



# MADAGASCAR CONSERVATION & DEVELOPMENT

INVESTING FOR A SUSTAINABLE NATURAL ENVIRONMENT FOR FUTURE GENERATIONS OF HUMANS, ANIMALS AND PLANTS OF MADAGASCAR

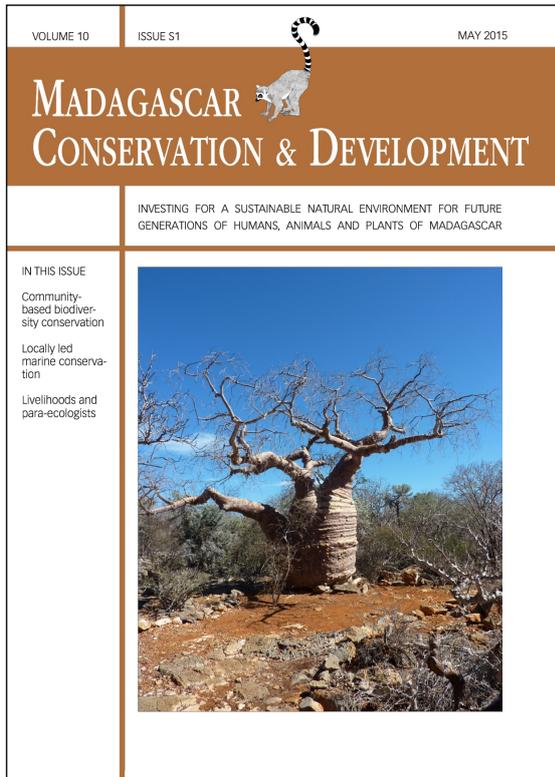
## IN THIS ISSUE

Community-based biodiversity conservation

Locally led marine conservation

Livelihoods and para-ecologists





Madagascar Conservation & Development is the journal of Indian Ocean e-Ink. It is produced under the responsibility of this institution. The views expressed in contributions to MCD are solely those of the authors and not those of the journal editors or the publisher.

All the Issues and articles are freely available at <http://www.journalmcd.com>



Contact Journal MCD  
[info@journalmcd.net](mailto:info@journalmcd.net) for general inquiries regarding MCD  
[funding@journalmcd.net](mailto:funding@journalmcd.net) to support the journal

Madagascar Conservation & Development  
 Institute and Museum of Anthropology  
 University of Zurich  
 Winterthurerstrasse 190  
 CH-8057 Zurich  
 Switzerland

io@i

Indian Ocean e-Ink  
 Promoting African Publishing and Education  
[www.ioeink.com](http://www.ioeink.com)

 MISSOURI BOTANICAL GARDEN

Missouri Botanical Garden (MBG)  
 Madagascar Research and Conservation Program  
 BP 3391  
 Antananarivo, 101, Madagascar

## TABLE OF CONTENTS

## EDITORIAL

- 3 Community-based conservation in Madagascar, the ‘cure-all’ solution? *Lena M. Reibelt, Julia Nowack*
- 42 Impressum

## ARTICLES

- 6 The freedom to choose: integrating community-based reproductive health services with locally led marine conservation initiatives in southwest Madagascar. *Laura Robson, Fanjavola Rakotozafy*
- 13 Ten years into the marshes – *Hapalemur alaotrensis* conservation, one step forward and two steps back? *Antje Rendigs, Lena M. Reibelt, Fidimalala B. Ralainasolo, Jonah H. Ratsimbazafy, Patrick O. Waeber*
- 21 Improving livelihoods, training para-ecologists, enthraling children: Earning trust for effective community-based biodiversity conservation in Andasibe, eastern Madagascar. *Rainer Dolch, Jean-Noël Ndrimiary, Tianasoa Ratolojanahary, Mad Randrianasolo, Irène Augustine Ramanantenasoa*
- 29 Conservation communautaire de la forêt humide de basse altitude d’Andriantantely, Madagascar. *Maholy Ravaloharimanitra, Hery N. T. Randriahaingo, Lova H. Ranaivosoa, Christelle Chamberlan, Tony King*
- 35 Community-managed conservation efforts at Tsingy Mahaloka/KOFAMA, northern Madagascar: Right place at the wrong time? *Ian C. Colquhoun*

## EDITORIAL

<http://dx.doi.org/10.4314/mcd.v10i1.S1>

## Community-based conservation in Madagascar, the 'cure-all' solution?

As one of the poorest countries worldwide, Madagascar suffers from severe environmental degradation and an ongoing loss of its unique biodiversity. To promote conservation efforts on the island, lemurs are used as a flagship species to draw attention and funding for conservation. Lemur-based research has indeed helped to draw international and national attention to Madagascar's wildlife and the conservation importance of several sites; the country has received a lot of international conservation and development assistance for several decades (Horning 2008). As most lemurs need large areas of relatively undisturbed forest, lemur conservation means preserving forest ecosystems – with all the species within, as well as the ecosystem functions. However, while new lemur species are still being discovered, these mammals face ever-increasing threats. Today, an alarming 91% of lemur species are considered threatened with extinction, i.e., classified on the IUCN Red List of Threatened Species as either Critically Endangered (CR), Endangered (EN), or Vulnerable (VU) (Schwitzer et al. 2013).

In 2013, some 200 researchers from 21 different countries gathered in Madagascar for the International Prosimian Congress (IPC) to exchange on "How science and policy can pull prosimians back from the brink of extinction". A considerable number of presentations dealt in some way with community-based conservation (CBC) projects. The collection of papers presented in this Special Issue provides a snap-shot of the diverse ways rural communities across Madagascar are engaging in locally-managed conservation efforts, describing advantages, but also problems of the CBC approach.

Community-based conservation is often regarded as a panacea for achieving today's conservation goals. It is assumed to provide win-win solutions, i.e., promote development or livelihood security while assuring conservation at the same time. But is this really the case? CBC is the result of different conservation approaches from the past. Until the 1970s, conservation was preservation-oriented with centralized control and exclusion of local people by denying or restricting their subsistence forest-based activities without due compensation (Mehta and Kellert 1998). The resulting park-people conflicts have weakened long-term biodiversity conservation efforts, but helped to develop the understanding that local stakeholders need to be involved in planning and implementing policies and programs to conserve biodiversity. Today, it is widely acknowledged that conservation initiatives cannot succeed without the support of local populations and without considering their livelihood concerns (Sunderland et al. 2008). CBC became popular in the 1980s, and currently promotes biodiversity management by, for, and with local communities.

