmail.com) – Financial & Administration Manager. Sabrina joined the association in October 2015. She is responsible for the general functioning of the office and financial affairs. Sabrina also plays an important role in the sale of Association Vahatra publications. Recently she has been following coursework at a well-known business school in Antananarivo and received an advance diploma in Management, Financial Management, and Leadership. See section below on "Person in Focus", for more details on Madame Sabrina.
7. Mr. Rachel Razafindravao and known as "Ledada" – logistic coordinator. Ledada started working with the ETP some 30 years ago and transferred to Vahatra in October 2007. He has helped organize logistics for hundreds of field missions to some of the remotest areas on Madagascar.
8. Mrs. Sandra Ratsirahaingotiana – domestic help. She has worked with Vahatra since May 2016.
9. Mr. Elisa Malaimbohitsy, Mr. Mara Avisoa, and Mr. François Tsitindria – guardians.

VAHATRA'S BOARD OF DIRECTORS

In order to provide needed guidance and counseling for the current and future Vahatra programs, a Board of Directors has been designated and includes the following individuals:

Malagasy nationals

1. Professor Daniel Rakotondravony – Retired Professor from the Mention Zoologie et Biodiversité Animale, Université d'Antananarivo.
2. Nanie Ratsifandrihamanana – Country Director, WWF-Madagascar.
3. Chantal Andrianarivo – Former Head of Research and Biodiversity, Madagascar National Parks, and also Technical Advisor at Indian Ocean Commission (Mauritius). She is now Regional Advisor for the United Nations associated with biosafety.
4. Professor Joelisoa Ratsirarison – Département des Eaux et Forêts de l'Ecole Supérieure des Sciences Agronomiques, Université d'Antananarivo and ex-Vice President of l'Université d'Antananarivo and in Charge of International Relations.
4. Jean Chrysostome Rakotoary – Former General Director of the Office National pour l'Environnement (ONE).
5. Professor Raoelina Andriambololona – Retired General Director of the Institut National des Sciences et Techniques Nucléaires (INSTN), Université d'Antananarivo, and Doyen of the Malagasy Academy.

Foreign members

1. Professor Jörg U. Ganzhorn – Retired professor, Tierökologie und Naturschutz, University of Hamburg.
2. Paul Goodman – Principal, Kingfisher Group and Allied District Properties.
3. Olivier Langrand – Executive Director, Critical Ecosystem Partnership Fund (CEPF).
4. Michael Polsky – President, Invenergy.

STUDENTS

As capacity building for the next generations of field and conservation biologists is at the core of Association Vahatra activities, we work directly with Malagasy students registered within the national university system and following different types of higher diplomas: Licence Professionnelle, Master's II or Ph.D. degrees. The association continues to support financially some graduate students and post-docs. In 2013, the Malagasy national university shifted from the classical French scheme to that of an Anglophone License-Masters-Doctorate (LMD) system. The scientific members of Vahatra are also in contact with many other Malagasy students working in the national university system as secondary advisors or members of thesis and other types of mentoring committees. We make a dedicated effort to work with graduate students in universities outside of the capital city of Antananarivo, including the former provincial capitals of Antsiranana, Toliara, Fianarantsoa, Toamasina, and Mahajanga, as well as regional universities. In addition, each year Vahatra scientists advise numerous Malagasy students on aspects of their research, access to literature based on the extensive library housed at our office, and other forms of mentorship. Furthermore, several Ph.D. candidates working with other institutions, some outside of Madagascar, request Vahatra scientists to be members of their graduate study committees. The office overlooks the University of Antananarivo and it is only a few minutes walking distance between the two.

Since Vahatra open its doors in late 2007, something approaching 2636 different student and research visitors not directly part of the association's mentoring program have visited the office to use the library facilities or consult with the scientific staff. (These figures are based on a sign-in notebook for arriving library users.) The Vahatra library, with respect to modern books on Madagascar and a range of aspects associated with its biodiversity, is one of the most extensive on the island and represents an important bibliographic resource. The individuals consulting these books in 2023 included mostly students from different university faculties (science, agronomy, veterinary medicine, etc.) of national and private universities, as well as Malagasy researchers, who accessed hundreds of documents (books, reprints, theses, etc.). It is worth noting that over the past five years or so, fewer students are using the library facilities at Vahatra and this is most likely related with the reflex of "the new generations" finding documents on the internet, rather than physically consulting them.

Malagasy students passing through the Vahatra program have considerable success finding permanent jobs within the national governmental and non-governmental sectors. In many cases, these posts are in domains related to biology and conservation, for example, university appointments, working within NGOs, associated with the Madagascar National Parks, etc. Some of the former students hold or have held key posts, for example, in different managerial capacities, such as at UNESCO, mining companies, Ministry of Higher Education and Scientific Research, and Ministry of the Environment and Sustainable Development. Some former students have taken a different direction and created their own associations that are actively involved in the management and conservation of biodiversity in collaboration with local communities. Hence, taking a broad view, one of the mandates of the association, to advance science and conservation on Madagascar with focused mentorship of graduate students and conservation biologists, is indeed meeting the intended expectations. A good example of this is that numerous Vahatra graduates have obtained university appointments, providing an even greater means to advance capacity building for Malagasy field and conservation biologists.

In a section below is a listing of Malagasy graduate students having completed in 2023 their Licence Professionnelle, Master's II, or Ph.D. degrees under the direction of Vahatra scientists or as committee members, as well as those currently in preparation. After receiving their higher degrees

from the university in collaboration with Association Vahatra scientists, these generally well-trained young researchers are for the most part dynamic and with long-term visions, capable of designing and implementing research projects, and obtaining associated funding.

Graduate diplomas presented in 2023 or in preparation

As can be seen from the following lists, the scientific members of Vahatra are actively involved in the advancement of Malagasy graduate students. We consider this one of the hallmarks of the association's interventions to advance science on the island and prepare future generations. Further, we encourage students to publish the results of their scientific work (see below, "Scientific outputs of Vahatra during 2023") and take their rightful place in the international scientific community.

A) Master's and Ph.D. diplomas presented by student members of Association Vahatra and under the direction of Vahatra scientific members

1. Mahevazaka, A. 2023. Description des approches de restauration écologique adaptée aux conditions du milieu de la Nouvelle Aire Protégée de Montagne de Français. Mémoire de Master, Faculté des Sciences, Université d'Antsiranana.

2. Marcelline, T. 2023. Choix des espèces candidates à la restauration écologique des habitats dégradés de la Nouvelle Aire Protégée de la Montagne des Français. Mémoire de Master, Faculté des Sciences, Université d'Antsiranana.
3. Nomenjanahary, Z. B. 2023. Biologie et biogéographie de deux espèces d'Anatidae endémiques de Madagascar : *Alopochen sirabensis* (espèce éteinte) et *Aythya innotata* (espèce existante). Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.
4. Rakotoarisoa, F. E. 2023. Etude de la variation saisonnière des populations de rongeurs, de leur déplacement et exploration de leurs terriers dans la Réserve Spéciale d'Ambohitantely, Madagascar. Mémoire de Master, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo.
5. Rasoarimanana, V. M. C. 2023. Ecologie des diptères ectoparasites de *Rousettus madagascariensis* (Chiroptera : Pteropodidae) dans la Réserve Spéciale d'Ankarana, Madagascar. Mémoire de Master, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo.
6. Rasolonjatovo, H. A. M. 2023. Les oiseaux subfossiles de la Grotte de Vintany, Parc National de Tsimanampesotse, Sud-ouest de Madagascar : Histoire, taphonomie et paleoécologie. Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.

B) Licence, Master, and Ph.D. diplomas defended with implication of Vahatra scientists as a supervisor, lecture committee member or jury member

1. Andrianalijaona, N. J. C. 2023. Structure de la population et activités de *Pyxis planicauda* (Grandidier, 1897), espèce En danger critique d'extinction, dans la forêt sèche de Kirindy CNFEREF, Madagascar. Mémoire de Master, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo.
2. Faina, P. 2023. Paléoclimats du Nord-ouest et du Sud-ouest de Madagascar à la fin de l'Holocène : implications pour le rôle du climat dans l'extinction des mégafaunes. Doctorat en sciences, Sciences de la Terre et de l'Evolution, Faculté des Sciences, Université d'Antananarivo.
3. Fanomezantsoa, H. F. 2023. Comportement alimentaire de *Propithecus verreauxi* dans le site Namaza, Parc National d'Isalo. Mémoire de Licence, Institut des Sciences et Techniques de l'Environnement, Université de Fianarantsoa.
4. Fulgence, T. R. 2023. Distribution d'amphibiens et de reptiles selon les cours d'eau et suivant le gradient d'utilisation des terres du Nord-est de Madagascar. Cas d'interaction interspécifique entre les amphibiens et les arthropodes. Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.
5. Magnina, T. G. 2023. Contribution à l'étude de la distribution du groupe de *Propithecus coquereli* dans le bloc forestier d'Anjiamangirana, District d'Antsohihy, Région Sofia. Mémoire de Licence, Institut des Sciences et Techniques de l'Environnement, Université de Fianarantsoa.
6. Rakouth, H. N. 2023. Taxonomie, développement d'outils d'identification et modélisation de la distribution des espèces de grands arbres de *Diospyros* (Ebenaceae) de Madagascar. Thèse pour l'obtention du Diplôme de Doctorat en Sciences de la Vie et d'Environnement, Université d'Antananarivo.
7. Randriamanantena, H. J. 2023. Effet de la structure de l'habitat et de la perturbation anthropique sur les comportements de Propithèque de Decken, *Propithecus deckenii* (Peters, 1870) dans les Aires Protégées du Complexe Manambolomaty et Mandrozo, Ouest de Madagascar. Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.
8. Razanamahenina, S. N. 2023. Etude du territoire et de l'éco-biologie de reproduction de Coua géant, *Coua gigas* (Aves, Cuculidae) dans la forêt sèche de Kirindy CNFEREF, Morondava, Madagascar. Mémoire de Master, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo.

C) Licence, Master's, Ph.D., and HDR diplomas in preparation in direct collaboration with scientific members of the Associated Vahatra

1. Andrianantenaina, F. In preparation. Etude de la corrélation entre l'exploitation des ressources naturelles et la proximité des villages par rapport au Parc National de Zombitse-Vohibasia, Madagascar. Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.
2. Faliarivola, M. F. In préparation. Distribution altitudinale des oiseaux de sous-bois de la forêt humide du Parc National d'Andohahela, Madagascar. Mémoire de Master, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo.
3. Nasolonjanahary, B. F. In preparation. Etude de la variation temporelle de la communauté des petits mammifères non-volants du Parc National de Ranomafana. Mémoire de Master, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo.
4. Radovimiandrinifarany, H. T. R. In preparation. Etude éco-biologique et lutte contre les rongeurs exotiques nuisibles dans la Commune Rurale d'Analavory Itasy, Madagascar. Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.
5. Rafaliarintsoa, H. In preparation. Répartition écologique et domaine vital d'*Erymnochelys madagascariensis* dans le lac Ravelobe du Parc National Ankarafantsika au Nord-ouest de Madagascar. Mémoire de Master, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo.
6. Rahelinirina, S. In preparation. Compréhension et gestion de risque de maladies zoonotiques transmises par les rongeurs. Mémoire de HDR, Ecole Doctorale, Faculté des Sciences, Université d'Antananarivo.

7. Rakotoarimalala, D. M. F. In preparation. Structure de la population, Distribution spatiale et variabilité génétique des communautés de caméléons (Chamaeleonidae : *Calumma* spp.) des Hautes Terres de Madagascar. Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.
8. Rakotondrina, A. J. V. In preparation. Ecologie et population de *Calumma tarzan* Gehring, 2010 (Chamaeleonidae), dans les forêts humides de Madagascar. Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.
9. Ramahefason, A. N. In preparation. Etude comparative de la population de *Mantella cowani* (Boulenger, 1882) des trois sites : Fohisokina, Itremo et Betafo. Mémoire de Master, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo.
10. Ramaherison, R. P. In preparation. Etude et investigation sur l'influence des prédateurs à travers les distributions des lémuriens diurne et nocturne dans la région d'Andasibe-Mantadia. Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.
11. Ranaivoson, T. N. In preparation. Diversité, écologie et ectoparasites chez les petits mammifères de la forêt humide sempervirente, des écotones et des milieux anthropiques de la Région de Mandena – Marojejy, Madagascar. Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.
12. Rasoarimalala, M. S. In preparation. Etude de la variation temporelle des populations de Tenrecidae de la Réserve Spéciale d'Ambohitantely, Ankazobe, Madagascar. Mémoire de Master, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo.
13. Rasolobera, F. In preparation. Etude bio-écologique des Tenrecidae, diversité et distribution altitudinale des petits mammifères terrestres dans le Parc National de Marojejy, Nord-Est de Madagascar. Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.
14. Ravelomandrato, F. In preparation. Etude des interactions sociales mère enfant chez *Daubentonia madagascariensis,* Gmelin, 1788, dans la Forêt Classée de Kianjavato, Sud-est de Madagascar. Thèse de Doctorat, Faculté des Sciences, Université d'Antananarivo.
15. Razafimandimby, J. L. In preparation. Structure de la communauté de petits mammifères du Parc National de Marojejy. Mémoire de Master, Mention Zoologie et Biodiversité Animale, Université d'Antananarivo.
16. Razanatsara, N. M. In preparation. Activités déployées par *Propithecus verreauxi* dans le site de Namaza. Mémoire de Licence, Institut des Sciences et Techniques de l'Environnement, Université de Fianarantsoa.

VAHATRA MEMBERS AS REVIEWERS OF PAPERS SUBMITTED TO SCIENTIFIC JOURNALS

As an indication of the role Association Vahatra scientists play in the realm of published scientific papers, they served in 2023 as reviewers for papers submitted to the following international journals:

- *Acta Chiropterologica*
- *Ecological Genetics and Genomics*
- *Frontiers in Ecology & Evolution*
- *Journal of Mammalogy*
- *Journal of Medical Entomology*
- *Malagasy Nature*
- *Mammalia*
- *Mammalian Review*
- *Plants, People, Planet*
- *Salamandra*
- *Science*
- *Zoological Journal of the Linnean Society*

NEW BLOOD AT ASSOCIATION VAHATRA AND THE FUTURE OF THE ORGANIZATION

The founding scientific members of Association Vahatra, including Achille Raselimanana, Marie Jeanne Raherilalao, Voahangy Soarimalala, and Steve Goodman, have been active in field research, advancing science for Malagasy graduate students and the public, and other pedagogic activities for decades. To put this in a different perspective, cumulatively between the four of them, they have about 120 years of experience working in the forests of Madagascar. After a range of discussions and the fact that not one of them is getting any younger, it was clear that at least one new individual needed to be recruited by Vahatra to take the reins and advance the organization in new directions. The person picked for this post is Andonahary Jacquis Tahinarivony, a well-experienced field botanist and with important skills in ecological restoration and an accomplished geomatics (discipline concerned with the collection, distribution, analysis, processing, presentation of geographic data).

He presented his Diplôme d'études approfondies (in the former French system a near equivalent to a Master's) in 2010 at the University

of Antananarivo on the vegetation of an area in northwestern Madagascar. Soon thereafter he became directly involved to place one of his study sites into the country's protected area system, as well as different associated studies. In 2011, he followed training at The Conservatory and Botanical Garden of Geneva on satellite imagery technology, which in part led to his obtaining a diploma in geomatics at The University of Geneva. The next step, based on different collaborations with colleagues in Geneva and Madagascar, including Association Vahatra, was the presentation of his Ph.D. at The University of Antananarivo in 2016 on the use of new technology in employing vegetation and ecological data to define zones in need of conservation.

Jacquis has taken part in numerous field missions around the island, in a range of different vegetational types, and using classical and modern techniques in data collection and associated analyses. While exploring different forests, he seems tireless and able to continue in a manner that few of his peers can match, always pleasant and cheerful. In recent years, he has been working with Vahatra as a field botanist during different biological inventories, as well as helping to obtain data for different studies on the importance of vegetational structure to interpret the distribution of a variety of vertebrates. He has been the driving force for the tree nursery and habitat restoration project of Vahatra at Ambohitantely (see below Vahatra's ecological restoration project at Ambohitantely). In many ways, Jacquis represents the young generation of Malagasy field biologists and conservationists that are making a difference for the future of biodiversity of this island nation. We are very pleased to have him as part of Association Vahatra.

An image of Jacquis (holding greenish pencil and looking up) during a field school in Ambohitantely and explaining to students the manner to install and obtain data from vegetational plots.

MALAGASY NATURE

Our intention with the scientific journal *Malagasy Nature*, published by Association Vahatra and with free online download of articles, is to advance peer-reviewed papers at high scientific and technical standards and specifically for young researchers and graduate students from Madagascar and neighboring islands. *Malagasy Nature* has an International Standard Serial Number (ISSN) rating and, hence, considered an international scientific journal. Manuscripts in French or English are passed through an editorial team, including a review process of international norms. An important difference with most scientific journals is that the editorial staff of *Malagasy Nature* works closely with Malagasy or regional western Indian Ocean authors to help them understand the process of composing and writing scientific articles. In many cases, the first couple of publications of a young researcher pose considerable hurdles and the editors of *Malagasy Nature* provide the means for less experienced scientists to negotiate such problems. Based on this approach, the journal plays an important role in regional capacity building, which in turn separates it from other international journals, for which the editors and associated editorial committee are not readily available to help at the same levels with manuscript submission and revisions. Further, given that article downloads are free, *Malagasy Nature* allows national and regional scientists to easily return information to the worldwide scientific world. All of these aspects together, provide professional advancement for the western Indian Ocean scientific community, specifically a certain sense of responsibility and for regional authors to understand the importance of invested efforts when producing scientific articles.