However, after two decades of implementation, various criticisms arise on CBC initiatives and projects. Murphree's (2000) overview summarizes some of them and can, together with

Scales (2014), provide helpful insights for practitioners of CBC. Fifteen years ago, Murphree already warned not to overvalue community-based conservation, i.e., not to see it as a 'solves-all-problems' approach. Today, community-based conservation is at risk to become a paradigm without much meaning as many institutions and organizations claim to do community-based conservation, either to be 'en vogue' or to secure funding. As mentioned in the beginning, CBC is one concept amongst others and has evolved to support other approaches that were not convincingly successful, but not as a 'stand-alone'-approach. Or to put it in the words of Murphree (2000: 3–4): "CBC was never designed as a substitute for protected area approaches; it was designed to be part of a suite of conservation approaches within national conservation strategies, for particular contexts and circumstances". This adaptation process will certainly not end, as our social, natural, political and economic environments are constantly changing, thus demanding continuously adapted or even new approaches, also depending on the respective contexts and settings. Understanding and accepting this will help us to avoid unrealistic expectations (Scales 2014). CBC has been projected as the most practical approach to stem biodiversity loss in developing countries (Mehta and Kellert 1998), but it is not an approach that is easily accomplished. Considerable time investment and clear policy require highly professional practitioners. At the same time, as it has been repeatedly addressed over the past 15 years, we need to abandon the imposition of ideas from external groups in favor of a real conversation and negotiation in conservation with local sources (Richard and Dewar 2001, Gezon 2014). This would imply to respect and even to address non-conservation priorities. Scales (2014) describes external initiation and imposition and indirect re-establishment of state or elite control as fundamental barriers to the success of the concept. It does not help to (re)invent participatory approaches if the respective institutions in charge are not ready to implement them. This illustrates that CBC is not necessarily always a win-win solution, but the transfer of power, resources and rights may also generate losers (Murphree 2000, Gezon 2014). Additionally, the much-quoted terms 'social justice', 'participation', 'sustainability', 'ethics', 'resilience', and 'trust' are all meaningful words and we are running the risk of forgetting their real deep meaning, leaving just empty shells.

To balance conservation with development remains a challenging task due to the complex nature of the subject. We will probably not find the 'cure-all' solution, but need to consider and deal with the respective contexts. Each case involves a multitude of stakeholders, often with contrasting and conflicting priorities. Berkes (2007: 15192–3) advises to no longer ignore the "multilevel nature of linkages and multiple partners required for any biodiversity conservation project to be successful" and insists on the necessary recognition of "vertical and horizontal institutional interplay". As biodiversity conservation nowadays is as much about people as it is about endangered species or ecosystems (Mace 2014), the dimensions of complex socio-ecological issues cannot be revealed by one single perspective and require consideration of multiple knowledge systems with multiple, sometimes contrasting, objectives. Ferguson and Gardner (2010: 76) propose that "Madagascar could consider drawing on experience from the participatory policy planning processes developed in other developing countries through FAO National Forest Programmes (FAO 2006)" in order to find ways how to

implement an inclusive policy, i.e., how to involve a multitude of national and international stakeholders in the necessary policy processes. We should withdraw from the idea of 'Eden-like' nature in Madagascar and rather than trying to preserve the past and to halt human actions, we need to focus on how to manage change and negotiate our impact during the transition from past to future (Adams 2003). In this process, we should avoid creating the impression amongst locals that conservationists care more about lemurs or the forest than they do about people.

CBC is a concept suitable for some circumstances, but not applicable or efficient in others. On our search for effective and holistic ways of future management forms we might discover more such approaches, some of which we will improve and use, others of which we will need to abandon due to their high costs or low efficiency. Scales (2014) cites Bill Adams' (2003: 209) statement that, "There is no right way to do conservation. There are only choices." and adds that "To help make these choices, research and policy in Madagascar desperately need more conversations – between biologists, anthropologists, archaeologists, economists, environmental historians and geographers; between researchers and practitioners; and between 'experts' and the individuals, households and communities directly dependent on the island's natural resources for their livelihoods". Exchange is crucial for effective learning and to avoid making the same mistakes again and again. Ganzhorn (2010) calls for (better) evaluation and accessibility of experiences from various projects and suggests a central database that will enable us to learn from former successes and failures, and that can be the basis for the development of future programs. Additionally, publications in open-access journals such as Madagascar Conservation & Development, and discussions in forums or networks such as the Madagascar Environmental Justice Network, or the recently established Lemur Conservation Network, offer additional opportunities for the much needed exchange.

The demand for evidence-based conservation approaches from scientists, practitioners, policy-makers and donors is growing. This Special Issue on 'Community based biodiversity for conservation' aims to provide the needed fuel for vivid discussions and exchanges on how to improve and adapt some current activities or even mindsets. The five contributions describe CBC approaches in different regions of Madagascar, partly based on lemur conservation aims.

Robson and Rakotozafy (2015) present Blue Ventures' successful multifaceted approach that includes sustainable management of marine resources and access to public health services, strengthened by community education and strong cross-sector partnerships. Colquhoun (2015) describes struggles to establish a community-managed protected area near Ankarana National Park; he advises to conduct a needs assessment before project initiation. Mitsinjo's positive experiences with handing over responsibilities to local communities, including tourism, education and reforestation are illustrated by Dolch et al. (2015). Ravaloharimanitra et al. (2015) describe The Aspinall Foundation's previous and current activities to realize management transfer contracts; a long-term conservation strategy is to be developed. Madagascar Wildlife Conservation's work for the conservation of Hapalemur alaotrensis is reflected by Rendigs et al. (2015). They call for further cooperation between institutions, but also with the community, to have a greater impact.

For conservation to be successful in the long-term it is

important to gain the support and involvement of local people and this is why community-based conservation is crucial. We hope that this collection of case studies will inform researchers and practitioners who are aiming to engage in community-based conservation projects.

Lena M. Reibelt  
Ecology and Environmental Education Group  
University of Hildesheim, Germany  
Madagascar Wildlife Conservation (MWC)  
Ambatondrazaka, Madagascar.  
reibelt.lena@googlemail.com

Julia Nowack  
School of Environmental & Rural Science  
University of New England, Australia  
SuLaMa, Department of Animal Ecology and Conservation  
University of Hamburg, Germany  
jnowack@une.edu.au