For Malagasy students preparing their theses at a university in the national system, they are required to have published a certain number of scientific publications before they can finalize the thesis submission. An

article published in or accepted by *Malagasy Nature* counts towards this quota.

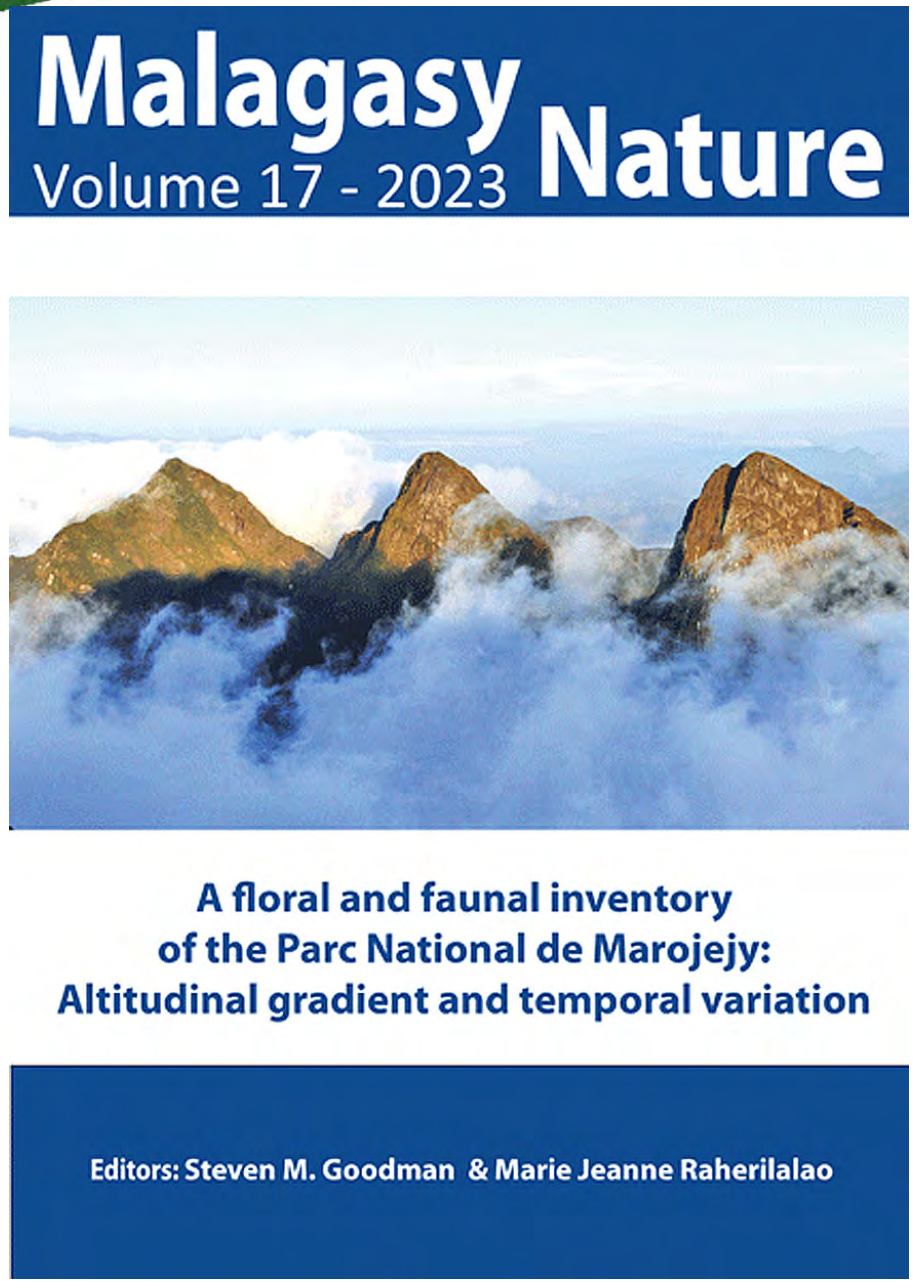
As a further point of explication, several researchers preparing their theses submit articles to *Malagasy Nature*, as they understand that when needed or appropriate they will get assistance from the editorial team to improve their manuscripts. The on-line publication of the journal also guarantees the local availability of research results in the fields of ecology and biology conducted on Madagascar and neighboring islands, as compared to foreign scientific journals for which electronic files are often not readily downloadable or repatriated to Madagascar. All numbers published to date of *Malagasy Nature* are available online and with free access (http://www.vahatra.mg/malagasynaturefr.html).

Marie Jeanne Raherilalao and Steve Goodman are the co-editors of *Malagasy Nature* and several associated editors assist in different aspects with submitted manuscripts. Malalarisoa Razafimpahanana is responsible for the design and type-setting of each volume, as well as posting articles on the journal website. On average, at least one volume of the journal is published each year. The editorial board of *Malagasy Nature* is composed of both national and international scientists, from both the Anglophone and Francophone worlds, made up of the following individuals:

The most recent volume of the journal, number 17, was published in later portion of 2023 and is a monograph dedicated to scientific research on the Marojejy Massif in northeastern Madagascar. The articles can be downloaded at http://www.vahatra.mg/volume17.html. Volume 17 includes the following papers:

Volume 17 (2023)

- **Description of the Parc National de Marojejy, Madagascar, and the 2021 biological inventory of the massif** – Steven M. Goodman, Achille P. Raselimanana & Jacquis A. Tahinarivony
- **Elevational variation of temperature and relative humidity in the Parc National de Marojejy** –Lovanomenjanahary Marline, Rivoharifara Randrianarimanana & Erik Patel
- **Species new to science described from Marojejy since 1988: An extraordinary area of discovery in one of Madagascar's most biodiversity rich protected areas** – Steven M. Goodman, Brian L. Fisher, Frank Glaw & Peter B. Phillipson
- **Etude descriptive de l'évolution de la végétation du Parc National du Marojejy entre 1995 et 2022** – Jacquis A. Tahinarivony
- **A checklist of the mosses and liverworts of the Parc National de Marojejy, northeastern Madagascar** – Rivoharifara Randrianarimanana, Nicholas Wilding, Tamás Pócs, Claudine Ah-Peng, Roger Lala Andriamiarisoa, Terry A. J. Hedderson & Lovanomenjanahary Marline
- **Typologie des habitats en fonction du gradient altitudinal : Cas du Parc National de Marojejy** – Jacquis A. Tahinarivony
- **Description d'*Anatispinosa*, nouveau genre de phasme du massif du Marojejy, Madagascar, comprenant deux espèces nouvelles réparties selon l'altitude (Phasmatodea, Antongiliidae)** – Nicolas Cliquennois



- **Diversity and altitudinal distribution of grasshoppers from the Parc National de Marojejy (Orthoptera: Tetrigoidea, Eumastacoidea, Acridoidea)** – Sylvain Hugel
- **Aperçu global de la tendance de la structure de la communauté herpétofaunique le long du gradient altitudinal du versant Est du Parc National de Marojejy au cours de ces 25 dernières années** – Fandresena Rakotoarimalala & Achille P. Raselimanana
- **Bird communities of the Parc National de Marojejy, Madagascar: With reference to species diversity and elevational distribution changes between 1996 and 2021** – Marie Jeanne Raherilalao, Tahiry Langrand & Steven M. Goodman
- **Diversité et distribution des petits mammifères terrestres dans le Parc National de Marojejy, Nord-est de Madagascar : Gradient altitudinal et variation temporelle** – Voahangy Soarimalala, Fifaliantsoa Rasolobera & Steven M. Goodman
- **The bats of the Parc National de Marojejy and surrounding areas** – Steven M. Goodman, Daniel Falimiarintsoa, Christian Manana, Johanna M. Rafanomezanjanahary, Mercia Rasoanoro & Lomeris J. Todilahy
- **Diversity and altitudinal distribution of lemurs on the eastern slopes of the Marojejy Massif** – Rindrahatsarana Ramanankirahina & José M. Ralison
- **Ecosystem change, market participation, and human health in villages proximate to Parc National de Marojejy** – Randall A. Kramer, James P. Herrera, Michelle Pender, Voahangy Soarimalala & Charles L. Nunn

The next issue of *Malagasy Nature*, volume 18, will appear in the first portion of 2024 and will be composed of an assortment of unrelated scientific papers.

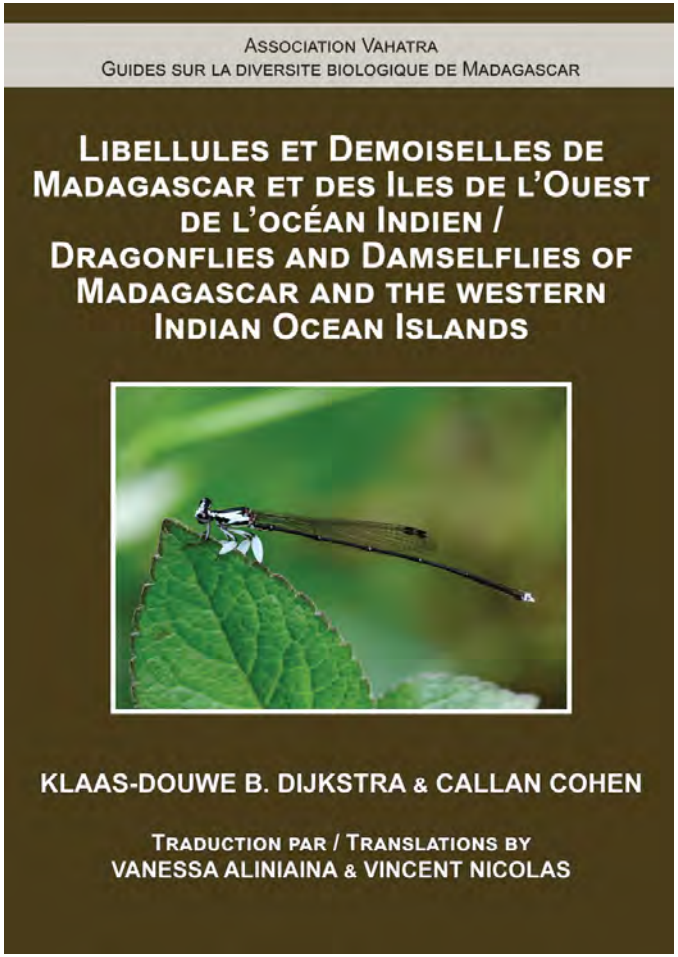
THE PUBLISHING HOUSE OF ASSOCIATION VAHATRA

The year 2011 marked an important advancement for Association Vahatra with the creation of its own publishing house, first focusing on a series entitled “Guides sur la diversité biologique de Madagascar” [Guides to the biological diversity of Madagascar]. For individuals that grew up over the past decades in, for example, North America, portions of Latin America or western Europe, information on regional plants and animals are readily available in field guide book format. These types of books, generally presented by taxonomic group (e.g. ferns, reptiles, birds, etc.) and region (e.g. east of the Mississippi, Peru, European Alps), revolutionized making information on biodiversity available and penetrable for members of various age and social groups in different parts of the world. Such guides provide the

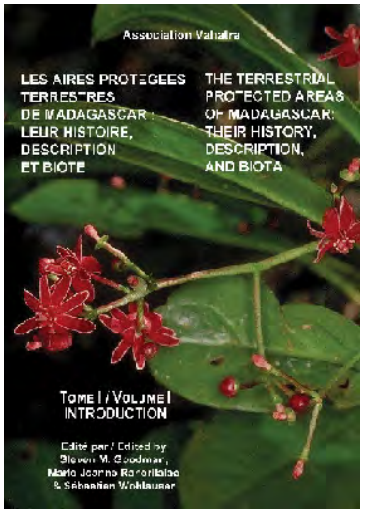
means for individuals to become familiar with different plants and animals found in areas where they live or travel, and, most critically, integrating this familiarity into how they perceive the importance of the natural world. It is not an exaggeration to state that these types of guides have been important elements in the "greening" of different societal sectors in numerous countries. More recently, the availability of such information has been advanced by an assortment of different online sites and smart phone applications, although for certain individuals there is a sort of satisfaction and practicality in the field to physically have such books in the hand. For Madagascar, which is so rich in biological diversity and being one of the world's principal tropical conservation priorities, the largely previous lack of such books created a considerable void, which Association Vahatra strongly believes needed to be filled.

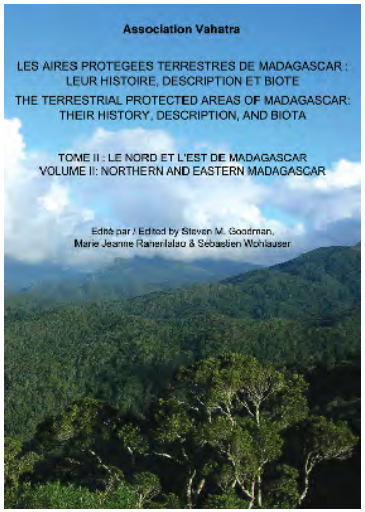
Since 2011, nine books are published in the series, which is edited by Marie Jeanne and Steve, and designed and typeset by Malalarisoa Razafimpahanana:

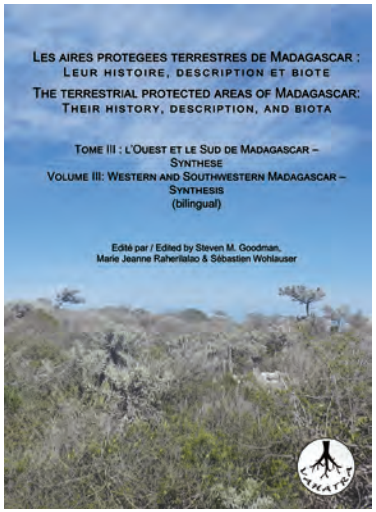
1. *Les chauves-souris de Madagascar* [The bats of Madagascar] by Steven M. Goodman, 2011, 129 pp.
2. *Les petits mammifères de Madagascar* [The small mammals of Madagascar] by Voahangy Soarimalala & Steven M. Goodman, 2011, 176 pp.
3. *Histoire naturelle des familles et sous-familles endémiques d'oiseaux de Madagascar* [The natural history of the families and subfamilies of endemic Malagasy birds] by Marie Jeanne Raherilalao & Steven M. Goodman, 2011, 146 pp.
4. *Les Carnivora de Madagascar* [The Carnivora of Madagascar] by Steven M. Goodman, 2012, 158 pp.
5. *Les animaux et écosystèmes de l'Holocène disparus de Madagascar* [The extinct Holocene animals and ecosystems of Madagascar] by Steven M. Goodman & William L. Jungers, 2013, 249 pp.
6. *Les amphibiens des zones arides de l'Ouest et du Sud de Madagascar* [The dry forest amphibians of western and southwestern of Madagascar] by Franco Andreone, Gonçalo M. Rosa & Achille P. Raselimanana, 2014, 180 pp.
7. *Les amphibiens du Nord de Madagascar* [*The amphibians of northern Madagascar*] by Franco Andreone, Angelica Crottini, Gonçalo M. Rosa, Andolalao Rakotoarison, Mark D. Scherz & Achille P. Raselimanana, 2018, 355 pp.
8. *Fourmis de Madagascar : Un guide pour les 62 genres* / *Ants of Madagascar: A guide to the 62 genera* (a bilingual French-English book) by Brian Fisher & Christian Peeters, 2019, 253 pp.
9. *Libellules et demoiselles de Madagascar et des Iles de l'Océan Indien occidentale* / *Dragonflies and damselflies of Madagascar and the western Indian Ocean Islands* (a bilingual French-English book) by K. D. Dijkstra & Callen Cohen, 2021, 194 pp.



The production of the first three books in the series was financed by a grant from the Critical Ecosystem Partnership Fund (CEPF). Subsequently, a generous gift from the Ellis Goodman Family Foundation and Paul Goodman (just a coincidence and no family relation to Steve Goodman) allowed additional guides in the series to be published. To date, other than free or at production costs diffusion of Association Vahatra Press books to Malagasy students and scientists, copies have been sold to people coming





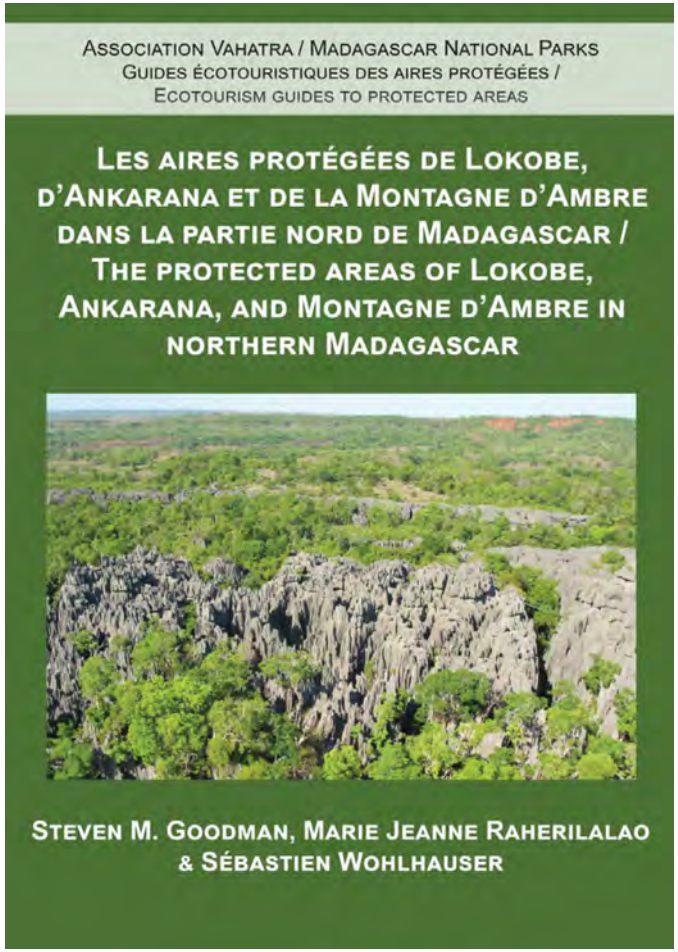


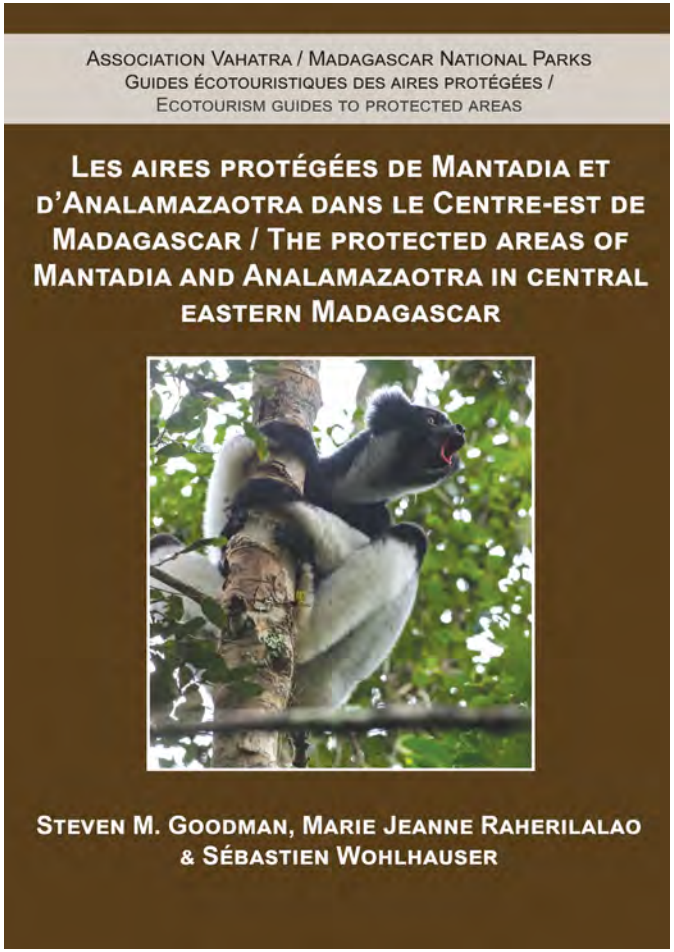
to the Vahatra office, at different fairs in Antananarivo, and through local and overseas booksellers. We are pleased with the interest these books have generated, which includes seeing young Malagasy students and naturalists, as well as tourists, carrying and consulting the books on trips to different forested areas. Further, these books are important resources for national students and researchers, as well as reference works for university courses. For certain titles, the printed stock is depleted and we are considering reprinting some of these books. The University of Chicago Press is responsible for the distribution of Vahatra books (see http://www.press.uchicago.edu/ucp/books/publisher/pu3431914_3431915.html) in the New World and Europe, which also include the *Atlas of selected vertebrates of Madagascar* published in late 2013, and *Les aires protégées terrestres de Madagascar : leur histoire, description et biote / The terrestrial protected areas of Madagascar: Their history, description, and biota* released in March 2018. Further, many of these books are available from book dealers in Europe, including Natural History Book Service (https://www.nhbs.com/shop/publisher/vahatra) and from Amazon in Europe and North America.

The ecotourism guide series published by Association Vahatra in collaboration with Madagascar National Parks

The extraordinary levels of animal and plant species diversity on Madagascar, including high levels of endemism, well known to naturalists, biologists, and conservation interested tourists, as is the heavy burden of anthropogenic pressures, making the island one of the world's most critical biodiversity "hotspots". Association Vahatra is of the view that one important way to advance worldwide attention to the island's protected areas system is through dissemination of information on the sites.

About 5% of the incoming foreign currency to Madagascar, at least before the COVID-crisis, was associated with tourism; hence, an important infusion into the national economy. With this aspect in mind and looking for a means to advance further ecotourism on the island, Association Vahatra started a new book series called "Guides écotouristiques des aires protégées" [Ecotourism guides to protected areas] and published in collaboration with Madagascar National Parks. At least in part, by augmenting the amount of information and scientific reliability available to both foreign and national tourists visiting protected areas in a series of simple pocket books, our hope is that this will increase interest in these sites, which in turn will augment

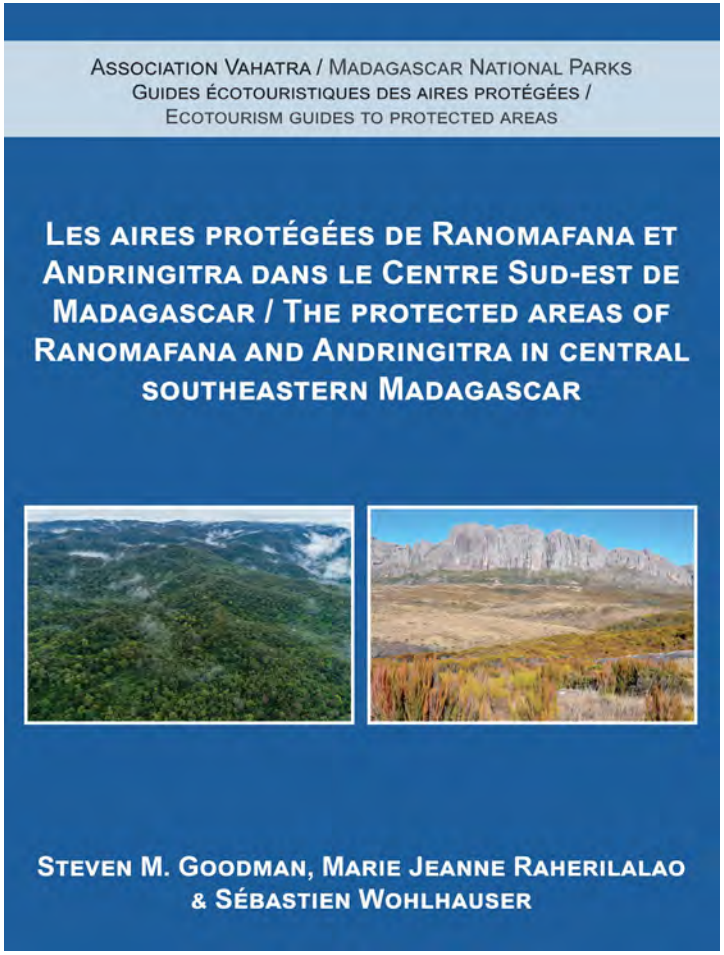




the number of visitors. Further, this will help to advance the local socio-economics around the protected areas, as well as the national economy. Finally, books in the series are important to help local guides update their knowledge on the protected areas they work, a sort of retooling. Thanks to the generous donations of several private individuals, we have secured funding for the first four books in the series.

At the first stage of this project, we will produce four bilingual (French-English) books before the end of 2024, each covering well-visited protected areas. These sites are part of standard tourist circuits, in close vicinity to national roads, and with advanced local infrastructure (guides, hotels, and restaurants). All of the protected areas covered are under the management of Madagascar National Parks, who is a direct collaborator in this project. The first four books include the following sites:

1. Northern set of protected areas (Lokobe, Ankarana, Montagne d'Ambre) – published in 2022,
2. Central east set of protected areas (Analamazaotra and Mantadia) – published in 2022,



3. Southeastern set of protected areas (Ranomafana and Andringitra) – published in 2023
4. Southwestern set of protected areas (Isalo and Zombitse-Vohibasia) – at an advanced writing stage.

We hope in 2025 to start working on a book for the sites of Marojejy and Anjanaharibe-Sud in the northeast and are currently seeking funds for that project.

Presentation of *The new natural history of Madagascar* at the Field Museum

In early January, Steve was in the USA and presented *The new natural history of Madagascar* at the Field Museum. The talk was well attended by museum staff, the general public, and local people that have helped Steve's work on Madagascar, as well as Association Vahatra over the years. He was joined by his family at the presentation.

Dissemination of information on Vahatra publications

Air Madagascar, now called Madagascar Airways, has a monthly publication known as *Prime Magazine*, which is available for passengers flying on national and international flights of the airlines. The articles in the magazine are generally associated with tourism of different sorts on Madagascar, often with a focus on ecotourism. To help advance dissemination on new books available on Madagascar, particularly its biodiversity and protected

area system, as well as new publications from the Association Vahatra press, three separate articles were published in the magazine:

1. Details on *The new natural history of Madagascar*, in August 2023.
2. Details on the Guides to the biological diversity of Madagascar series, in September 2023.
3. Details on the Ecotourism guides to protected areas series, in November 2023.

At the end of each article is a brief section on where the books are available overseas or at bookshops in Antananarivo. The first two articles were written by Steve Goodman and Marie Jeanne Raherilalao, and for the third article in collaboration with Ollier Duranton Andrianambinina of Madagascar National Parks.

/ BOOKS

ÉTUDE *De La Nature*

Les savoirs sur l'histoire naturelle de Madagascar sont si vastes qu'il faut deux volumes pour contenir toutes les informations et les images de l'étude approfondie acclamée par la critique et de la publication magnifiquement illustrée, *La nouvelle histoire naturelle de Madagascar*. Avec des contributions d'experts renommés du monde entier, y compris de nombreux scientifiques malgaches, il a été édité par Steven M. Goodman, biologiste de la conservation et de terrain de renommée internationale.

Nature STUDY

The current state of knowledge of the natural history of Madagascar is so extensive that it takes two volumes to contain all the information and images in the critically-acclaimed in-depth study and beautifully-illustrated publication, *The New Natural History of Madagascar*. With contributions by renowned experts from around the globe including many Malagasy scientists, it has been edited by Steven M. Goodman, internationally acclaimed conservation and field biologist.

Séparée du continent africain pendant des dizaines de millions d'années, Madagascar a développé une biodiversité d'une richesse époustouflante, abritant des milliers d'espèces qui ne se trouvent nulle part ailleurs sur la planète. *La nouvelle histoire naturelle de Madagascar* fournit la synthèse la plus complète et la plus récente des trésors biologiques inestimables de cette nation insulaire. Ce compendium magnifiquement illustré, publié en deux volumes et comptant un peu moins de 2250 pages, présente les contributions de plus de 600 experts de renommée mondiale qui couvrent l'histoire de l'exploration scientifique à Madagascar, la géologie et les sols de l'île, le climat, l'écologie forestière, l'écologie humaine, les écosystèmes marins et côtiers, les plantes, les invertébrés, les poissons, les amphibiens, les reptiles, les oiseaux et les mammifères. Cette référence inestimable comprend également des discussions détaillées sur les efforts de conservation à Madagascar qui présentent plusieurs programmes réussis d'aires protégées qui peuvent servir de modèles pour les écosystèmes menacés dans le monde entier.

- Fournit l'aperçu le plus complet de la riche histoire naturelle de Madagascar.
- Coédité par 18 spécialistes différents.
- Comprend un peu plus de 400 contributions d'experts de renommée mondiale.
- Couvre un large éventail de sujets, de la géologie et du climat aux animaux, aux plantes et à la vie marine.
- Met en lumière les espèces nouvellement découvertes et s'appuie sur les dernières découvertes scientifiques.
- Une ressource essentielle pour tous ceux qui s'intéressent à Madagascar ou aux écosystèmes tropicaux en général, qu'il s'agisse de biologistes, de défenseurs de l'environnement, d'écotouristes ou de naturalistes.

Pour plus d'informations sur l'obtention de ce livre à Antananarivo, veuillez contacter l'Association Vahatra à l'adresse associatvahatra@moov.mg ou au numéro 020 22-27755.

Separated from Africa's mainland for tens of millions of years, Madagascar has evolved a breathtaking wealth of biodiversity, becoming home to thousands of species found nowhere else on the planet. *The New Natural History of Madagascar* provides the most comprehensive, up-to-date synthesis available of this island nation's priceless biological treasures.

This beautifully-illustrated compendium published in two volumes and slightly less than 2250 pages, features contributions by more than 600 globally renowned experts who cover the history of scientific exploration in Madagascar, the island's geology and soils, climate, forest ecology, human ecology, marine and coastal ecosystems, plants, invertebrates, fishes, amphibians, reptiles, birds, and mammals.

This invaluable reference book including detailed discussions of conservation efforts in Madagascar that showcase several successful protected area programmes that can serve as models for threatened ecosystems throughout the world also:

- Provides the most comprehensive overview of Madagascar's rich natural history.
- Is co-edited by 20 different specialists.
- Features more than 400 contributions by world-class experts.
- Covers a broad array of topics, from geology and climate to animals, plants, and marine life.
- Sheds light on newly discovered species and draws on the latest science.
- Is an essential resource for anyone interested in Madagascar or tropical ecosystems in general, from biologists and conservationists to ecotourists and armchair naturalists.

For further information on obtaining this book in Antananarivo, please be in contact with Association Vahatra at associatvahatra@moov.mg or 020 22-27755 or Princeton University Press www.press.princeton.edu for international delivery.

Steven M. Goodman *Association Vahatra*

Un livre bilingue Français–Anglais, par K. D. Dijkstra & Cailen Cohen, 2021, 194 pp., 205 photos en couleur.

A bilingual French-English book, by K. D. Dijkstra & Cailen Cohen, 2021, 194 pp. 205 drawings and colour photos.

(fr) | Libellules et demoiselles de Madagascar et des Iles de l'Océan Indien occidentale »
Dragonflies and Damselflies of Madagascar and the Western Indian Ocean Islands

"Libellules et demoiselles de Madagascar et des Iles de l'Océan Indien occidentale / Dragonflies and damselflies of Madagascar and the western Indian Ocean Islands" est un livre bilingue français-anglais. La première partie du livre est une introduction comprenant des sections sur la diversité et l'endémisme, la conservation, la recherche et la collecte d'odonates et l'identification. La deuxième partie couvre les différents genres présents à Madagascar et dans les Iles de l'Ouest de l'océan Indien, avec un accent particulier sur les caractères d'identification.

Libellules et demoiselles de Madagascar et des Iles de l'Ocean Indien occidentale / Dragonflies and damselflies of Madagascar and the western Indian Ocean Islands is a bilingual French-English book. Part 1 of the book is an introduction and includes sections on diversity and endemism, conservation, finding and collecting odonata and identification. Part 2 covers the different genera occurring on Madagascar and western Indian Ocean islands, with particular emphasis on identification characteristics.

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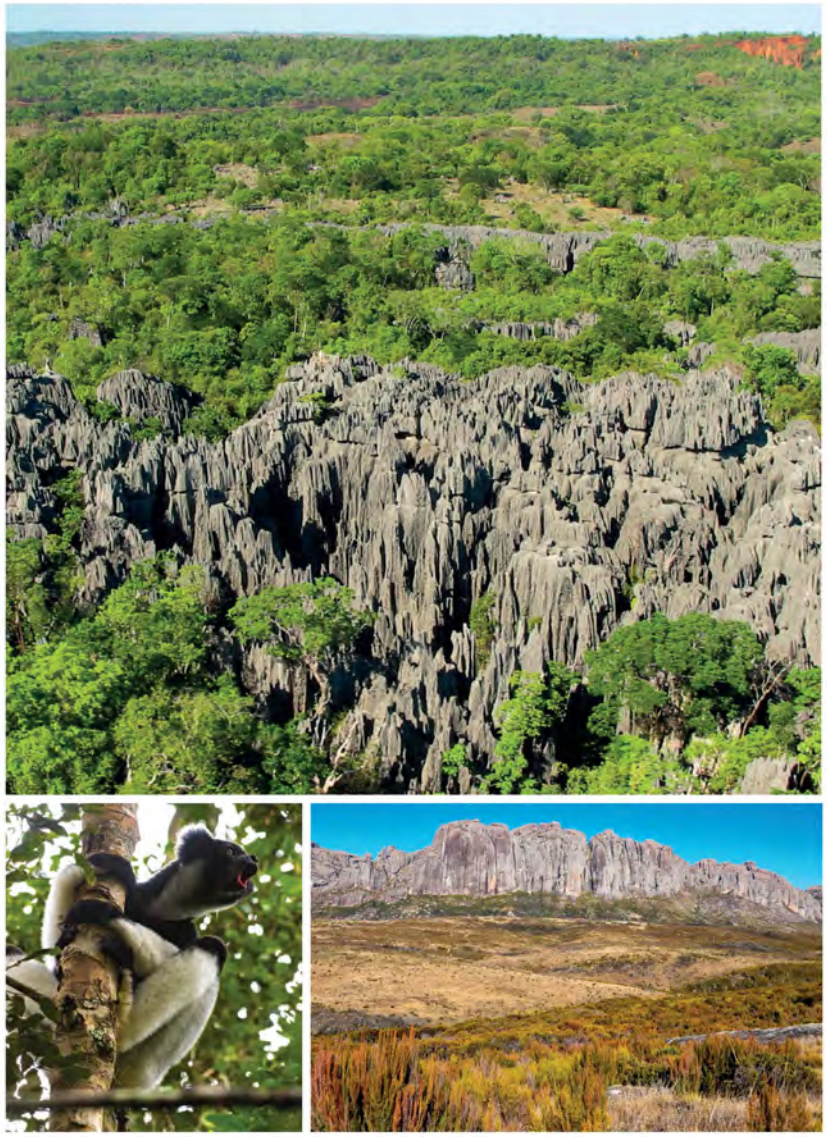
Pour plus d'informations pour obtenir des livres publiés dans cette série au cours de votre séjour à Antananarivo, veuillez contacter l'Association Vahatra : <associatvahatra@moov.mg> ou +261 020 22-27755 ; une carte du bureau de Vahatra peut être téléchargée sur http://www.vahatra.mg/planeng.html. Pour ceux qui souhaitent se procurer ces livres à l'étranger, nous pouvons suggérer de faire la commande en Europe auprès de NHBS (https://www.nhbs.com/shop/publisher/vahatra), Royaume-Uni ou en Amérique du Nord auprès de *University of Chicago* (https://press.uchicago.edu/ucp/books/publisher/pu3431914_3431915.html). Ces livres sont également disponibles dans des librairies d'Antananarivo, comme Il Etait Une Fois (+261 34 47 177 27), au-dessus de Leader Price, Ankorondrano ; Librairie Lecture & Loisirs (+261 20 22 325 83), dans le Complexe Tana Waterfront, Ankorondrano ; et au rayon livres chez Jumbo Score (+261 20 22 210 00), Ankorondrano.