## REFERENCES

- Adams, W. M. 2003. *Future Nature: A Vision for Conservation*. Earthscan, London.
- Berkes, F. 2007. Community-based conservation in a globalized world. *Proceedings of the National Academy of Sciences of the United States of America* 104, 39: 15188–15193. (doi:10.1073/pnas.0702098104)
- Colquhoun, I. C. 2015. Community-managed conservation efforts at Tsingy Mahaloka/KOFAMA, northern Madagascar: Right place at the wrong time? *Madagascar Conservation & Development* 10, S1: 34–41. (doi:10.4314/mcd.v10i1.S6)
- Dolch, R., Ndriamiary, J.-N., Ratolojanahary, T., Randrianasolo, M. and Ramanantenaso, I. A. 2015. Improving livelihoods, training para-ecologists, enthraling children: Earning trust for effective community-based biodiversity conservation in Andasibe, eastern Madagascar. *Madagascar Conservation & Development* 10, S1: 21–28. (doi:10.4314/mcd.v10i1.S4)
- FAO (Food and Agriculture Organization of the United Nations). 2006. *Understanding National Forest Programmes: Guidance for Practitioners*. The National Forest Programme Facility, FAO, Rome.
- Ferguson, B. and Gardner, C. J. 2010. Looking back and thinking ahead – where next for conservation in Madagascar? *Madagascar Conservation & Development* 5, 2: 75–76.
- Ganzhorn, J. U. 2010. A combined research agenda towards integrated conservation and development for Madagascar. *Madagascar Conservation & Development*. 5, 2: 79–84. (doi:10.4314/mcd.v5i2.63134)
- Gezon, L. 2014. Who wins and who loses? Unpacking the "local people" concept in ecotourism: a longitudinal study of community equity in Ankarana, Madagascar. *Journal of Sustainable Tourism* 22, 5: 821–838. (doi:10.1080/09669582.2013.847942)
- Horning, N. R. 2008. Strong support for weak performance: donor competition in Madagascar. *African Affairs* 107, 428: 405–431. (doi:10.1093/afraf/adn036)
- Kull, C. A. 2014. The roots, persistence, and character of Madagascar's conservation boom. In: *Conservation and Environmental Management in Madagascar*. I. R. Scales (ed.), pp 146–171. Routledge, London.
- Mace, G. M. 2014. Whose conservation? *Science* 345, 6204: 1558–1560. (doi:10.1126/science.1254704)
- Mehta, J. N. and Kellert, S. R. 1998. Local attitudes toward community-based conservation policy and programmes in Nepal: a case study in the Makalu-Barun Conservation Area. *Environmental Conservation* 25, 4: 320–333. (doi:10.1017/S037689299800040X)
- Murphree, M. W. 2000. Community-based conservation: Old ways, new myths and enduring challenges. Conference on African Wildlife Management in the New Millennium, 13–15 December 2000, Mweka, Tanzania. Available at <<http://goo.gl/svnADC>>
- Ostrom, E., Janssen, M. A. and Anderies, J. M. 2007. Going beyond panaceas. *Proceedings of the National Academy of Sciences of The United States of America* 104, 39: 15176–15178. (doi:10.1073/pnas.0701886104)

- Pollini, J., Hockley, N., Muttenter, F. D. and Ramamonjisoa, B. S. 2014. The transfer of natural resource management rights to local communities. In: Conservation and Environmental Management in Madagascar. I. R. Scales (ed.), pp 172–192. Routledge, London.
- Ravaloharimanitra, M., Randriahaingo, H. N. T., Ranaivosoa, L. H., Chamberlan, C. and King, T. R. 2015. Conservation communautaire de la forêt humide de basse altitude d'Andriantantely, Madagascar. *Madagascar Conservation & Development* 10, S1: 29–34. (doi:10.4314/mcd.v10i1.S5)
- Rendigs, A., Reibelt, L. M., Ralainasolo, F. B., Ratsimbazafy, J. H. and Waeber, P. O. 2015. Ten years into the marshes – Hapalemur alaotrensis conservation, one step forward and two steps back? *Madagascar Conservation & Development* 10, S1: 13–20. (doi:10.4314/mcd.v10i1.S3)
- Richard, A. F. and Dewar, R. E. 2001. Politics, negotiation and conservation: a view from Madagascar. In: African Rain Forest Ecology and Conservation: An Interdisciplinary Perspective. W. Weber, L. J. T. White, A. Vedder and L. Naughton-Treves (eds.), pp 535–544. Yale University Press, New Haven, USA.
- Robson, L. and Rakotozafy, F. 2015. The freedom to choose: integrating community-based reproductive health services with locally-led marine conservation initiatives in southwest Madagascar. *Madagascar Conservation & Development*. 10, S1: 6–12. (doi:10.4314/mcd.v10i1.S2)
- Scales, I. R. 2014. The future of biodiversity conservation and environmental management in Madagascar: lessons from the past and challenges ahead. Conservation and Environmental Management in Madagascar. I. R. Scales (ed.), pp 342–360, Routledge, London.
- Schwitzer, C., Mittermeier, R. A., Davies, N., Johnson, S. E., Ratsimbazafy, J., et al. 2013. Lemurs of Madagascar: A Strategy for their Conservation 2013–2016. IUCN SSC Primate Specialist Group, Bristol Conservation & Science Foundation, Conservation International, Arlington, USA.
- Schwitzer, C., Mittermeier, R. A., Johnson, S. E., Donati, G., Irwin, M., et al. 2014. Averting lemur extinctions amid Madagascar's political crisis. *Science* 343, 6173: 842–843. (doi:10.1126/science.1245783)
- Sunderland, T. C. H., Ehringhaus, C. and Campbell, B. M. 2008. Conservation and development in tropical forest landscapes: a time to face the trade-offs? *Environmental Conservation*. 34, 4: 276–279. (doi:10.1017/S0376892908004438)
- Virah-Sawmy, M., Gardner, C. J. and Ratsifandrihamanana, A. N. 2014. The Durban vision in practice. Experiences in the participatory governance of Madagascar's new protected areas. Conservation and Environmental Management in Madagascar. I. R. Scales (ed.), pp 216–251. Routledge, London.
- Walpole, M. J. and Leader-Williams, N. 2002. Tourism and flagship species in conservation. *Biodiversity and Conservation* 11, 3: 543–547. (doi:10.1023/A:1014864708777)

## ARTICLE

<http://dx.doi.org/10.4314/mcd.v10i1.S2>

# The freedom to choose: integrating community-based reproductive health services with locally led marine conservation initiatives in southwest Madagascar

Laura Robson, Fanjavola Rakotozafy

Correspondence:

Laura Robson

Blue Ventures Conservation, Madagascar

E-mail: [laura@blueventures.org](mailto:laura@blueventures.org)

## ABSTRACT

Madagascar's diverse marine ecosystems serve as critical biodiversity habitats and are also essential to the livelihoods, food security and culture of coastal people, including semi-nomadic Vezo fishers based along the southwest coast. Commercialisation of their traditional fisheries, rapid coastal population growth related to unmet family planning needs, and lack of alternatives to fishing in this arid region are resulting in the unsustainable exploitation of coastal resources. In response to these challenges, marine conservation organisation Blue Ventures has developed an approach to community-based conservation and development that reflects the inextricable links between humans, their health and the environment. We describe how this model has evolved in the Velondriake locally managed marine area, home to approximately 10,000 people, over the last decade through strong cross-sector partnerships. It has entailed the integration of community-based reproductive health services with locally led marine conservation initiatives including temporary octopus fishery closures, permanent marine reserves and alternative coastal livelihood activities such as aquaculture. All of these programmes are underpinned by community education that engages men, women, youth and children in both health and conservation topics. The provision of voluntary family planning services in the Velondriake area is estimated to have averted more than 800 unintended pregnancies since 2007, and the temporary octopus fishery closure model has been implemented over 150 times along the southwest coast since 2004. Preliminary, anecdotal reports from community members and programme staff indicate that this integrated Population-Health-Environment approach enables couples to plan and better provide for their families, empowers women, improves food security and directly supports the sustainability of local conservation efforts. It is proving to be an easily replicable model for addressing community health needs and advancing biodiversity conservation efforts in some of Madagascar's most remote and under-served areas.