Steven Goodman et Marie Jeanne Raherilalao

For further information on obtaining the books published in this series, please contact Association Vahatra in Antananarivo(associatvahatra@moov.mg or +261 020 22-27755; a map to the Vahatra office can be downloaded onhttp://www.vahatra.mg/planeng.html. For those who would like to purchase these books overseas, in Europe we can suggest ordering them via NHBS (https://www.nhbs.com/shop/publisher/vahatra), in the United Kingdom or in North American from The University of Chicago Press (https://press.uchicago.edu/ucp/books/publisher/pu3431914_3431915.html).The books are also available in local book shops in Antananarivo, such as Il Etait Une Fois (+261 34 47 177 27), above Leader Price in Ankorondrano; Librairie Lecture & Loisirs (+261 20 22 325 83), in the Tana Waterfront complex in Ankorondrano; and the book section at Jumbo Score (+261 20 22 210 00), Ankorondrano.

Steve Goodman and Marie Jeanne Raherilalao



LARGE-SCALE FIELD SURVEY OF THE ANDRAFIAMENA-ANDAVAKOERA PROTECTED AREA

As we have done for several decades, the start of the rainy season (November and December) marks the period that Vahatra scientists and associated colleagues and students commence the period for detailed biological inventories of poorly known forested areas on the island, often parks and reserves. This year was not different and the zone of intervention was the Andrafiamena-Andavakoera protected area in the north of Madagascar, an area of close to 74,000 ha (about 300 miles^2) that is largely biologically unknown, with the exception of primates.

In collaboration with Association Fanamby, the protected area manager, and funding from the Agence Française pour le Développement, the reconnaissance mission to pick three sites within the protected area was conducted by Steve in early November. The rest of the field team arrived in Ambilobe, the town closest to the first site on 15 November and with the

materials, food supplies, and equipment needed to conduct the field surveys. The group included botanists (Jacquis Tahinarivony, Alain Rasolonjatovo, and Laurent Gautier and Carlos Boluda from Geneva Herbarium and Botanical Garden), herpetologists (Achille Raselimanana and Fandresena Rakotoarimalala – Ph.D. student working at Vahatra, Sara Ruane from the Field Museum, and Arianna Kuhn from the Virginia Museum of Natural History), ornithologist (Marie Jeanne Raherilalao), small mammal specialists (Steve Goodman and Voahangy Soarimalala), bats (Steve Goodman and Cleasman Anthoni and Loita Razafindranosy – both Master's students at the University of Antsiranana), and primatologists (Patrick Rafalimanana and Rhynia Hanitriniana – Master's student at The University of Antsiranana). The team also included Rachel "Ledada" Razafindravo, who was responsible for organizing food, and a range of local assistants. The first locality was relatively remote and after arriving at the closest village to where a four-wheel drive vehicle could approach, it was a several hour walks to the study site; over 60 porters were engaged from the local village to get all of the baggage in and out.

To understand better the biodiversity and heterogeneity of the protected area, the three inventoried sites were in different types of forests, with sites

1 and 3 being moist semi-deciduous forest, and site 2, a dry deciduous forest on limestone and with *tsingy* formations. We are still working up the data and in some cases verifying specimen identifications, but important discoveries were made, for example more than doubling the known bat fauna of the protected area from five to 12 species. During this biological inventory, 43 species of frogs and reptiles were recorded of which 15 are new records for the site and including an exciting arboreal snake of the genus *Langaha*. There were several remarkable surprises, such as the first camp where Steve's tent being under a fossa (*Cryptoprocta ferox*) mating tree.

VAHATRA'S ECOLOGICAL RESTORATION PROJECT AT AMBOHITANTELY

The Ambohitantely Special Reserve, a few hours drive from Antananarivo, holds one of the last montane humid forests in the Central Highlands, a forest type that was formerly widespread across this vast geographic zone; these montane forests represent one of the most endangered vegetation formations on the island. A few decades ago, Ambohitantely protected area, managed by Madagascar National Parks (MNP), contained about 90 different forest blocks from minuscule parcels to those over 1200 ha, and separated from each other by grassland. This was an ideal setting to study the relationship between species richness in a given block and its surface area, and this aspect was examined for birds, small mammals, and amphibians. Over the past decades, the forest cover of the protected area has been drastically reduced, mostly associated with fires that sweep across the grasslands; these are set to renew pasture lands for cows, naturally started by lightning strikes, or acts of anarchy mostly against the state.

Over the past decades, scientific members of Vahatra, who are all field biologists specializing on land vertebrates, have worked in the protected area, and watched the natural forest habitat disappear. We decided that immediate actions were needed to save what remained. A botanist, Jacquis Tahinarivony (see above, New blood at Association Vahatra and the future of the organization), was engaged to spearhead the project and who has considerable experience with reforestation and ecological restoration. The different aspects Jacquis took under his wing included curbing the fire problem through a firebreak system, installing a large nursery to produce annually thousands of trees for planting, creating 10 sites to generate

compost for the restoration parcels, and ecological restoration of deforested areas including between forest fragments. The overall intent was to save this endangered forest and its associated flora and fauna from disappearing from the face of the earth. With funding from Save the Rainforest Sweden (Rädda Regnskog) for a two-year project that started in 2021, and a second phase in 2023, as well as a kind donation from the tourist company Madagascar Classical Collection, the following landmark accomplishments were made.

1) Firebreaks

Firebreaks are the most efficient manner to protect the remaining forests of Ambohitantely against the intrusion of grassland fires. In the context of this project, a considerable effort was made to repair and expand a firebreak system and to have this completely encircle the principal forest block. In 2020 and 2021, about 65 km of firebreak were constructed or repaired, all by hand, but one section in a zone with difficult topography remained incomplete. The system involves two parallel firebreak lines, each line about 8 m wide, and with a cleared zone of vegetation between them of about 25 m. At the end of the rainy season, the central area between the two firebreaks is the subject of a controlled burn, creating a band without vegetation of about 40 m, which is considered sufficiently wide to block the entry of grassland fires into the forest. All of this work was done by local people living in communities around the protected area, which for the most part are economically deprived, and provides important levels of income to these villagers. Further, their involvement in the creation and maintenance of the firebreaks, as well as other aspects of the general project, constitute a form of awareness of the need for and their contribution to forest conservation, for which they are proud.

Bushfire management remains a challenge for Ambohitantely. In collaboration with MNP and local community members, an additional 27.1 km of firebreak is currently being installed. This firebreak system is accompanied by surveillance activities during the dry season. Between June and October 2023, three firefighting intervention courses led by the Vahatra team were conducted with the intent of helping MNP and local villagers anticipate and stop the spread of fire into the protected area.

Illustrated here is the southern corner of the largest remaining forest block at Ambohitantely and surrounded by firebreaks. The white lines are firebreaks and where the upper vegetation and humus layer have been removed. In the lower left corner, a controlled burn-off is being conducted of the area between the firebreaks. This activity is performed yearly before the seasonal peak of grassland fires in the period between September and November and provides a good protection from fires spreading into the forests.

2) Biological Station

Over the past couple of years, under the guidance of Achille Raselimanana and Jacquis Tahinarivony, a small and simple station building was built at the site by a construction team composed mostly of local people; the station was inaugurated on 20 December 2022. This new structure has considerably facilitated logistics of scientists working in the protected area, including different ongoing Vahatra research projects; the ecological restoration project (see below); and storing equipment between visits. The building has three principal rooms, a kitchen and dining area that includes a set of bunkbeds, a laboratory area, and a dormitory area with two sets of bunk beds. The camping area just behind the station was refurbished and there are places for at least 10 tents. A system of solar panels have been installed at the station, which provides enough electricity for lighting and other uses, including running a water pumping system that brings water up from a nearby stream to a large 3000 liter reservoir next to the station.

A logistic problem for local villagers working with MNP and Association Vahatra at Ambohitantely is the 1-2 hour hike between their homes and the station. To make this round trip each day is both time-consuming and tiring. During the construction phase of the station, a building was erected to stock different supplies, and this has now been converted to a guesthouse for local workers, a place where they can eat and sleep. A separate outdoor kitchen was built to permit these people to cook.

The presence of the station will increase research activity at the site for Vahatra and non-Vahatra teams. Portions of the building are available for rent and the revenues go directly to MNP to maintain infrastructure at the site. In turn, the station will have the benefit of generating and increasing income opportunities for local people, including the purchase of food products, and engaging individuals for cooking, forest guides, porters, helpers, camp management, field assistants, long-term data monitoring, which in turn provides incentives for preserving the forest. These aspects are critical for the long-term success of conserving the remaining forest fragments of the protected area and in collaboration with local communities and MNP. Finally, it is very clear, at least on Madagascar, that with biological stations and associated presence of students and researchers, less illicit activities take place in the surrounding forest. Over the next year or so, further infrastructure equipment and other modifications will be made to the station and with the vision of having better functioning facilities for visiting researchers.

3) Reforestation and ecological restoration

Association Vahatra, through the efforts largely of Jacquis Tahinarivony and in collaboration with local people, have invested considerably in advancing a reforestation project at the site, with the ultimate goal being ecological restoration. More specifically, to extend the native forest surface area of the protected area and filling in gaps between existing separated forest parcels. The different aspects of this work are presented here.

A) Choice of planted tree species

Only species that exist in the natural forests of Ambohitantely have been used in the ecological restoration project.

B) Tree nursery

To date, Association Vahatra has installed about 1,420 m^2 (or 153,000 ft^2) of tree nursery growing beds, subdivided into three sections:

- Section A includes eight tree-growing beds, two germination boxes, and a compost pit. Each tree-growing bed measures 10 m x 1.2 m, with a capacity of about 1000 seeded pots. At the start of the project, this section was the initial nursery.
- Section B is composed of 12 tree-growing beds and five germination boxes. Each tree-growing bed can accommodate up to 1750 pots, the largest of which measures 15 m x 1.2 m.
- Section C accommodates four tree-growing beds, measuring 10 m x 1.2 m, with a total capacity of 4,000 pots; it is largely designated for growing what will become large forest trees.

In its current form, the nursery can produce up to 32,000 young plants per semester, or more than 50,000 young plants per year.

Nursery activities include those such as preparing soil and potting, and local villagers are responsible for transporting the pots to the transplanting parcels. A period of potting involves about 30 people, 70% of whom are women, and the process takes about 10 days to complete. In 2023, each potting phase involved about 400 people/days.

The soils surrounding the forested areas of Ambohitantely have been degraded mostly associated with the frequent passage of fires, which burns-off the organic material, followed by nutrient leaching associated with heavy rainfall. To remedy this problem and to stimulate rapid growth of planted trees, we have employed a composting process. The compost, is largely composed of different types of plant debris ground-up with a machine, mixed with quantities of organic fertilizer (cow dung), and watered once per month to speed-up decomposition. Each pit produces up to 48 m^3 (1700 ft^3) of compost every five or six months and gives an annual production of 960 m^3 (34,000 ft^3) per year. The use of compost enhances a high survival rate of transplanted plants and considerable subsequent growth, as well as its production a good source of economic opportunities for local communities.

C) Schemes for reforestation and ecological restoration

The Vahatra intervention zone extends over a total area of 335 ha and is located in the southern part of the protected area, specifically around the core area of the reserve. Around 120 ha, or 36% of the area, is largely intact natural montane forest, and 64% covered by degraded or secondary formations. Using in part GIS-technology with subsequent ground-verification, the degraded areas comprise 81 ha that was identified as having important potential for active ecological restoration activities and an additional 134 ha via assisted passive regeneration. The success of both techniques can only really be effective if threats, mostly fire, are controlled.

Assisted passive restoration focuses on the eradication of invasive species that impedes natural regeneration of seeds in the soil. It is a hand method employing machetes and axes, which is practiced in a continuous cycle to remove unwanted vegetation. In 2023, 25 ha of degraded formations have been treated using passive regeneration, mostly against *Dicraopteris linearis*, an invasive fern. Further, all of the 335 ha of the Vahatra intervention zone were cleared of introduced pine trees.

Using GIS technology and on site verification, the 81 ha zone of active restoration was subdivided into 11 different restoration plots according to topographical features, of which eight plots have been to date the subject of Association Vahatra interventions. These aspects advance based on stages and season. One intervention is the digging deep holes (0.8 m x 0.8 m x 0.8 m) where trees will be transplanted, and filling them several months in advance with organic compost. The next steps include planting, silvicultural maintenance, and monitoring the health and growth of trees. Before transplanting the young trees, we employ a matrix system of stakes next to the holes, the markers are painted with a color code, each color representing a tree species. This technique guarantees the correct placement of each species in a heterogeneous matrix and little confusion of what plants go where during the labor intense planting period.

D) Monitoring planted trees

A monitoring program was established to evaluate the characteristics of the restored habitats. The system in part employs SMART type tracking and using the KoboCollect platform. Data collection and management applications have been adapted to the objectives of ecological restoration.

These include around 10 variables aimed at describing the growth and health state of each planted individual, which provide the basis for a variety of activities (reinforcing restoration approaches; silvicultural interventions, such as soil aeration, pruning, and weeding; and mechanical control activities against invasive plants and pest insects). These data contribute significantly to improving management strategies, aimed at optimizing plant growth and health, thereby supporting the overall effectiveness of the ecological restoration program.

To date, active restoration has achieved a 90% success rate with respect of planted trees that survive the process. This is a rather a high rate as compared to most other reforestation projects at least on Madagascar where planting a considerable number of trees is the objective and survival rate is not taken into consideration. On average, several species reached a growth of 70 cm in height in one year and others up to 140 cm.

4) Broad overview

The concept of ecological restoration, established in the first phase of the project, remains the guiding aspect of the reforestation interventions of Vahatra at Ambohitantely. The major achievements in 2023 include an increase in production of young plants within the nursery center for transplanting, as well as augmenting the surface areas of the restoration plots. The care the Vahatra project takes to plant correctly trees, using compost to increase survival rates, and monitoring the trees is what separates our work from all other reforestation projects we are familiar with on Madagascar.

FIELD SCHOOL IN AMBOHITANTELY

In late October 2023, Association Vahatra held a field school at Ambohitantely and the new biological station (see above) was used for a range of different activities. During the field school, the participants were divided in several rotating groups, presented by different specialists and included plants (with an emphasis on the reforestation activities at the site and the planting of 2,500 trees), reptiles and amphibians, birds, small mammals, and bats; for the different animal groups there was a focus on aspects of ecology, capture, manipulation, and zoonotic disease research. The participants included two students and a post-doc from The University

of Free State (South Africa), a professor and student from The University of La Réunion, 12 students from Zoology and Animal Biology Department at The University of Antananarivo, and the five scientists from Association Vahatra. A series of seminars were also given during the field school in the lab space of the station. Most of the meals were served in a structure with open sides built by Vahatra some years back.

Field school activities included a standard inventory of two different forested zones, including the Jardin Botanique, where we have been studying small mammal population dynamics and the zoonotic diseases of these animals for several years, and the core zone associated with the Vahatra reforestation project (see above). At the latter site long-term monitoring transects were installed spanning the zone from largely intact forests to the restoration plots and beyond.

This style of field school serves several different important functions. Firstly, introducing the students to real hands-on activities outside of a classroom context, and allowing them to understand different aspects of conducting field research for a variety of different organisms. This constitutes a major step for their graduate studies by helping them to decide on the subject and group they will focus on. Secondly, on the side of Vahatra, field schools act as an important filtering process for the young Master's students to be invited to conduct their studies under the direction of a Vahatra scientist. After spending a couple of weeks with a group of students in a field school setting, based on their level of interest, curiosity, and intellectual capacity, it is evident which are the best candidates to receive the mentorship of Vahatra scientists. Four of the 12 Malagasy students that took part in the Ambohitantely field school will be invited in early 2024 to conduct their Master's research with Vahatra, and we are now searching for funds to cover the associated costs, including stipends, research costs, and duplication of their memoirs.

VOAHANGY'S VISIT TO DUKE UNIVERSITY

During the northern summer of 2023, from 5 May to 30 June, Voahangy Soarimalala was a visiting researcher at Duke University in the Global Health Institute and in collaboration with Charlie Nunn of that university. In the context of this collaboration, Association Vahatra has several different projects financed by National Institute of Health and the National Science Foundation associated with zoonotic diseases in the Marojejy area of

Voahangy giving a seminar at Duke University. (Photo by Charlie Nunn.)

northeastern Madagascar (see below, Current Vahatra projects and grants). The principal purposes of Voahangy's visit were to interact with Charlie and members of the project team on refining databases, working on manuscripts, as well as new grant proposals. She also made a presentation at the Duke Evolutionary Medicine Summer Institute on Madagascar, well received by the attendees. This was also a period she was able to quietly work on her Habilitation à Diriger des Recherches (HDR) memoir, that will be presented in the near future at The University of La Réunion.

STEVE GOODMAN'S VISIT TO CAPITOL HILL IN WASHINGTON, D.C.

For three days in the first portion of July 2023, Steve Goodman was invited to Capitol Hill in Washington, D.C., for different meetings, and accompanied by Charles Katzenmeyer, Vice President for Institutional Advancement at the Field Museum, and Anne Metcalf, the museum's federal lobbyist based in Washington, D.C. The two principal purposes of the visit were to present information on the activities of the Field Museum staff concerning scientific research and capacity building programs of nationals in the different countries museum staff work, as well as underlining conservation priorities on Madagascar and the current dire situation of the island's remaining forests. Steve gave talks and briefings at the Bureaus of African Affairs and Oceans and Environment (US Department of State), House Committee on Natural Resources (US Congress), and conducted meetings with Congressman Mike Quigley and the staff of Congressman Dick Durbin and Congresswoman Tammy Duckworth. He was also interviewed by Dino Grandoni at The Washington Post.

From left to right, Charles Katzenmeyer, Anne Metcalf, and Steve Goodman in the entrance hall of the State Department. (Photo by Anne Metcalf.)

STEVE GOODMAN RECEIVES FULBRIGHT GRANT

Each academic year, the U. S. Department of State and Fulbright Program selects one candidate to fill the post of Fulbright U.S. Scholar for Madagascar. Steve Goodman applied and received the grant for 2023-2024. His specific interventions in the context of the grant, in collaboration with other colleagues at Vahatra, will be working with graduate students (Master's and Ph.D.) at The University of Antananarivo associated with field schools, and seminars on the use of bibliographic resources, writing scientific papers, and grant proposals. Part of his activities will include working with graduate students that have recently finished their theses and young faculty members, specifically to help them finalize manuscripts for submission to international scientific journals. The plan is to work with them one-on-one to help refine papers before the submission stage. Funds from the grant were also used to finance the October 2023 field school at Ambohitantely (see above, Field school in Ambohitantely).

NEW WEBSITE FOR ASSOCIATION VAHATRA

The current bilingual (French and English) website of Association Vahatra (http://www.vahatra.mg/indexeng.html) was created by Madame Malalarisoa Razafimpahanana nearly 15 years ago and she has maintained it over years as site webmaster. In the interim period, the format and style of websites have evolved considerably and the Vahatra site is notably old fashion and

not interactive as in more modern sites. Through the interventions of a Malagasy student, Rotsy Rafamantanantsoa, studying communications at a private university in Antananarivo, and in collaboration with Malalarisoa, the website has been updated and the new version will be on line in 2024. This worked served as a sort of thesis project for Rotsy to complete a higher degree. The new website will have a Secure Sockets Layer (SSL) certificate that ensures its authenticity and resolves different security issues. We thank Rotsy and Malalarisoa for all of the time and effort they have put into this project and producing a new and modern website.

CURRENT VAHATRA PROJECTS AND GRANTS

Duke University / National Institute of Health and the National Science Foundation – land use in the SAVA Region and global health challenges

This project is associated with grants awarded to Duke University, with Dr. Charles Nunn as the Principal Investigator, and that started in 2019 with financing from the Ecology and Evolution of Infectious Diseases (EEID) program, a joint initiative between the National Institute of Health and the National Science Foundation (NSF). This large-scale project aims to understand the linkages between diseases circulating in the foothills of the Marojejy Massif in northeastern Madagascar across a habitat mosaic of native forest, agricultural areas, and near villages where endemic and introduced (including domestic) animals may act as reservoirs and the source of transmission. Association Vahatra is one of the many collaborating organizations and our contribution is associated with the capture of bats, endemic and introduced small mammals, and collecting the needed samples for the zoonotic disease analyses. After nine field sessions, which included a considerable effort for the multi-disciplinary team, the field studies for the first phase ended in late 2021. An extension was received from the granting agencies for some follow-up work at two of the study sites, which took place in early 2022.

Subsequently, additional funding was received from NSF (EEID program) and the project enters into a new phase of four years. Dr. Toky Randriamoria, a post-doc at Vahatra, is responsible for the field sampling and seconded by Voahangy and Steve. Further, an assistant, Rianja Nantenaina Randriamifidisoa, was engaged to reinforce the group, together

with numerous local collaborators from northern Madagascar and villages neighboring Marojejy. Numerous other specialists in different research domains and from different institutions in the USA, France (La Réunion), Israel, and Singapore, are studying multiple facets of local circulating zoonotic diseases and parasites, and using a range of different advance techniques, including molecular and modeling tools. This research project aims to study novel methods to predict disease spread, particularly different infectious diseases being important human health concerns on Madagascar.

KOICA / UNESCO / Madagascar National Parks / Association Vahatra. BIOCOM II, Restauration Patrimoine mondial: Forêts humides de l'Atsinanana

The moist evergreen forests of the eastern region of Madagascar are home to an exceptional diversity of plants and animals and these ecosystems play a fundamental role in maintaining biodiversity and ecological processes. The

integration of several protected areas some years into UNESCO's network of World Heritage Sites and known as "The Rainforest of the *Atsinanana*" [*atsinanana* in Malagasy means "east"], was a crucial step in supporting efforts to preserve their Outstanding Universal Values. Unfortunately, these ecosystems for different economic and cultural/political reasons are often subject to anthropogenic pressures. The 2009 political crisis on Madagascar, a period of near total anarchy in certain areas of the island, allowed people to enter massively protected areas for illegal exploitation of rosewoods, gold panning, charcoal production, and to acquire new agricultural lands via deforestation. The integrity of the biological diversity of The Rainforest of the *Atsinanana* and their Outstanding Universal Values have been seriously threatened. The magnitude of the situation was such that UNESCO's World Heritage Committee decided in 2010 to classify The Rainforest of the *Atsinanana* in the World Heritage list of sites "In Danger". The purpose of the Phase I of the BIOCOM project and financed at the level of several million US dollars by the Korea International Cooperation Agency (KOICA) is to rectify the situation through several different approaches: economic development, public education, and studies of the regional biota.

This tri-partite project is with UNESCO-Madagascar, Madagascar National Parks (MNP), and Association Vahatra. The role of Vahatra in the project is to examine patterns of biotic diversity at three focal sites, all protected areas through biological inventories, with an emphasis on change through time. Vahatra scientists and students surveyed several of these sites some 20-25 years ago and comparisons of possible change at the scale of several decades are possible, and if such changes have taken place, to determine the probable causal reasons. BIOCOM I is about to reach its end. Together with UNESCO and MNP, we are in the process of working with KOICA for a BIOCOM II project, which we hope will start in late 2024 or early 2025.

Save the Rainforest Sweden (Rädda Regnskog) project at Ambohitantely

The Réserve Spéciale d'Ambohitantely is one of the last remnant Central Highland montane forests on the island and it is of high priority to conserve. This fragile and vulnerable relict forest is home to a relatively rich and unique biodiversity ranging from plants, invertebrates, and vertebrates. Since 2007, Association Vahatra has organized at the site regular research missions, field schools or forms of ecological and biological training for students, as well as for conservation agents and managers.

Over the past decades, between the anthropogenic pressures of wild grassland fires in the Central Highlands, which enter into the remaining natural forest, the number of forest parcels at Ambohitantely and their surface areas have been dramatically reduced or completely disappeared. In a collaborative project between Association Vahatra and Madagascar National Parks, the organization responsible for the management of the protected area, and with funding from Save the Rainforest Sweden, we have taken steps to try to conserve Ambohitantely and with the active involvement of local villagers. In 2023, Save the Rainforest Sweden provided additional funding for phase 2 of the project for a 12-month period. The Ambohitantely project is discussed in detail in an earlier section of this report.

Developing effective rodent control strategies to reduce disease risk in ecologically and culturally diverse rural landscapes financed by Global Challenges Research Fund (GCRF), United Kingdom Research and Innovation (UKRI)

This project, named REDROZ (Reduce Rodent Zoonosis), aims at reducing the risk of rodent-borne infections in Africa, including Madagascar, by increasing knowledge and expertise needed to develop holistic rodent management applicable for local conditions and at the community level. Research is designed to answer whether sustainable community-based rodent management can reduce risks of disease transmission and improve overall human health and wellbeing. Multidisciplinary activities conducted in Tanzania and Madagascar, focus on three rodent-borne infections (leptospirosis, plague, and rickettsiosis) and proceed in two different stages. First, we fill-in knowledge gaps, and deepening our collaborations with communities and stakeholders, allowing us to co-develop rodent control that are holistically evaluated in the second stage. We are developing a spatially realistic modelling tool to explore likely responses of rodent populations and rodent-borne infections to localized rodent control. Analyses of rich archived datasets and new experimental trials are being used to parameterize models and test output.

In Madagascar, the study is in collaboration with Institut Pasteur de Madagascar (IPM) and Association Vahatra. In early 2023, a meeting was held at IPM with numerous national and international researchers under the theme “developing effective rodent control measures for introduced rodents”. In the first stage, the project focuses on work in 12 villages within Analavory/Miarinarivo commune (Central Highlands to the west of Antananarivo), where villages act as replicates, experimentally determining how rodent movements and the prevalence of rodent-borne infections are impacted by control. We use a range of qualitative and quantitative social science techniques to produce a deeper understanding of community practices, behavior, and understanding around relevant issues of health, hygiene, and pest management, and work with stakeholders from health, agriculture, and environment spheres to understand their perceptions, policies, and support services. In the second stage, we are conducting a comparative trial in 12 intervention - non-intervention village pairs (n=24), co-developing and trialing rodent management strategies over one year, and monitoring changes to human practices and attitudes, rodent damage, disease within the rodent population (i.e. leptospirosis, plague, and rickettsiosis), human health indicators and time/financial inputs. Collaborative workshops

are designed to facilitate cross-country comparisons and exchanges between the Ph.D. students from Madagascar and Tanzania. A student from The University of Antananarivo, Todisoa Radovimiandrinifarany, is integrated in the project in the context of his Ph.D. research, and three students from The University of Fianarantsoa have taken part in the fieldwork in the context of capacity building.

SCARIA (Towards sustainable community-based mitigation of rodent issues in African cities)

Rodents are implicated in an estimated 400 million worldwide annual zoonotic infections, and associated with massive crop and stock destruction, thus representing a major threat to both health and food security. Farmers following an Ecologically Based Rodent Management (EBRM) system have made progress in rural tropical areas, especially through field trials and associated with new monitoring techniques. This management scheme relies

on a good knowledge of the biology of pest rodents and community-based sustainable modifications of the environment in order to decrease rodent populations. However, large gaps in knowledge remain about urban rodents that are abundant and highly deleterious to the lives of millions of city inhabitants, especially in poor and rapidly expanding settings. Accordingly, on the basis of recent scientific studies and WHO expert syntheses, there is an urgent need for interventional research on rodent-associated issues in cities, especially in developing countries.

SCARIA is a sustainability science project that explicitly aims at addressing such challenges via pathways to sustainable, community-based mitigation of rodent impacts in four African countries (Benin, Ethiopia, Niger, and Madagascar), specifically focusing on city slum settings. To achieve this, a panel of academics, public services, social enterprises, local NGOs, associations, and governmental representatives pursue two main objectives: (1) to build and animate multi-stakeholder local working groups in four urban living labs who rely on both scientific and local knowledge to formalize an urban EBRM adapted approach to each local socio-economic, cultural, and environmental context; (2) to produce baseline data (cartography; rodent diversity, mobility, and spatial distribution; zoonotic pathogens in rodents and humans; socio-economic impacts of rodents; project perception by the inhabitants) in all four pilot sites to provide socio-environmental proxies for future urban EBRM implementation and evaluation. For Madagascar, Voahangy Soarimalala, Steve Goodman, and student assistant from Institut des Sciences et Techniques de l'Environnement, Université de Fianarantsoa, are involve on this project.

BEPREP Project

BEPREP, which stands for Best Practices for Biodiversity Recovery and Public Health Interventions, aims to elucidate the role of undisturbed and restored biodiversity in mitigating threats to health security from zoonotic and vector-borne diseases along the infect-shed-spill-spread cascade, in order to identify best practices of nature restoration, including rewilding. The design of this research project, funded by the European Commission, is to identify and characterize these aspects in natural forest, degraded,

One of the study sites in the BEPREP project, Ankafobe in the Central Highlands, is a montane forest fragment that is the subject of a reforestation project. Here the graduate student engaged in the project, Salohy Ravelotafita, is shown at the forest edge. (Photo by Voahangy Soarimalala.)

and restored habitats, using live-capture traps to examine the presence and population dynamics of small mammals. Research designed for Africa, including Madagascar, includes the collection of biological samples from possible small mammal reservoirs and invertebrate vectors to characterize novel and established pathogen networks. The traits and interactions of pathogens, vectors, and reservoirs that contribute to increased disease risk and spread to test if ecosystem restoration by rewilding can recover biodiversity and mitigate disease risk (e.g., by reducing population size of introduced rodent reservoirs). Study sites on Madagascar are Ankafobe in the Central Highlands, a relict and very small montane humid forest, and Ankarabolava and Agnakatrika in the southeast, both lowland moist evergreen forest fragments. A Ph.D. student from The University of Antananarivo, Salohy Ravelotafita, is integrated in this project in the context of her thesis.

MEETINGS AND CONFERENCES IN 2023 ATTENDED BY ASSOCIATION VAHATRA

As the world of travel gets back to normal after the COVID-19 interruptions, it is now possible for students and researchers to more easily attend international meetings. In 2023, Voahangy Soarimalala and Steve Goodman, as well as a Ph.D. student at Vahatra, Todisoa Radovimiandrinifarany, attended a meeting in Namibia, the 14th African Small Mammal Symposium. Presentations from researchers associated with Vahatra included:

1. Voahangy with Toky Randriamoria, a post-doc at Vahatra, entitled "Distribution and abundance of introduced small mammal in Madagascar."
2. Steve, in collaboration with Voahangy and Ntsoa Rasolobera, a Ph.D. student at Vahatra, "Patterns of elevational distribution of small mammals on the Marojejy Massif, NE Madagascar: two repeated transects 20 years apart."
3. Voahangy was a co-author together with her colleagues associated with the REDROZ project (see above under Current Vahatra projects and grants), "Can intensive community-led trapping reduce *Rattus rattus* abundance inside houses in a plague focus?"
4. Todisoa made a presentation with Voahangy "Movement of introduced rodents in Analavory, Itasy, Madagascar".

Some of the participants working on Malagasy small mammals that made presentations at the 14th African Small Mammal Symposium in Namibia (from left to right): Soanandrasana Rahelinirina, Steve Goodman, Voahangy Soarimalala, Gauthier Dobigny, Minoarisoa Rajerison, and Todisoa Radovimiandrinifarany.

In October 2023, the Graduate School at the University of Antananarivo organized a symposium under the title "Colloque des sciences de la vie et de l'Environnement" that was attended by Achille and Marie Jeanne. A number of presentations were made by Vahatra students, which included:

1. Fandresena Rakotoarimalala – Processus écologiques et évolutifs : Implications pour la conservation des caméléons des vestiges de forêts du Haut Plateaux de Madagascar [Ecological and evolutionary processes: Implications for the conservation of chameleon forest remnants in the Central Highlands of Madagascar].
2. Todisoa Radovimiandrinifarany – Etude des mouvements des rongeurs exotiques dans la commune rurale d'Analavory Itasy, Madagascar [Study of movements of introduced rodents in the commune rurale d'Analavory Itasy, Madagascar].
3. Tamby Nasaina Ranaivoson – Diversité des micromammifères terrestres suivant un gradient de perturbation dans le massif de Marojejy et les zones dégradées avoisinantes [Diversity of terrestrial small mammals along a disturbance gradient transect on the Marojejy Massif and surrounding degraded areas].

Fandresana won the prize for the best student oral presentation at the meeting. We extend our congratulations to her for this achievement.

PERSON IN FOCUS

Madame Sabrina Raharinirina

Sabrina is originally from Antalaha, a town of about 35,000 people located in the northeast of Madagascar. It is famous at a world scale for the quality of vanilla produced locally. She did her primary, secondary, and high school education in Antalaha. After graduating from high school in 2005,

she came to Antananarivo to continue her studies at The University of Antananarivo, where she majored in business management. She obtained her bachelor's degree in 2009 and master's degree in 2011 in the field of Management Science. She joined Association Vahatra in October 2015 as the Administrative and Financial Manager, replacing in part the retiring Madame Malalarisoa Razafimpahanana; Sabrina still holds this post. She is responsible for the financial management of the association and all internal and external administrative aspects. Subsequently, she also followed advanced training in Management, Financial Management, and Leadership at a well-known business school in Antananarivo. Sabrina is the person with their finger on the pulse of Vahatra activities. When the scientific members of Vahatra are in the field and not contactable, she manages a wide variety of activities and responsibilities on her own. We wish to underline that her professionalism and devotion to Vahatra is at a high level and we count on her for a range of different management and administrative aspects. She lives in Antananarivo within a relatively short walking distance to the Vahatra office and with her 11-year old son, an avid soccer player.