## RÉSUMÉ

Non seulement les écosystèmes marins de Madagascar abritent-ils une biodiversité exceptionnelle mais ils sont également

intrinsèquement liés au mode de vie et à la sécurité alimentaire des populations côtières, notamment des pêcheurs semi-nomades qui vivent le long de la côte sud-ouest. La commercialisation des produits de la pêche traditionnelle, la croissance rapide de la population qui est en partie liée à des défauts en matière de planification familiale et l'absence d'alternatives à la pêche dans cette région aride se traduisent par une exploitation non durable des ressources côtières. Pour trouver une solution à cette situation, l'organisation de conservation marine Blue Ventures a élaboré une approche holistique qui considère les liens obligés entre les Hommes, leur santé et l'environnement. L'évolution du modèle élaboré pour l'aire marine de Velondriake est décrite ici ; elle concerne environ 10 000 personnes au cours de cette dernière décennie et des partenariats multisectoriels. Le modèle a intégré des services de santé reproductive avec des initiatives de conservation marine gérées localement, comme des fermetures temporaires de la pêche aux poulpes, des réserves marines permanentes et des activités génératrices de revenus telles que l'aquaculture. L'ensemble de ces programmes est soutenu par des actions d'éducation en mobilisant les hommes, femmes, jeunes et enfants sur des thèmes aussi variés que la santé ou la protection de l'environnement. Ainsi, on estime que la prestation des services de planification familiale volontaire dans la région de Velondriake a pu éviter plus de 800 grossesses non désirées depuis 2007, et des fermetures temporaires de la pêche aux poulpes plus de 150 fois le long de la côte sud-ouest depuis 2004. Des rapports préliminaires et anecdotiques de membres des communautés et des personnels du programmes indiquent que cette approche intégrée « Santé – Population – Environnement » permet aux couples de planifier et de mieux subvenir aux besoins de leurs familles, aux femmes de s'émanciper et aux familles d'améliorer leur sécurité alimentaire tout en soutenant directement la durabilité des activités de conservation marine gérées localement. Ce modèle s'est révélé être facilement reproductible pour répondre aux besoins de santé communautaire et pour faire avancer les efforts de conservation de la biodiversité dans les régions les plus reculées et les plus isolées de Madagascar.

## INTRODUCTION

With 80% of its species found nowhere else on earth, Madagascar is renowned globally as a biodiversity hotspot. The country's vast array of unique flora and fauna does not stop at its shores, with over 5,500 km of coastline spanning more than 14 degrees of latitude, harbouring a diversity of marine and coastal habitats that is unparalleled in the Indian Ocean (Harris 2011). Madagascar's southwest coast hosts one of the largest coral reef systems in the region (Cooke et al. 2000), which not only serves as critical marine biodiversity habitats, but is also essential to the survival of the local coastal population; semi-nomadic fishing communities known as the *Vezo*, or 'people of the sea', who depend on the marine environment for food, income and cultural identity (Astuti 1995).

### SMALL-SCALE FISHERIES: NOT SO SMALL AFTER ALL.

Velondriake is a locally managed marine area in the district of Morombe that spans more than 750 km<sup>2</sup> and is home to approximately 10,000 people (Harris 2007). 87% of adults in this region are fishers or gleaners (Barnes-Mauthe et al. 2013). Locally caught seafood, primarily fin fish, constitutes the sole protein source in 99% of all household meals with protein (Barnes-Mauthe et al. 2013). Small-scale fisheries are the economic lifeblood of Velondriake communities, yielding an estimated value of almost \$US7 million in 2010. This includes both commercial sales, accounting for 83% of the total (with fin fish, octopus and sea cucumber being the most important species), and also subsistence catch (Barnes-Mauthe et al. 2013). Unsustainable fishing pressure is mounting on these marine ecosystems, due in part to the commercialisation of the region's traditional small-scale fisheries over the last decade (L'Haridon 2006). The arrival of international seafood collection companies has connected remote coastal communities with higher paying export markets, leading to an increase in the value and associated exploitation of fresh octopus and other target species (L'Haridon 2006, Harris 2007).

### UNMET FAMILY PLANNING NEEDS AND POPULATION GROWTH.

The coastal population is growing more rapidly in this region compared to the country as a whole, and is expected to double within 10–15 years (Harris et al. 2012). This trend is fuelled in part by high levels of migration from arid inland zones where agricultural productivity and employment opportunities are severely limited (Harris 2011). Fertility rates are also high, with women in the Atsimo-Andrefana region (where the Velondriake area is located) giving birth to an average of 6.2 children, compared to the national average of 4.8 (INSTAT 2010). The nation's demographic structure is heavily positively skewed, with almost 50% of the population aged under 15 years (INSTAT 2010). This reflects significant population growth and increasing anthropogenic pressure on natural resources.

High fertility rates may be explained by limited access to reproductive health services in this region (Harris et al. 2012). People living in isolated communities in rural Atsimo-Andrefana have to travel up to 50 km to reach the nearest public health centres, most of which are under-staffed and under-stocked. Government spending on health was reduced by more than half during the country's political impasse in 2009–2013 (IRIN News 2012), resulting in the closure of numerous clinics and a decline in the national contraceptive prevalence rate (UNFPA Madagascar Country Representative, pers. comm.), which stood at

just 29% in 2008–9 (INSTAT 2010).

Almost a quarter of women in Atsimo-Andrefana reported unmet family planning needs prior to the political upheaval and budget cuts (INSTAT 2010), resulting in negative impacts on maternal and child health outcomes. Malagasy women face a 1 in 45 lifetime risk of maternal death (UNFPA 2011), and 112 children per 1,000 live births die before their fifth birthday in Atsimo-Andrefana, which is almost double the national average of 62 (INSTAT 2010). Addressing unmet family planning needs and enabling women to space their births can reduce maternal and child mortality by at least 25% in such contexts (Setty-Venugopal and Upadhyay 2002, Ahmed et al. 2012, Agarwal 2013). It can also help to address gender inequity and alleviate poverty (USAID et al. 2009), as the inability to make their own reproductive health choices marginalises women and places significant economic burdens on families (Harris et al. 2012, Westerman et al. 2012).

### UNSUSTAINABLE EXPLOITATION OF COASTAL RESOURCES.

With growing numbers of mouths to feed, and commercial markets driving further exploitation, fishing activity is on the rise (L'Haridon 2006, Le Manach et al. 2012). Recent evidence suggests that national catches have been under-reported by as much as 500% since 1950 (Le Manach et al. 2012). Small-scale artisanal and subsistence fishers have been particularly overlooked, accounting for 72% of total catches in the 2000s (Le Manach et al. 2012). Such yields are not sustainable and signs of decline have already been observed in several stocks, in particular those collected through reef gleaning (ibid). Meanwhile, institutional capacity for monitoring fisheries and managing marine areas is severely limited, with few available resources and significant infrastructural challenges in reaching thousands of kilometres of extremely remote coastline (Harris 2011). Consequently, almost nothing is known about the scale of illegal, unreported and unregulated fishing in Madagascar's exclusive economic zone (EEZ); the nation's fishery surveillance centre has just three monitoring vessels, 8 speedboats, 18 inspectors and 22 observers to patrol an area almost twice the size of France (Le Manach et al. 2012).

All of these factors – the commercialisation of traditional fisheries, coastal population growth, unmet family planning needs, limited access to reproductive health services, lack of alternatives to fishing in the arid southwest, and inadequate management capacity – are converging to result in the unsustainable exploitation of coastal resources, which in turn is threatening the diverse marine ecosystems upon which *Vezo* livelihoods, food security and culture depend.

This paper documents the evolution of an integrated approach to community-based conservation and development in southwest Madagascar, developed by marine conservation organisation Blue Ventures in response to the interconnected challenges of unmet reproductive health needs, food insecurity, unsustainable resource use and environmental degradation in this region. The model combines voluntary family planning services with locally led conservation initiatives including temporary octopus fishery closures, permanent marine reserves and alternative coastal livelihood activities such as aquaculture.

We have started by outlining the rationale for this approach in terms of the environmental, economic and social context in which this model has been developed. Next we describe how Blue Ventures' locally led marine resource management, alternative coastal livelihood and reproductive health programmes

have evolved in this region over the last decade, including important lessons learned and adaptations made by each initiative. Then we describe how the integration of these different activities works in practice, from all-round community education to coordinated field missions. Next we outline the multifaceted impacts of this model, as experienced and reported by community members and programme staff. We conclude by noting the significant potential for replicating this integrated approach in other biodiverse and under-served areas of Madagascar, particularly through cross-sector partnerships.

## APPROACH

**TEMPORARY FISHERY CLOSURES: A FOOT-IN-THE-DOOR FOR MARINE CONSERVATION.** Blue Ventures first started working with the coastal village of Andavadoaka in 2003, in collaboration with the University of Toliara's Institut Halieutique et des Sciences Marines (IHSM) and the Wildlife Conservation Society (WCS), holding meetings with fishers to discuss the state of their marine resources and options for more sustainable management. In October 2004, community leaders decided to establish a *dina*, or local law, to implement a temporary closure of approximately 15% of their fishing grounds for several months (Harris 2007). The restriction only applied to *Octopus cyanea*, one of the village's most important commodities and a very rapidly growing species, which was therefore predicted to respond well to short-term management efforts.

Results from the first experimental octopus fishery closure, implemented between November 2004 and June 2005 with endorsement from seafood collection company Copefrito, were very promising (Harris 2007). The temporary closure boosted octopus landings and fisher incomes upon opening, resulting in an unprecedented groundswell of community interest in more ambitious marine resource management efforts (ibid). Nevertheless, catch per unit effort (CPUE) did not increase as expected following this first trial closure; an unanticipated outcome attributed to intense activity by visiting fishers ('free-riders') on the days following the reserve opening (Benbow et al. 2014). This compelled people in Andavadoaka to encourage neighbouring villages to organise their own temporary closures.

As the temporary octopus fishery closure model began to spread along the coastline, representatives from 25 villages in the region came together in Andavadoaka between July and October 2006 to propose a series of *dina* for creating a network of marine and coastal protected areas, and banning destructive practices such as poison fishing and beach seining, with community-based monitoring and locally enforced fines for infractions (Harris 2007, Andriamalala and Gardner 2010). The aim of the network is to safeguard biodiversity while improving livelihoods. It encompasses permanent coral reef and mangrove reserves, temporary octopus fishery closures, special areas for aquaculture and ecotourism, and protected dry forest zones with *Adansonia grandidieri* baobab trees. This locally managed marine area (LMMA), called Velondriake, which means "to live with the sea", covers more than 750 km<sup>2</sup> and is governed by a management committee consisting of members elected from every village in the network (Harris 2007, Mayol 2013).

**A LOCALLY LED MARINE CONSERVATION REVOLUTION.** The Velondriake LMMA is now serving as a demonstration and learning site for other fishing villages across Madagascar.

Community exchanges facilitated by Blue Ventures and partner NGOs are driving the replication of this approach to locally led marine conservation, with more than 35 other LMMAs established along Madagascar's southern, western and northern coastlines to date (Harris 2011, Mayol 2013).

Meanwhile, the temporary fishery closure model has been embraced by numerous communities; implemented over 150 times along hundreds of kilometres of coastline for reef octopus, and applied to other fisheries including mangrove crabs and spiny lobster in northern and eastern Madagascar. Blue Ventures is pursuing ways of further increasing financial incentives for fishers and seafood collectors to adopt sustainable management practices, with the traditional octopus fishery of southwest Madagascar currently engaged in the Marine Stewardship Council (MSC) eco-certification process (Harris 2011). If successful, this may afford access to premium prices.

**FARMING THE SEA FOR ALTERNATIVES TO FISHING.** In parallel with these marine resource management initiatives, Blue Ventures has also been developing community-based aquaculture in the Velondriake area since 2007 by connecting local farming teams with private sector partners, and providing them with technical support and business training. *Holothuria scabra* (sea cucumbers) are initially reared in hatcheries by private sector partner Indian Ocean Trepang (IOT), formerly Madagascar Holothurie, in the regional capital of Toliara. The juveniles are then transferred to community-run pens and grown out until they reach commercial size, when they can be harvested for international export to Asian markets by seafood collection company Copefrito (Robinson and Pascal 2009). In addition, *Kappaphycus alvarezii* (red seaweed) is cultivated along lines before being dried and sold to Copefrito.

Challenges relating to high levels of juvenile holothurian mortality following transfer to lagoonal enclosures are being addressed through the culling of predatory crabs and a number of technical improvements to pen design, which have been successful in increasing survivorship from 40% to 77% (Rougier et al. 2013). Loss of sea cucumbers through theft is another major challenge for this programme as these are highly valuable commodities with numerous traders operating in the region, and wild stocks are severely overexploited (Robinson and Pascal 2009). Farmers are tackling this problem by constructing watchtowers from which to monitor their pens, and implementing a rotation system of night guarding involving members of all farming teams in order to identify and penalise poachers (Rougier et al. 2013).