WITH A SPECIAL THANKS

We would like to give a special thanks to a number of individuals that have financially supported different Vahatra projects in 2023, including the advancement of Malagasy graduate students and a range of other activities, such as the new "Ecotourism guides to protected areas" series. The list is ordered alphabetically by family name:

- Robert Crawford
- Ellis Goodman Family Foundation
- Paul Goodman
- Gail & Bob Loveman
- Madagascar Classic Collection
- Michael and Tanya Polsky
- Abigail Ross
- Bob & Charlene Shaw
- Jai Shekhawat
- Adele Simmons

ACTIVITIES OF VAHATRA SCIENTISTS DURING 2023

Members of the Vahatra scientific staff were involved in a variety of undertakings, which are summarized below by month. Our intention is not to be exhaustive with these details, but to present a range of the different activities members are involved.

January

- Jeanne was occupied with exams and teaching activities at The University of Antananarivo, as well as the preliminary report concerning a biological inventory in the Parc National d'Andohahela carried out in the context of BIOCOM I project of the UNESCO (see above under Current Vahatra projects and grants). She worked on the penultimate version of a Master's memoir of one of her students, as well as with several other students advancing on their memoirs. Together with Steve, she advanced on the ecotourism guide for the protected areas of Mantadia and Analamazaotra.
- Voahangy took an active role of a REDROZ and NIH/NSF-Duke projects (see above under Current Vahatra projects and grants). She was also occupied this month with teaching activities and exams at The University of Fianarantsoa. Together with Steve, she worked on the Master's memoir of a student studying small mammals at Ambohitantely. She also was occupied organizing the logistic and administration aspects for fieldwork next month at Ranomafana National Park.

- Achille served as a jury member presented at The University of Antananarivo. Achille was also occupied with teaching activities and exams at the university. He advised two Ph.D. students from The University of Toliara and from The University of Antsiranana associated with research design and thesis content.
- Jacquis and Ledada dedicated approximately 12 days during the month to tree planting in a restoration plot at Ambohitantely. The balance of the month Jacquis devoted to organizing the herbarium packets collected during the expedition to Andohahela in late 2022 as part of the BIOCOM I project (see above under Current Vahatra projects and grants).
- In early January, Steve was at the Field Museum in Chicago to present his new book, *The natural history of Madagascar* (see above under Presentation of *The new natural history of Madagascar* at the Field Museum). The balance of the month he worked on different manuscript projects and with graduate students on their memoirs and theses.

February

- Jeanne worked on an article concerning the bird communities of the Marojejy Massif, as well as teaching at The University of Antananarivo. She served as a committee member for one Master's memoir and one Ph.D. thesis.
- Voahangy and Steve conducted fieldwork in the Ranomafana National Park and resampled a site they were at in 2000 to evaluate possible changes through time in the small mammal fauna.
- Achille continue his teaching activities and for a good portion of the month, he was in the field at Anjozorobe with a Ph.D. student working through Vahatra.
- Jacquis continued with different tree planting activities at Ambohitantely, taking advantage of the rainy season. He also went to Marojejy to conduct botanical surveys of the different small mammal study plots in the context of the NIH/NSF-Duke project (see above under Current Vahatra projects and grants).
- A large-scale event was organized by Vahatra at the Académie Malgache in Antananarivo, where Steve presented *The new natural history of Madagascar* to the national scientific and conservation community. The event was also attended by the US Ambassador to Madagascar and covered by local media and television. Also associated with the book, Steve was interviewed on two occasions during the month by US television. Before heading to the field with Voahangy and several visiting scientists, he presented two lectures to visiting American students from the School for International Training.

March

- Jeanne taught at The University of Antananarivo and served on a Ph.D. thesis committee. She conducted data analyses associated with bird research, continued with the writing and editing of the report to UNESCO associated for work at Andohahela, and started with the exam period for university students. With Steve, she edited articles for the Marojejy monograph to be published in *Malagasy Nature*.
- Voahangy continued with her contribution to the REDROZ project at Analavory (see above under Current Vahatra projects and grants). She also was busy this month with teaching activities and exams at The University of Fianarantsoa. Together with Steve, she completed the fieldwork at Ranomafana in the first portion of the month.
- As a member of the Ecole Doctorale-Sciences de la Vie et de l'Environnement, Faculty of Sciences, The University of Antananarivo, Achille spent a considerable amount of time this month evaluating proposals from new Ph.D. candidates. He also served as a Ph.D. review commission member.
- Jacquis concentrated a portion of the month on analyzing and processing data related to the flora and vegetation of Andohahela, while concurrently

drafting the report for UNESCO. He was also at Ambohitantely for two weeks, where he worked on aspects of tree planting and repotting of seedlings.

- After finishing fieldwork in Ranomafana, Steve made a presentation at the Alliance Français in Fianarantsoa on the extinct Holocene ecosystems and animals. He also gave a talk during the month at the American Corner, The University of Antananarivo.

April

- Jeanne continued editing submitted scientific papers for the next issue of *Malagasy Nature*, as well as a new book in the protected area series.
- Voahangy was occupied with coursework at The University of Fianarantsoa. She was engaged in different aspects of a national stakeholder workshop associated with the REDROZ project (see above under Current Vahatra projects and grants). Together with Steve, she attended a two-day meeting at The Institut Pasteur de Madagascar on problems associated with introduced rodents on the island.
- Achille was solicited to give classes at The Veterinary School, University of Antananarivo. He also worked with several of his students on the design of their research proposals.
- A report was completed on Vahatra activities at Ambohitantely, providing Jacquis the opportunity to highlight the accomplishments of the project under his leadership. He also conducted different herbarium studies on the plants collected at Andohahela, which will result in a checklist of the protected area's flora.
- Steve spent a portion of the month leading a tour of northern Madagascar with a donor group from the Field Museum. Their visit ended at the Vahatra office in Antananarivo and the chance for these individuals to meet past and current students working with the association. As mentioned above, these different individuals made generous donations to Vahatra and for the most part to support Malagasy graduate students.

May

- Jeanne and Steve continued writing and the editing of the Marojejy monograph, as well as a new book in the protected area guide series. She served as a Ph.D. thesis committee member for a student from The University of Antananarivo.
- During this month, Voahangy left Madagascar for a visit to Duke University as a visiting scholar and at the invitation of the Duke Global Health Institute (see above under Voahangy's visit to Duke University).
- Achille attended thesis commission meetings to evaluate the progress of three Ph.D. candidates, particularly with respect to their research activities.
- Jacquis devoted the majority of his time to integrating feedback from reviewers for his three contributions to the upcoming Marojejy monograph. Simultaneously, he, along with Achille, initiated electrical installation and water supply works for the biological station at Ambohitantely.
- Steve and Voahangy attended a meeting at Duke University that included all of the collaborating organizations, including Vahatra, in the NIH/NSF project under the direction of Charlie Nunn of that university.

June

- Jeanne continued different editing projects. Together with Steve, she was a jury member of a Ph.D. thesis and a master's memoir. She worked with Voahangy on the concept paper for the BIOCOM II project (see above under Current Vahatra projects and grants).
- Voahangy continued her activities at Duke University with her collaborators. She also had time to work on her HDR thesis.
- Achille spent portions of the month writing, commenting, and editing different manuscripts co-authored with other scientist colleagues.
- Jacquis, Achille, and Steve accompanied a group from UNESCO and The University of Free State (South Africa) for a visit to Ambohitantely. This visit provided an excellent opportunity to show case the ecological restoration activities carried out by Vahatra. These interactions where the basis of discussions with Vincent Clark, Director of the Afromontane Research Unit, University of the Free State, to establish an MOU with Vahatra, particularly with respect to work at Ambohitantely. Concurrently, Jacquis continued his role in supervising the work of two Master's students from The University of Antsiranana, with a specific focus on the ecological restoration of Montagne des Français.
- In the middle of the month, Steve left Madagascar for his annual northern summer visit to the Field Museum in Chicago. This was associated with different research and manuscript projects, as well as to purchase materials for Association Vahatra for the upcoming field season.

July

- Jeanne continued working on the Andohahela report for UNESCO, as well as different teaching activities at The University of Antananarivo.
- Voahangy returned to Madagascar and was occupied with coursework at The University of Fianarantsoa. She also spent time developing the terms of reference and budget for the BEPREP project at Ankafobe and Ankarabolava-Agnakatrika (see above under Current Vahatra projects and grants). Voahangy continued to contribute different aspects to the NIH/NSF-Duke and REDROZ projects. She organized a group meeting of the urban population living near Ankasina in Antananarivo in the context of the SCARIA project (see above under Current Vahatra projects and grants).
- Jacquis, Achille, Sabrina, and Steve formulated a proposal submitted to the Critical Ecosystem Partnership Fund to support ecological restoration activities at Ambohitantely. Additionally, Jacquis and Achille traveled to Anjozorobe to obtain data on chameleon habitat and community structure in the context of the Ph.D. work of a Vahatra student.

- Steve went to Capitol Hill in Washington, D.C., for a couple days of meetings and presentations with congress members and different committees (see above under Steve Goodman's visit to Capitol Hill in Washington, D.C.). He also took place in a meeting at the Field Museum with curators from The Royal Ontario Museum in Toronto that are developing an exhibit on the Indian Ocean history, culture, and biodiversity.

August

- Jeanne continued with the editing of the Andohahela report for UNESCO, as well as commenting on two Master's memoirs of Vahatra students. Together with Malalarisoa Razafimpahanana and Steve, Jeanne worked on the page proofs for the Marojejy monograph to be published in the next issue of *Malagasy Nature*.
- Voahangy spent portions of the month on different activities associated with her responsibilities at The University of Fianarantsoa. In the context of the SCARIA project and in collaboration with Institut Pasteur de Madagascar (see above under Current Vahatra projects and grants), she carried out a workshop at Ankasina (urban Antananarivo) on problems of introduced rodents.
- Achille and Steve visited a site under the direction of Ecovision, between the Analamazaotra and Mantadia protected areas, for a reconnaissance of the Kalonoro Forest in the context of the proposed BIOCOM II project (see above under Current Vahatra projects and grants), specifically to understand better their local activities concerning forest ecological restoration.
- At Ambohitantely, Jacquis diligently oversaw the installation and maintenance of firebreaks. Concurrently, he and Achille successfully completed the final touches of the biological station and additional camping sites.
- In the first portion of the month, before his return to Madagascar, Steve attended a meeting at the Lincoln Park Zoo in Chicago about a collaborative project in the Mantadia National Park in eastern Madagascar. In late August, he returned to Paris to work in the Muséum national d'Histoire Naturelle.

September

- Jeanne and Steve worked together on finalizing a new issue of *Malagasy Nature*, a monograph on the Marojejy Massif. Jeanne also gave courses at The University of Antananarivo. Together with Steve, she was a committee member of a Ph.D. thesis of a Vahatra student.
- Voahangy and Steve attended the 14th ASMS in Swakopmund, Namibia (see above under Meetings and conferences in 2023 attended by Association Vahatra). Upon returning to Madagascar, she was busy organizing the logistic and administration aspects for an upcoming field school in Ambohitantely.
- Achille with his colleagues at The University of Antananarivo spent considerable time to prepare a symposium organized by the Ecole Doctorale (see above under Meetings and conferences in 2023 attended by Association Vahatra). Jacquis began analyzing the growth monitoring data of individuals and species planted in the restoration plots at Ambohitantely, which included establishing a spatial database.

October

- Jeanne worked on the memoir of a Master's student working with her at Vahatra.
- Voahangy carried out a reconnaissance mission in the Ankafobe Forest in the context of BEPREP project (see above under Current Vahatra projects and grants). She also took an active role in the NIH/NSF-Duke project at Marojejy.
- From 10 to 13 October, Achille and Jeanne took part in the scientific symposium under the name "Colloque des Sciences et la Vie et de l'Environnement" organized by the Ecole Doctorale at The University of Antananarivo. Achille was one of the moderators during the meeting.

- All Vahatra scientific members were involved in a biological inventory and field school in the Ambohitantely protected area between 22 and 30 October (see above under Field school at Ambohitantely). They shared their knowledge with students, demonstrating various methods for characterizing habitats and documenting aspects of faunal communities.
- In the first portion of the month, Steve was in the Kirindy (CNFEREF) forest in central western Madagascar together with Riana Ramantsalama, an Alexander von Humboldt post-doc at the German Primate Center in Göttingen and former Vahatra Ph.D. student. The purpose of the visit was to study circulating viruses in the local native and introduced mammal community.

November

- Jeanne and Steve took part as jury members of the Ph.D. defense of a student working with Vahatra.
- Voahangy was busy organizing the logistic and administration aspects for biological inventory in Andavakoera-Andrafiamena (see above under Large-scale field survey of the Andrafiamena-Andavakoera protected area). She also attended a meeting at Analavory in the context of REDROZ project (see above under Current Vahatra projects and grants).
- During the latter portion of this month to the second week of December, the five scientific members of Vahatra took part in a biological inventory of the Andavakoera-Andrafiamena protected area in northern Madagascar (see above under Large-scale field survey of the Andrafiamena-Andavakoera protected area).
- In the first portion of the month, Steve left for the north to conduct the reconnaissance mission to pick the three survey sites in Andrafiamena-Andavakoera and then joined the group arriving from Antananarivo to start the fieldwork.

December

- The team came out of the field from the Andavakoera-Andrafiamena survey on 9 December and the same day had meetings in Antsiranana with the protected area manager (Fanamby) and the local representative of the Minister of Environment, Agence Française de Développement,

and colleagues from The University of Antsiranana. The team returned to Antananarivo in mid-December.

- Jeanne worked on the revisions of a Master's memoir.
- Achille traveled to Ambohitantely to join a Master's student working on amphibian ecology, also helping with data collection and identification of some species.
- Jacquis visited Ambohitantely to support the habitat descriptions for some work on amphibians, which is part of the work of a Master's student at Vahatra.
- Steve started in a detailed manner writing a new book on the bats of Madagascar.

VAHATRA SCIENTISTS TAKE PART IN THE GOVERNING OF SCIENTIFIC RESEARCH AND CONSERVATION ACTIONS ON MADAGASCAR

A special committee has been reestablished by the Malagasy Government that evaluates research permit requests based on proposals submitted by national and international researchers for work on Malagasy biodiversity. This committee known as "Commission ad'hoc Faune et Flore/Comité d'Orientation de la Recherche Environnementale" (or CAFF/CORE) holds monthly meetings to assess submitted research proposals. Achille and Voahangy take an active role as committee members. In the context of the BIOCOM/UNESCO project (see above under Current Vahatra projects and grants), Voahangy is a member of the committee scientific and director of the project. Jeanne was solicited to be a member of the "Conseil Consultatif du WWF" (World Wide Fund for Nature, Madagascar).

NEW SPECIES DESCRIBED IN 2023 WITH IMPLICATION OF VAHATRA SCIENTISTS

One of the direct results of the biological inventories conducted by Vahatra and associated collection of specimens, is the discovery of species previously unknown to science. In 2023, Vahatra scientists were involved in the descriptions of the following new species from Madagascar.

Englert, M. C., **Goodman, S. M.** & Apanaskevich, D. A. 2023. Description of a new species of *Ixodes* Latreille, 1795 (Acari: Ixodidae), parasite of shrew tenrecs (Afrotheria: Tenrecidae) and rodents (Rodentia: Muridae) on Madagascar. *Systematic Parasitology*, 100: 745-750.