**THE FREEDOM TO CHOOSE: UPHOLDING REPRODUCTIVE RIGHTS.** In direct response to unmet reproductive health needs expressed by community members across the Velondriake LMMA, and following extensive local consultations, Blue Ventures launched a voluntary family planning service in the central village of Andavadoaka in August 2007 with the approval of community leaders and government health authorities (Mohan and Shellard 2014). The weekly drop-in clinic offers counselling and short-term contraceptive options (condoms, oral contraceptive pills and hormonal injections). Uptake of this service has been positive, with 20% of women of reproductive age from the village attending on the inaugural day alone (ibid). The opening of this clinic marked the beginning of Blue Ventures' reproductive

health programme, which enables women and their partners to choose the number and spacing of their births, and has therefore come to be known locally as *Safidy*, which means ‘the freedom to choose’.

With a broad absence of social barriers to the uptake of family planning services and significant demand from other villages, Blue Ventures went on to establish two fortnightly satellite clinics in April 2009, with further clinic sites added between 2010 and 2012. The service area expanded in May 2013 to include villages south of the Velondriake boundary where the Wildlife Conservation Society (WCS) and the World Wildlife Fund (WWF) are running community-based conservation programmes, in order to cover a total of 40 communities, home to approximately 15,000 people (Figure 1).

Long-acting reversible contraceptives (hormonal implants and intra-uterine devices) have been offered on a quarterly basis since September 2009, in partnership with Marie Stopes Madagascar’s mobile outreach teams: health professionals who travel to remote villages by 4x4 in order to offer free or subsidised contraceptive services (Marie Stopes International 2014). Blue Ventures is responsible for informing communities about this service. Long-acting reversible contraceptives broaden the range of methods available, reduce the risk of contraceptive failure through inadequate compliance, and address the considerable logistical challenges of providing regular clinics in the more isolated parts of Velondriake (Harris et al. 2012).

**COMMUNITY HEALTH WORKERS TRAINED TO PROVIDE VILLAGE-LEVEL SERVICES.** In view of the resource-intensive nature of clinic-based service delivery, a different approach was needed in order to meet the significant demand for counselling and contraceptives across such a large and remote area. Shifting the provision of short-term contraceptive methods to community health workers is recommended to improve access to family planning in resource-poor settings (IRIN News 2013, World Health Organization 2013). Blue Ventures therefore decided to introduce community-based reproductive health service delivery in Velondriake by recruiting and training 33 local women as community-based distributors (CBDs) of contraceptives in June 2010, in collaboration with Population Services International (PSI).

These CBDs are able to offer condoms, oral contraceptive pills and hormonal injections according to clear protocols and guidelines; they are supplied with these products at cost price and sell them to clients at very affordable retail prices set by PSI. For example, a one-month pack of oral contraceptive pills is sold for 100 MGA, which is approximately \$US0.05. This provides the CBDs with a little financial compensation for their otherwise voluntary work. They submit monthly reports to Blue Ventures, which are collated and shared with the Ministry of Health, and attend quarterly review training sessions run by Blue Ventures’ midwife for quality assurance in line with national best practice (Gallo et al. 2013). Thanks to the extensive coverage provided by CBDs, all villages within the Velondriake LMMA are now no more than five kilometres from a reproductive health service point. A total of 3,531 clinic consultations and 9,187 CBD consultations were held by the end of the programme’s sixth year in July 2013, with a significant and growing preference for community-based services (Figure 2).

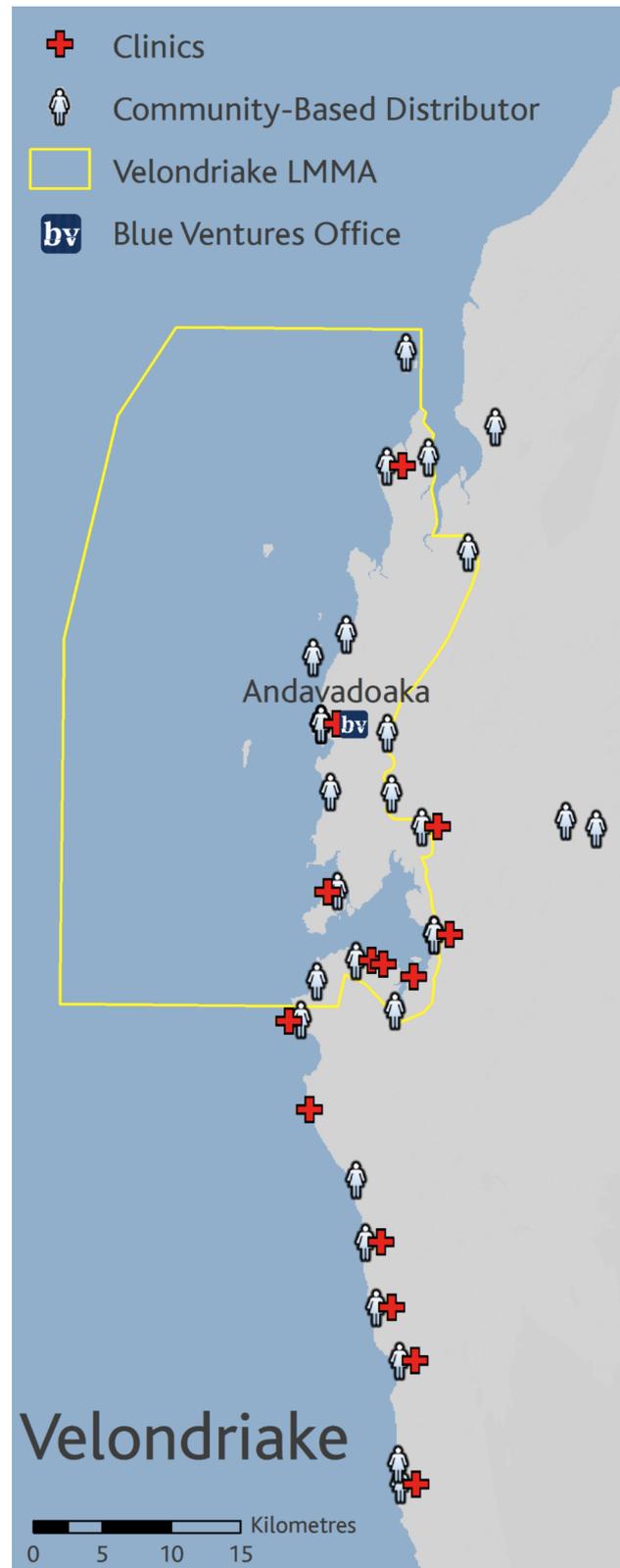


Figure 1. The *Safidy* programme service area.

**CONNECTING THE DOTS: INTEGRATION IN PRACTICE.** All of these initiatives, from marine resource management and aquaculture to family planning, are underpinned by a programme of community education, designed to promote the uptake of healthier and more environmentally sustainable practices. Village outreach tours have been running since August 2011, with health and conservation staff engaging over 5,000 community members

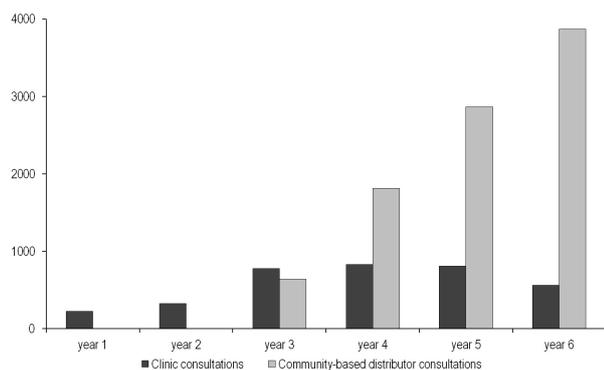


Figure 2. Number of clinic and community-based distributor consultations held by the *Safidy* programme in Velondriake between mid 2007 and mid 2013.

across the Velondriake LMMA every quarter through school workshops, youth club sessions and interactive presentations using music, drama, films and educational games (Mohan and Shellard 2014). Combining health, livelihood and environmental topics enables the organisation to reach broader audiences. For example, discussions about the links between reproductive health and food security involve women in decision-making about fisheries management and men in family planning (ibid). These educational activities form the cornerstone of Blue Ventures' integrated Population-Health-Environment (PHE) approach, which enables the organisation to engage with communities through a variety of entry points and thereby strengthen participation across the breadth of its programmes.

In addition to village outreach tours, peer education by CBDs targets people at all stages of the behaviour change process, from raising awareness to encouraging the sustained adoption of healthier and more environmentally responsible behaviours. This is further complemented by social marketing campaigns, with promotional merchandise such as t-shirts and pirogue sails branded with illustrations depicting key conservation and health messages, designed to positively influence attitudes and practices (Andriamalala et al. 2013). Frequent radio broadcasts featuring songs and short theatre sketches are also used to reach isolated populations with information, promote discussion and support behaviour change.

Conservation, fisheries, aquaculture, health and education staff based in the central village of Andavadoaka hold weekly meetings to ensure regular information exchange and coordination of activities, with internal monthly news updates from programme managers to the entire team. Joint field missions allow programmes to 'boat pool' or 'car pool', thus reducing travel costs and facilitating the sharing of staff or equipment such as generators and projectors. The organisation's annual three-day conference brings together its entire Madagascar team to reflect on progress made across all programmes, and to identify further opportunities for cross-sector working.

## IMPACTS

**TEMPORARY OCTOPUS FISHERY CLOSURES.** Data collected from eight years (2004–2012) of temporary octopus fishery closures and over 250,000 landed octopus in southwest Madagascar demonstrate significant closure effects in site-based fishery patterns and village-level incomes, with catch per unit effort and revenues increasing significantly in the month following octopus reserve openings, and no major decline in revenues during the closures (Oliver et al. In lit.).

**SEAWEED AND SEA CUCUMBER FARMING.** Aquaculture is proving to be an economically lucrative and socially viable livelihood activity in the Velondriake LMMA, with 184 farming teams earning over \$US10,000 in 2012, and participants reporting a reduced reliance on fishing for income-generation (Tampolove Village Leader, pers. comm.).

**REPRODUCTIVE HEALTH SERVICE PROVISION.** A total of 9,730 oral contraceptive pill packs (each providing one month of contraceptive protection), 3,101 depo-provera injections (each providing three months of contraceptive protection), 293 implanon implants (each providing up to three years of contraceptive protection) and 60 intra-uterine devices (each providing up to ten years of contraceptive protection) were provided through the *Safidy* programme between August 2007 and July 2013 (Mohan and Shellard 2014); equivalent to 2,432.4 couple years of protection (Figure 3). One couple year of protection represents one year of protection from unintended pregnancy for one couple, calculated by multiplying the number of contraceptives distributed by conversion factors relating to the duration of protection offered and the risk of inadequate compliance or contraceptive failure (Stover et al. 2000, Corby et al. 2009, USAID 2011).

Preliminary, anecdotal reports from community members and programme staff in Velondriake suggest that this integrated PHE approach enables couples to plan and better provide for their families, empowers women, improves food security and directly supports the sustainability of local conservation efforts. Should couples choose to space or limit their births, anthropogenic pressure on natural resources is reduced. The distribution of contraceptives through the *Safidy* programme between August 2007 and July 2013 is estimated to have averted a total of 804 unintended pregnancies among a population of approximately 15,000 people, calculated using Marie Stopes International's Impact 2 toolkit.

**WOMEN'S EMPOWERMENT.** As women gain access to family planning services, they report acquiring a greater sense of self-efficacy, and being able to spend more time engaging in income-generating and marine resource management activities by spacing or limiting their births (*Safidy* Community Organiser, pers. comm.). This particularly applies to the organisation of temporary octopus fishery closures and aquaculture farms, both of which involve high levels of female participation (Robinson and Pascal 2009, Barnes-Mauthe et al. 2013). Revenues generated through octopus gleaning and aquaculture are typically used by

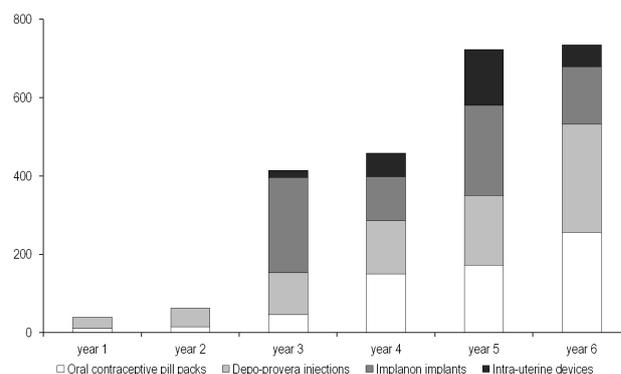


Figure 3. Number of couple years of protection provided by the *Safidy* programme in Velondriake between mid 2007 and mid 2013.

women to purchase food, reinforce houses and pay for children's education or medical care (Westerman et al. 2012). These findings correspond with evidence from studies of PHE programmes in the Philippines and Ethiopia, which show that integrating reproductive health services with sustainable livelihood and environmental initiatives can alleviate income poverty and empower women to play a more active role in natural resource management (D'Agnes et al. 2010, Belachew et al. 2013).

Overall, this integrated PHE approach is reported to enable Velondriake communities to live more healthily and sustainably alongside the marine environment upon which their livelihoods depend. "Family planning lets couple choose how many children they have, while marine reserves help to increase fish catches. If the population isn't growing so rapidly and the fish catches are increasing, then we can have a better balance between fish stocks and our population. This means that people and the environment can live together, and we all benefit from this" (President of the Velondriake Association, pers. comm.).