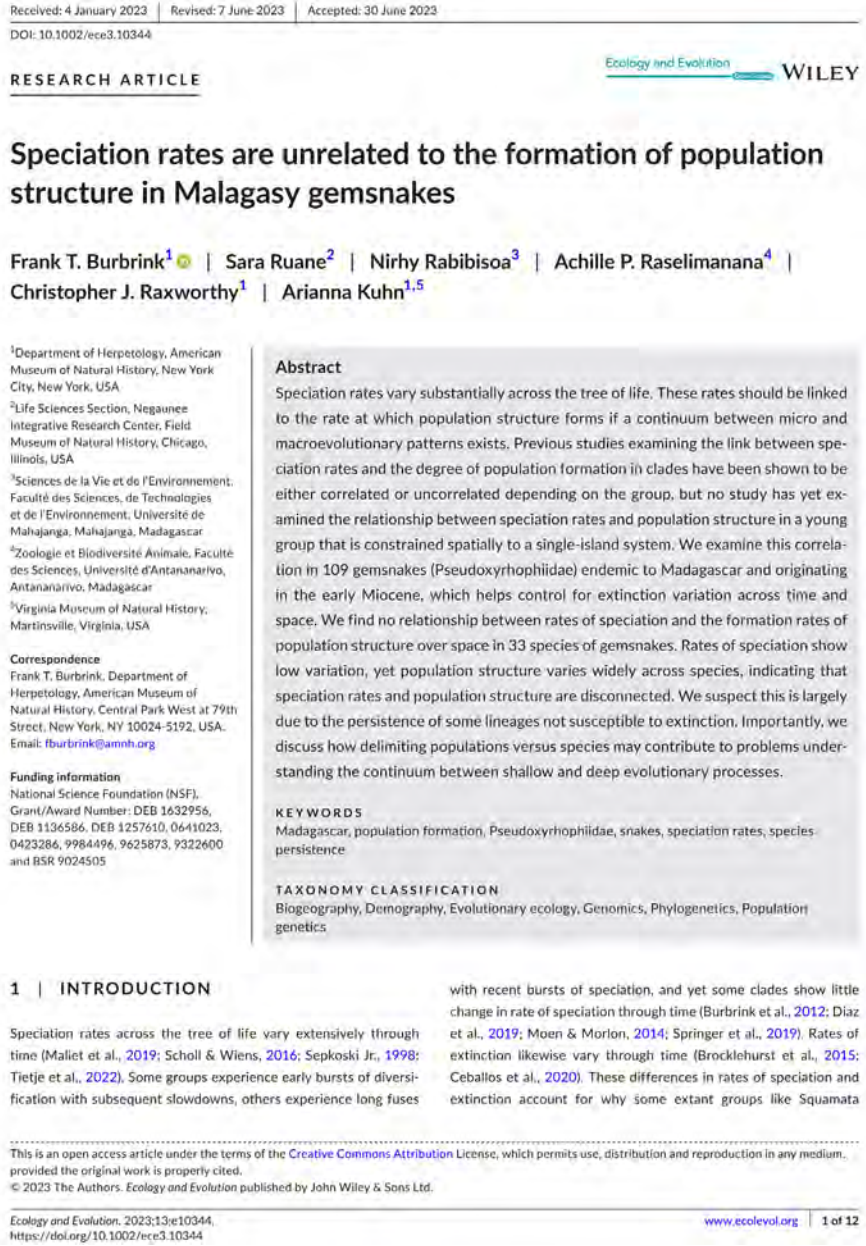
Glaw, F., Köhler, J., Ratsoavina, F. M., **Raselimanana, A. P.**, Crottini, A., Gehring, P.-S., Böhme, W., Scherz, M. D. & Vences, M. 2023. A new large-sized species of leaf-tailed gecko (*Uroplatus*) from northern Madagascar. *Salamandra*, 59 (3): 239-261.

Vences, M., Hutter, C. R., Glaw, F., Rakotoarison, A., **Raselimanana, A. P.** & Scherz, M. D. 2023. A new species of *Pandanus*-dwelling frog from northern Madagascar related to *Guibemantis* pulcher. *Zootaxa*, 5306 (1): 97-115.

SCIENTIFIC OUTPUTS OF VAHATRA DURING 2023

The year 2023 was a productive year for Vahatra scientists and students concerning scientific publications. Below we present a list of articles and books published during the year, including manuscripts in press and submitted. Names in **bold** are those of Vahatra scientific members, including post-docs, and those in *italics* are current or past Malagasy student members associated with work they conducted while at Vahatra.

1. Aguillon, S., Castex, C., Duchet, A., Turpin, M., Le Minter, G., Lebarbenchon, C., Hoarau, A. O. G., Toty, C., Joffrin, L., Tortosa, P., Mavingui, P., **Goodman, S. M.** & Dietrich, M. Submitted. Stuck on a small tropical island: Wide in-situ diversification of an urban-dwelling bat. *Global Ecology and Conservation*.
2. Ahmed-Abdou, A., Juillet, N., Payet, K., Yahaya, I., **Goodman, S. M.**, Baret, S., Rabarison, H., Abdou-Azali, H., Andrianantoandro, T., Andrianarivo, C., Bracco, I., Chambrin, L., Debenay, B., Fontaine, F., Guezou, A., Henriette, E., Ingrassia, F., Lavergne, C., Lusweti, A., Mohamed, A. M., Rambinintsaotra, S., Peyen, L., Rouillé, A., Salamolard, M., Tramier, C., Triolo, J., Tye, A., Valentin, T., Wabuyele, E., Reynaud, B., Strasberg, D. & Rouget, M. Submitted. Invasive alien plants in islands of the western Indian Ocean. *Austral Ecology*.
3. Antonelli, A., Farooq, H., Colli-Silva, M., Araújo, J. P. M., Freitas, A. V. L., Gardner, E. M., Grace, O., Gu, S., **Lovanomenjanahary, M.**, Nesbitt, M., Niskanen, T., Onana, J. M., Pérez-Escobar, O. A., Taylor, C. & Knapp, S. 2023. People-inspired names remain valuable. *Nature Ecology and Evolution*, 7: 1161-1162.
4. Burbrink, F. T., Ruane, S., Rabibisoa, N., **Raselimanana, A. P.**, Raxworthy, C. J. & Kuhn, A. 2023. Speciation rates are unrelated to the formation of population structure in Malagasy gemsnakes. *Ecology and Evolution*, 13: e10344. https://doi.org/10.1002/ece3.10344.
5. Carcauzon, V., Herrera, J., Kauffman, K., Baudino, F., Wickenkamp, N., Randriamoria, T., **Soarimalala, V.**, **Goodman, S. M.**, Nunn, C., Lebarbenchon, C. & Tortosa, P. Submitted. Astroviruses in terrestrial Malagasy mammals. *PLOS Neglected Tropical Diseases*.
6. Cordonin, C., Gomard, Y., Monadjem, A., Schoeman, M. C., Le Minter, G., Lagadec, E., Gudo, E. S., **Goodman, S. M.**, Dellagi, K., Mavingui, P. & Tortosa, P. 2023. Ancestral African bats brought their cargo of zoonotic pathogens to Madagascar under cover of colonization events. *Pathogens*, 12: 859.
7. Das, S., Greenbaum, E., Meiri, S., Bauer, A. M., Burbrink, F. T., Raxworthy, C. J., Weinell, J. L., Brown, R. M., Brecko, J., Pauwels, O. S. G., Rabibisoa, N., **Raselimanana, A. P.** & Merilä, J. 2023. Ultraconserved elements-based phylogenomic systematics of the snake superfamily Elapoidea, with the



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RESEARCH ARTICLE

Ecology and Evolution WILEY

Speciation rates are unrelated to the formation of population structure in Malagasy gemsnakes

Frank T. Burbrink[1] | Sara Ruane[2] | Nirhy Rabibisoa[3] | Achille P. Raselimanana[4] | Christopher J. Raxworthy[1] | Arianna Kuhn[1,5]

[1]Department of Herpetology, American Museum of Natural History, New York City, New York, USA
[2]Life Sciences Section, Negaunee Integrative Research Center, Field Museum of Natural History, Chicago, Illinois, USA
[3]Sciences de la Vie et de l'Environnement, Faculté des Sciences, de Technologies et de l'Environnement, Université de Mahajanga, Mahajanga, Madagascar
[4]Zoologie et Biodiversité Animale, Faculté des Sciences, Université d'Antananarivo, Antananarivo, Madagascar
[5]Virginia Museum of Natural History, Martinsville, Virginia, USA

Correspondence
Frank T. Burbrink, Department of Herpetology, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024-5192, USA.
Email: fburbrink@amnh.org

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Abstract

Speciation rates vary substantially across the tree of life. These rates should be linked to the rate at which population structure forms if a continuum between micro and macroevolutionary patterns exists. Previous studies examining the link between speciation rates and the degree of population formation in clades have been shown to be either correlated or uncorrelated depending on the group, but no study has yet examined the relationship between speciation rates and population structure in a young group that is constrained spatially to a single-island system. We examine this correlation in 109 gemsnakes (Pseudoxyrhophiidae) endemic to Madagascar and originating in the early Miocene, which helps control for extinction variation across time and space. We find no relationship between rates of speciation and the formation rates of population structure over space in 33 species of gemsnakes. Rates of speciation show low variation, yet population structure varies widely across species, indicating that speciation rates and population structure are disconnected. We suspect this is largely due to the persistence of some lineages not susceptible to extinction. Importantly, we discuss how delimiting populations versus species may contribute to problems understanding the continuum between shallow and deep evolutionary processes.

KEYWORDS
Madagascar, population formation, Pseudoxyrhophiidae, snakes, speciation rates, species persistence

TAXONOMY CLASSIFICATION
Biogeography, Demography, Evolutionary ecology, Genomics, Phylogenetics, Population genetics

1 | INTRODUCTION

Speciation rates across the tree of life vary extensively through time (Maliet et al., 2019; Scholl & Wiens, 2016; Sepkoski Jr., 1998; Tietje et al., 2022). Some groups experience early bursts of diversification with subsequent slowdowns, others experience long fuses with recent bursts of speciation, and yet some clades show little change in rate of speciation through time (Burbrink et al., 2012; Diaz et al., 2019; Moen & Morlon, 2014; Springer et al., 2019). Rates of extinction likewise vary through time (Brocklehurst et al., 2015; Ceballos et al., 2020). These differences in rates of speciation and extinction account for why some extant groups like Squamata

description of a new Afro-Asian family. *Molecular Phylogenetics and Evolution*, 180: 107700. https://doi.org/10.1016/j.ympev.2022.107700.

8. Demos, T. C., Webala, P. W., **Goodman, S. M.**, Kerbis Peterhans, J. C., Lutz, H. L., Agwanda, B. R., Cortés-Delgado, N., Briones, S., Ree, R. H. & Patterson, B. D. 2023. Ultraconserved elements resolve phylogenetic relationships and biogeographic history of African-Malagasy bent-winged bats (Miniopteridae). *Molecular Phylogenetics and Evolution*, 188: 107890.
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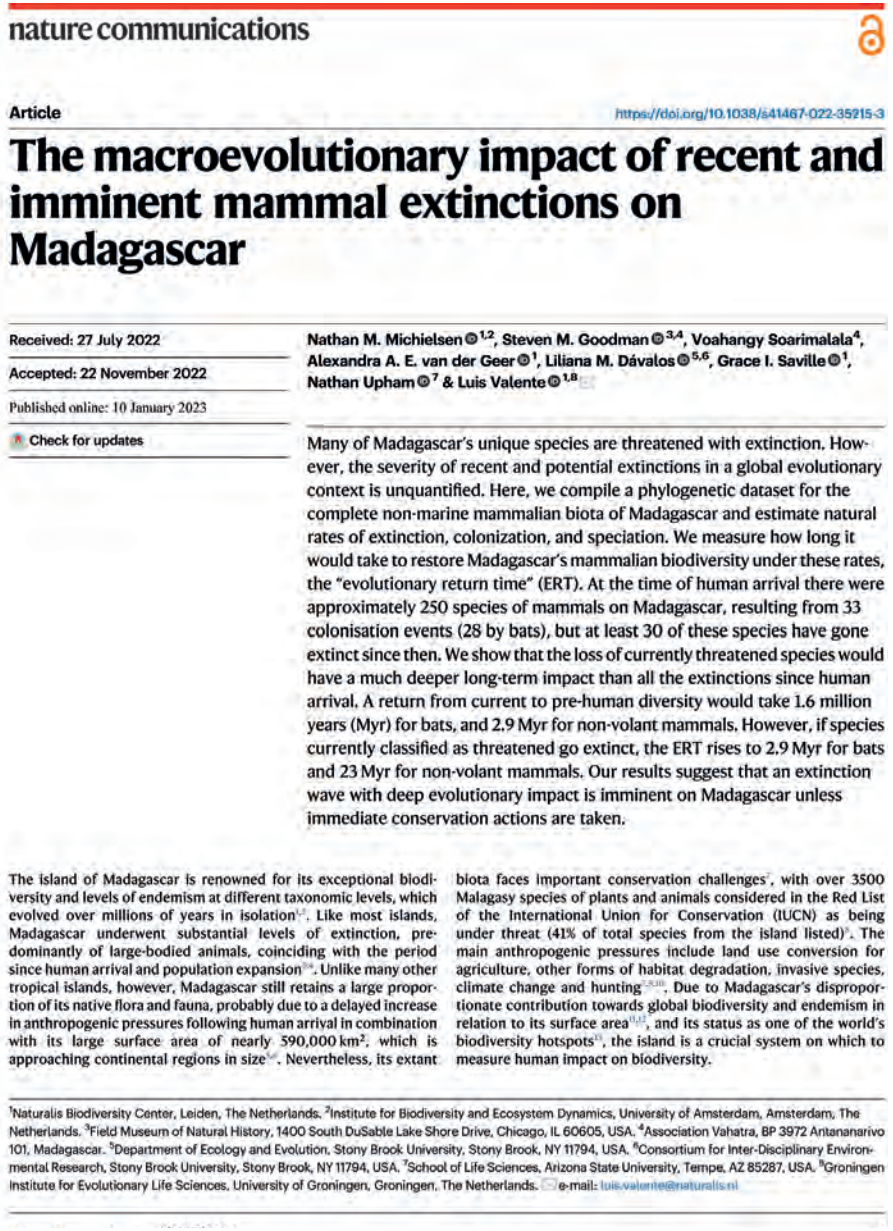
10. Díaz-Cao, J. M., Grossmann, N. **Goodman, S. M.**, Bosch, J., Guis, H., Rasamoelina, M., Rakotoarivony, R., Jori, F. & **Martínez-López, B. 2023.** A maximum entropy species distribution model to estimate the distribution of bushpigs on Madagascar and its implications for African Swine Fever. *Transboundary and Emerging Diseases*, doi.org/10.1155/2023/7976252**.**
11. Dubrulle, J., Kauffman, K., **Soarimalala, V.**, Randriamoria, T., **Goodman, S. M.**, Herrera, J., Nunn, C. & Tortosa, P. 2023. Effect of habitat degradation on hantavirus infection among introduced and endemic small mammals of Madagascar. *bioRxiv* 2023.12.24.573235. doi: https://doi.org/10.1101/2023.12.24.573235
12. Englert, M. C., **Goodman, S. M.** & Apanaskevich, D. A. 2023. Description of a new species of *Ixodes* Latreille, 1795 (Acari: Ixodidae), parasite of shrew tenrecs (Afrotheria: Tenrecidae) and rodents (Rodentia: Muridae) on Madagascar. *Systematic Parasitology*, 100: 745-750.
13. Glaw, F., Köhler, J., Ratsoavina, F. M., **Raselimanana, A. P.**, Crottini, A., Gehring, P.-S., Böhme, W., Scherz, M. D. & Vences, M. 2023. A new large-sized species of leaf-tailed gecko (*Uroplatus*) from northern Madagascar. *Salamandra*, 59 (3): 239-261.
14. **Goodman, S. M.** & **M. J. Raherilalao** (eds.). 2023. A floral and faunal inventory of the Parc National de Marojejy: Altitudinal gradient and temporal variation. *Malagasy Nature*, 17: 1-285.
15. **Goodman, S. M.** & *Rasolonjatovo, H. A. M.* Submitted. Description of the wing spur in the subfossil Malagasy lapwing, *Vanellus madagascariensis* (Aves: Charadriiformes, Charadriidae): Insights into some of its possible life history traits and why it is extinct. *Geobios*.
16. **Goodman, S. M.**, *Falimiarintsoa, D.*, *Manana*, C., *Rafanomezanjanahary*, *J. M.*, *Rasoanoro, M.* & *Todilahy*, *L. J.* 2023. The bats of the Marojejy National Park and surrounding areas. In A floral and faunal inventory of the Parc National de Marojejy: Altitudinal gradient and temporal variation, eds. S. M. Goodman & M. J. Raherilalao. *Malagasy Nature*, 17: 229-248.



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Article

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The macroevolutionary impact of recent and imminent mammal extinctions on Madagascar

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Check for updates

Nathan M. Michielsen[1,2], Steven M. Goodman[3,4], Voahangy Soarimalala[4], Alexandra A. E. van der Geer[1], Liliana M. Dávalos[5,6], Grace I. Saville[1], Nathan Upham[7] & Luis Valente[1,8]

Many of Madagascar's unique species are threatened with extinction. However, the severity of recent and potential extinctions in a global evolutionary context is unquantified. Here, we compile a phylogenetic dataset for the complete non-marine mammalian biota of Madagascar and estimate natural rates of extinction, colonization, and speciation. We measure how long it would take to restore Madagascar's mammalian biodiversity under these rates, the "evolutionary return time" (ERT). At the time of human arrival there were approximately 250 species of mammals on Madagascar, resulting from 33 colonisation events (28 by bats), but at least 30 of these species have gone extinct since then. We show that the loss of currently threatened species would have a much deeper long-term impact than all the extinctions since human arrival. A return from current to pre-human diversity would take 1.6 million years (Myr) for bats, and 2.9 Myr for non-volant mammals. However, if species currently classified as threatened go extinct, the ERT rises to 2.9 Myr for bats and 23 Myr for non-volant mammals. Our results suggest that an extinction wave with deep evolutionary impact is imminent on Madagascar unless immediate conservation actions are taken.

The island of Madagascar is renowned for its exceptional biodiversity and levels of endemism at different taxonomic levels, which evolved over millions of years in isolation[1,2]. Like most islands, Madagascar underwent substantial levels of extinction, predominantly of large-bodied animals, coinciding with the period since human arrival and population expansion[3,4]. Unlike many other tropical islands, however, Madagascar still retains a large proportion of its native flora and fauna, probably due to a delayed increase in anthropogenic pressures following human arrival in combination with its large surface area of nearly 590,000 km², which is approaching continental regions in size[5,6]. Nevertheless, its extant biota faces important conservation challenges[7], with over 3500 Malagasy species of plants and animals considered in the Red List of the International Union for Conservation (IUCN) as being under threat (41% of total species from the island listed)[8]. The main anthropogenic pressures include land use conversion for agriculture, other forms of habitat degradation, invasive species, climate change and hunting[7,9,10]. Due to Madagascar's disproportionate contribution towards global biodiversity and endemism in relation to its surface area[11,12], and its status as one of the world's biodiversity hotspots[13], the island is a crucial system on which to measure human impact on biodiversity.

[1]Naturalis Biodiversity Center, Leiden, The Netherlands. [2]Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, Amsterdam, The Netherlands. [3]Field Museum of Natural History, 1400 South DuSable Lake Shore Drive, Chicago, IL 60605, USA. [4]Association Vahatra, BP 3972 Antananarivo 101, Madagascar. [5]Department of Ecology and Evolution, Stony Brook University, Stony Brook, NY 11794, USA. [6]Consortium for Inter-Disciplinary Environmental Research, Stony Brook University, Stony Brook, NY 11794, USA. [7]School of Life Sciences, Arizona State University, Tempe, AZ 85287, USA. [8]Groningen Institute for Evolutionary Life Sciences, University of Groningen, Groningen, The Netherlands. e-mail: luis.valente@naturalis.nl

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Bird communities of the Parc National de Marojejy, Madagascar: With reference to species diversity and elevational distribution changes between 1996 and 2021

Marie Jeanne Raherilalao[1,2], Tahiry Langrand[3] & Steven M. Goodman[1,4]
[1] Association Vahatra, BP 3972, Antananarivo 101, Madagascar
E-mail: jraherilalao@gmail.com
[2] Mention Zoologie et Biodiversité Animale, Domaine Sciences et Technologie, BP 906, Université d'Antananarivo, Antananarivo 101, Madagascar
[3] 11816 Riders Lane, Reston, Virginia 20191, USA
E-mail: langrandt@gmail.com
[4] Negaunee Integrative Research Center, Field Museum of Natural History, 1400 South DuSable Shore Drive, Chicago, Illinois 60605, USA
E-mail: sgoodman@fieldmuseum.org

Abstract

Considering ongoing worldwide environmental change associated with a range of different factors, the related dynamics of bird community shifts in tropical forest environments remains poorly understood. Investigations along ecological gradients, such as elevational transects of mountains, where variables to potentially explain the distribution of different biotic elements, including shifts in temperature, humidity, and rainfall, change in a continuous manner. These are excellent natural settings to measure possible change. Herein we present details on such a study of birds and compare their distribution and density on the slopes of the Parc National de Marojejy in northeastern Madagascar and compare data from 1996 and 2021 collected in a comparable manner.

Three complementary standardized methods were used to collect data at five sites between 450 and 1875 m and near the Mandena-summit trail: general observations, mist-netting of understory birds, and point counts. The protocols for these methods followed in close detail those used in 1996 for a parallel ornithological elevational inventory of the same areas of the Marojejy Massif. During the 2021 survey, a total of 80 bird species were recorded at the five sites, a large proportion of these taxa being forest dependent. When the 2021 bird list is combined with those from 1996, 91 species were recorded in the survey zone.

Comparing data from the two inventories, four species were not recorded during the 2021 inventory in the upper elevational zone at 1875 m from montane ericoid thicket, but were present in 1996: *Margaroperdix madagarensis*, *Coturnix coturnix*, *Caprimulgus madagascariensis*, and *Eremopterix hova*. An overview of the point count data indicated that the local bird populations, despite variation in their observed densities between the two surveys, were largely unchanged except for three species of the endemic Malagasy subfamily Vanginae: *Tylas eduardi*, *Euryceros prevostii*, and *Artamella viridis*. The lack of measured changes in the density of the balance of bird taxa might reflect a certain level of resilience with respect to environmental dynamics. Moreover, given that most are forest-dependent and subject to changes in ecological conditions associated with 1) the effects of local anthropogenic pressures, for which we have little evidence in the transect area over the course of the past 25 years, 2) climate, for which there is evidence of change over the past few decades, and 3) natural events, principally the impacts of cyclones, these aspects, at least based on the measured time scale, seem not to have impacted aspects of their distribution and density within the forest transect zone.

Résumé détaillé

L'avifaune du Parc National de Marojejy est bien connue mais la dynamique de la communauté d'oiseaux des milieux forestiers face à celle de l'environnement reste mal connue. Aussi, une étude le long du gradient altitudinal sur la tendance des populations a été menée pour comprendre la résilience des espèces à la variation des conditions écologiques de l'environnement. Cinq sites entre 450 et 1875 m d'altitude en suivant la piste touristique principale Mandena-Sommet ont été inventoriés. Ils ont été installés de manière à couvrir les différents types d'habitats représentatifs du transect allant de la forêt humide sempervirente de basse altitude jusqu'aux fourrés éricoïdes et aux prairies de hautes montagnes. Trois méthodes complémentaires ont été utilisées pour collecter les données ; elles comprennent les observations générales, y compris les observations au-dessus de la canopée, la capture

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Fecal analysis of an endemic Malagasy fruit bat (*Rousettus madagascariensis*, Pteropodidae): evidence of ectoparasite consumption and insectivory

VOLANIAINA M. C. RASOARIMANANA[1, 2], STEVEN M. GOODMAN[2, 3, 7], BALSAMA RAJEMISON[4], CAMILLE LEBARBENCHON[5], and RIANA V. RAMANANTSALAMA[5, 6]

[1]*Mention Zoologie et Biodiversité Animale, Université d'Antananarivo, BP 906, Antananarivo 101, Madagascar*
[2]*Association Vahatra, BP 3972, Antananarivo 101, Madagascar*
[3]*Negaunee Integrative Research Center, Field Museum of Natural History, 1400 South DuSable Lake Shore Drive, Chicago, Illinois 60605, USA*
[4]*Madagascar Biodiversity Center, Parc Botanique et Zoologique de Tsimbazaza, BP 4096, Antananarivo 101, Madagascar*
[5]*UMR Processus Infectieux en Milieu Insulaire Tropical (PIMIT), Université de La Réunion, Inserm, CNRS, IRD, 2 Rue Maxime Rivière, Sainte Clotilde 97490, La Réunion, France*
[6]*Behavioral Ecology & Sociobiology Unit, German Primate Center, Kellnerweg 4, 37077 Göttingen, Germany*
[7]*Corresponding author: E-mail: sgoodman@fieldmuseum.org*

The ecology of Malagasy bat ectoparasites has been little studied and to provide new insights we examine fecal contents of *Rousettus madagascariensis* and the consumption of invertebrates, specifically Diptera of the families Nycteribiidae and Streblidae. Scat samples from individual *Rousettus* captured in a cave passage either during the early evening or early morning were collected and analyzed to identify and quantify the arthropods they contained. The presence of fragments in the feces confirm that this species consumes their dipteran ectoparasites. Ingestion rates are higher for bats exiting the cave after dusk than those entering the cave at predawn, indicating that consumption rates are greater when bats are in the day roost site as compared to foraging outside the cave. The quantity of ectoparasite remains is related to the age of individual bats. Given that bat ectoparasites are known to be reservoirs of certain pathogens, the question is raised if transmission between bats of these zoonotic diseases can be via an oral route.

Key words: *Rousettus madagascariensis*, ectoparasite, fecal analysis, Réserve Spéciale d'Ankarana

L'écologie des ectoparasites des chauves-souris malgaches a été jusqu'ici peu étudiée. La présente étude évalue la consommation d'ectoparasite de *Rousettus madagascariensis*, en particulier les diptères de la famille des Nycteribiidae et Streblidae à partir du contenu fécal de la chauve-souris hôte. Des individus de *Rousettus* ont été capturés en début de soirée en sortant de la grotte ou tôt le matin à l'entrant qui leurs servent de gîte diurne. Leurs fèces ont été collectés et analysés pour identifier et quantifier les restes d'arthropode qu'ils contenaient. La présence de fragments de diptères ectoparasites dans les matières fécales confirmait que cette chauve-souris consomme ses ectoparasites. Le taux d'ingestion est plus élevé pour les chauves-souris qui sortent de la grotte après le coucher du soleil par rapport à celles qui entrent dans la grotte avant l'aube. Ce qui indique une forte consommation dans le gîte diurne durant le jour que durant les activités de quêtes de nourritures durant la nuit à l'extérieur de la grotte. La quantité d'ectoparasite ingérée varie en fonction de l'âge des chauves-souris. Etant donné que ces ectoparasites sont connus pour être des réservoirs de pathogènes, des questions surviennent sur la possibilité de transmission par voie orale de maladie zoonotique entre les chauves-souris.

Mot clés: *Rousettus madagascariensis*, ectoparasite, analyse de contenu fécal, Réserve Spéciale d'Ankarana

INTRODUCTION

Old World fruit bats of the family Pteropodidae are well known for their capacity to disperse plant seeds, as well as reservoirs of different pathogens (Izhaki *et al*., 1995; Ramanantsalama *et al.*, 2022*b* for review). Given that the majority of research on Malagasy pteropodids has focused on their systematics and general biology, little information is available on the ecology of their ectoparasites. Among the ectoparasites of Malagasy bats are two families of dipteran bat flies, both blood-feeding, the Nycteribiidae (flightless through their complete life-cycle) and the Streblidae (capable of flight in the adult

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ORIGINAL ARTICLE

INTEGRATIVE ZOOLOGY

Reproductive ecology of the black rat (*Rattus rattus*) in Madagascar: the influence of density-dependent and -independent effects

Kathryn SCOBIE,[1] Soanandrasana RAHELINIRINA,[2] Voahangy SOARIMALALA,[3] Fehivola Mandanirina ANDRIAMIARIMANANA,[2] Corinne RAHAINGOSOAMAMITIANA,[2] Toky RANDRIAMORIA,[3] Soloandry RAHAJANDRAIBE,[2] Xavier LAMBIN,[1] Minoarisoa RAJERISON[2] and Sandra TELFER[1]

[1]School of Biological Sciences, University of Aberdeen, Aberdeen, UK, [2]Plague Unit, Institut Pasteur de Madagascar, Antananarivo, Madagascar and [3]Association Vahatra, Antananarivo, Madagascar

Abstract

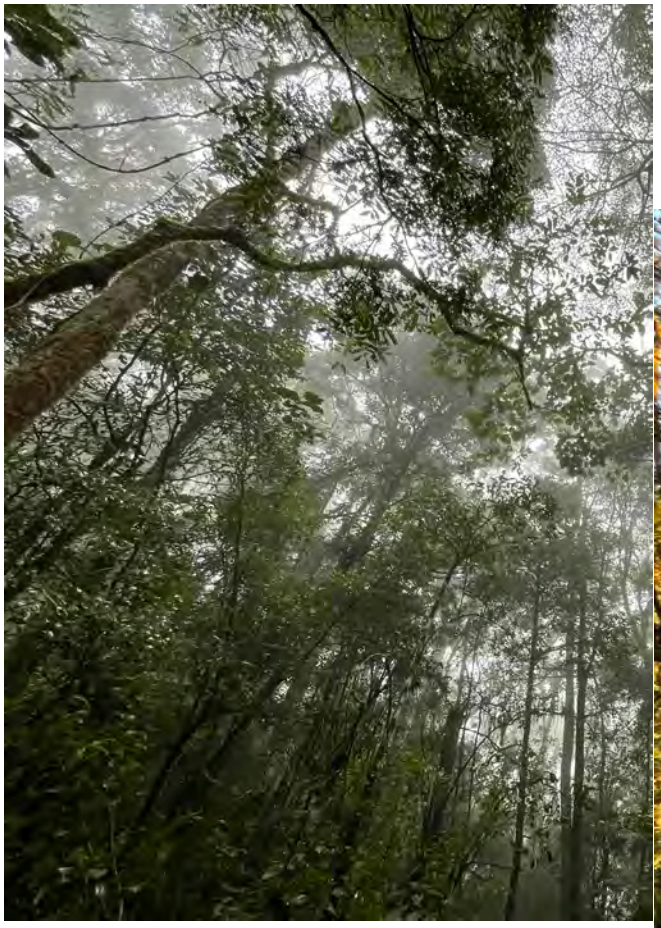
The black rat (*Rattus rattus*) poses a severe threat to food security and public health in Madagascar, where it is a major cause of pre- and post-harvest crop losses and an important reservoir for many zoonotic diseases, including plague. Elsewhere, ecologically based rodent management (EBRM) strategies have been developed using ecological information to inform decisions on where and when to target control. EBRM could deliver improved health and well-being outcomes in Madagascar if adapted to the local ecological context. Using data collected from removal studies, we explored spatio-temporal patterns in the breeding activity of the black rat (*R. rattus*) in domestic and agricultural habitats across Madagascar and investigated to what extent these trends are influenced by rainfall and rat density. We identified clear spatio-temporal variation in the seasonality of *R. rattus* reproduction. Reproduction was highly seasonal both inside and outside of houses, but seasonal trends varied between these two habitats. Seasonal trends were explained, in part, by variation in rainfall; however, the effect of rainfall on reproductive rates did itself vary by season and habitat type. A decline in breeding intensity with increasing rat density was recorded outside of houses. This has important implications for control, as populations may compensate for removal through increased reproduction. We recommend that sustained control initiated before the main breeding season, combined with improved hygiene and adequate rodent-proofing in homes and grain stores, could curtail population growth and reduce pre- and post-harvest losses provided that these measures overcome the compensatory response of rodent populations.

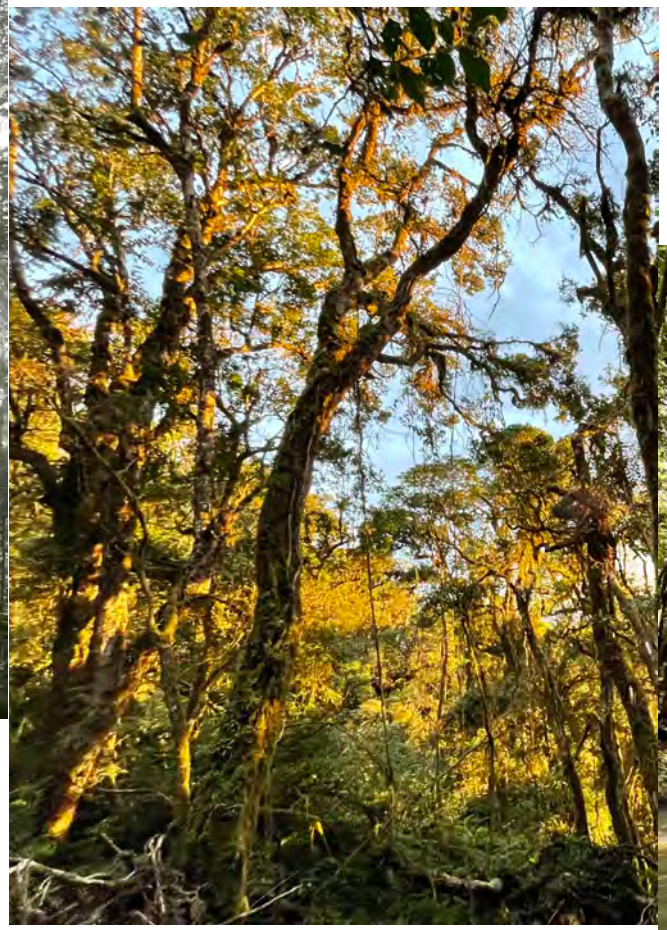
Key words: Madagascar, *Rattus rattus*, reproductive ecology, rodent control

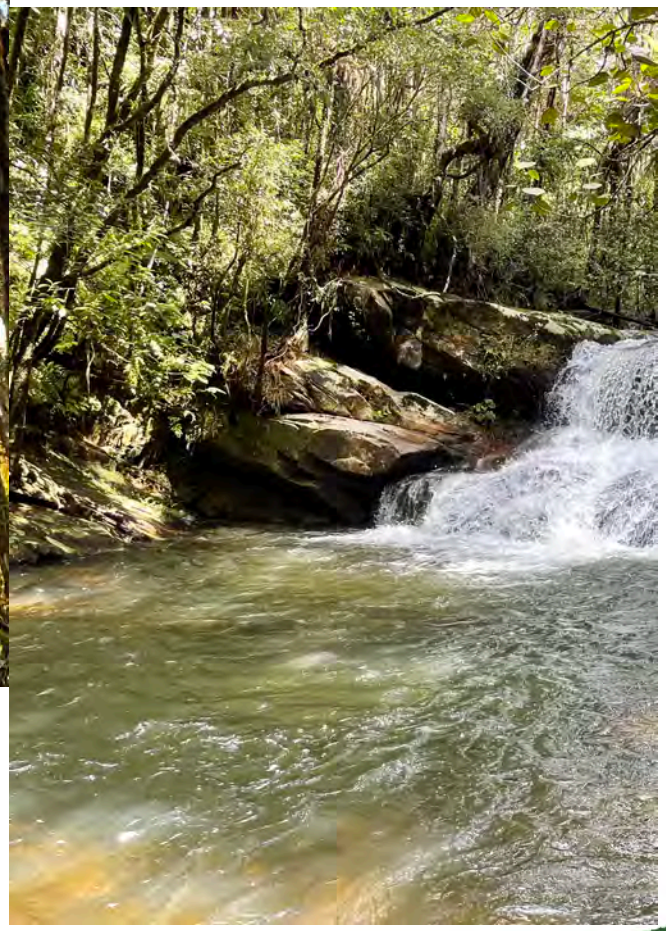
INTRODUCTION

Globally, rodent pests pose a serious threat to food security and public health (Meerburg *et al.* 2009; Capizzi *et al.* 2014). Control efforts largely depend on the use

Correspondence: Sandra Telfer, School of Biological Sciences, University of Aberdeen, Aberdeen, UK.
Email: s.telfer@abdn.ac.uk







Association Vahatra

BP 3972, Antananarivo 101, Madagascar - 261 20 76 277 55 - associatvahatra@moov.mg