**A WIN-WIN FOR CONSERVATION AND HEALTH AGENCIES: PARTNERSHIPS DRIVE ADOPTION.** Strong cross-sector partnerships have been fundamental to the development of this integrated PHE approach in Velondriake. Academic institutions such as the University of Toliara's IHSM, private sector partners such as Copefrito and IOT, health agencies such as Marie Stopes Madagascar and PSI, and conservation organisations such as WCS and WWF all contribute their respective expertise alongside Blue Ventures' interdisciplinary team. This experience demonstrates how the integration of community-based reproductive health services with locally led conservation initiatives can be a win-win approach for conservation and health agencies alike.

From an environmental perspective, the immediacy of reproductive health service benefits to Velondriake communities is reported to help bolster long-term support for the relatively 'slower-burn' progress of local conservation initiatives (Blue Ventures' Conservation Coordinator, pers. comm.). Communities are also seen to be healthier now, and therefore more able to engage in natural resource management activities than before these services were introduced (Blue Ventures' Medical Director, pers. comm.). From a health perspective, partnering with a well-established conservation organisation working in a highly remote and under-served area has enabled the delivery of family planning services to reach otherwise hard to reach populations, through leveraging Blue Ventures' existing operational infrastructure and strong community relations (Marie Stopes Madagascar Country Director, pers. comm.).

## CONCLUSION

Blue Ventures' integrated approach to community-based conservation and development has evolved progressively in the Velondriake area through a decade of engaging with local communities, understanding their needs and the threats to the ecosystems upon which their livelihoods depend, and supporting them to implement pragmatic solutions in collaboration with numerous partners. The learning derived from this experience has been distilled into a replicable PHE model, which Blue Ventures is now expanding further north along Madagascar's western coastline in the Belo sur Mer area; integrating community-based reproductive health services and aquaculture trials with existing mangrove fishery management efforts.

By mirroring the inextricable links between people, their health and the environment, PHE offers a powerful and locally adaptable way of supporting community-based conservation and development. There is great potential for replicating this integrated model in other marine and terrestrial biodiversity hotspots throughout Madagascar, with growing recognition among conservation and health agencies of the mutually beneficial synergies that can be generated through cross-sector partnerships. For example, the Duke Lemur Center recently started collaborating with Marie Stopes Madagascar's community health workers in order to provide remote villages around Marojejy National Park in the Sava region of northern Madagascar with access to contraceptives (Welch and Patel 2013), and Blue Ventures is supporting other organisations to explore similar partnerships through the Madagascar PHE Network. Such holistic initiatives break the mould with their joined-up thinking; bridging traditional siloes to address unmet family planning needs, uphold women's reproductive rights, and directly support the sustainability of community-based natural resource management efforts by enabling couples to freely choose the number and spacing of their births. Now is the time to scale up this integrated approach in order to safeguard Madagascar's unique natural heritage, and the irreplaceably diverse ecosystems upon which the livelihoods of millions depend.

## ACKNOWLEDGEMENTS

We extend our thanks to Joerg Ganzhorn and Erik Patel for inviting us to contribute to this special issue, and to Ian Colquhoun, Josia Razafindramanana, Lena Reibelt and Juliane Novack for coordinating our inclusion. Thanks also to Alasdair Harris for input on the manuscript, to Garth Cripps and Brian Jones for their photos, and to Leah Glass for the map. The activities described in this paper have been made possible through the invaluable support of numerous partners; several are mentioned in the manuscript and a full list is available on Blue Ventures' website: [www.blueventures.org](http://www.blueventures.org).

## REFERENCES

- Agarwal, K. 2013. Allowing women to nurture themselves and their children before giving birth again. USAID Blog. Available at <<http://blog.usaid.gov/2013/05/allowing-women-to-nurture-themselves-and-their-children-before-giving-birth-again>>
- Ahmed, S., Li, Q., Liu, L. and Tsui, A. O. 2012. Maternal deaths averted by contraceptive use: an analysis of 172 countries. *Lancet* 380, 9837: 111–125. Available at <[http://www.thelancet.com/journals/a/article/PIIS0140-6736\(12\)60478-4/fulltext](http://www.thelancet.com/journals/a/article/PIIS0140-6736(12)60478-4/fulltext)>
- Andriamalala, G. and Gardner, C. J. 2010. L'utilisation du dina comme outil de gouvernance des ressources naturelles: leçons tirées de Velondriake, sud-ouest de Madagascar. *Tropical Conservation Science* 3, 4: 447–472.
- Andriamalala, G., Peabody, S., Gardner, C. J. and Westerman, K. 2013. Using social marketing to foster sustainable behaviour in traditional fishing communities of southwest Madagascar. *Conservation Evidence* 10: 37–41.
- Astuti, R. 1995. *People of the Sea: Identity and Descent Among the Vevo of Madagascar*. Cambridge University Press, Cambridge, UK.
- Barnes-Mauthe, M., Oleson, K. L. L. and Zafindrasilivonona, B. 2013. The total economic value of small-scale fisheries with a characterization of post-landing trends: An application in Madagascar with global relevance. *Fisheries Research* 147: 175–185. (doi:10.1016/j.fishres.2013.05.011)

- Belachew, T., Sinaga, M., Mohammed, A., Teklu, N. and Stelljes, K. 2013. Effectiveness of the PHE approach for achieving family planning and fertility outcomes in Ethiopia: a comparative study in the Gurage zone. MEASURE Evaluation PRH Working Paper Series. Available at <<http://www.cpc.unc.edu/measure/publications/wp-13-134>>
- Benbow, S., Humber, F., Oliver, T., Oleson, K., Raberinary, D., Nadon, M., Ratsimbazafy, H. and Harris, A. 2014. Lessons learnt from experimental temporary octopus fishing closures in southwest Madagascar: benefits of concurrent closures. *African Journal of Marine Science* 36, 1: 31–37. (doi:10.2989/1814232X.2014.893256)
- Cooke, A., Ratomahenina, O. and Ranaivoson, E. 2000. Madagascar. In: *Seas at the Millennium*, C. Sheppard (ed.), pp 113–131. Elsevier Science Press, Oxford, UK.
- Corby, N., Boler, T. and Hovig, D., 2009. The MSI impact calculator: methodology and assumptions. Available at <[http://www.mariestopes.org/sites/default/files/MSI impact calculator \\_methodology.pdf](http://www.mariestopes.org/sites/default/files/MSI%20impact%20calculator_methodology.pdf)>
- D'Agnes, L., D'Agnes, H., Schwartz, J. B., Amarillo, M. L. and Castro, J. 2010. Integrated management of coastal resources and human health yields added value: a comparative study in Palawan (Philippines). *Environmental Conservation* 37, 4: 398–409. (doi:10.1017/S0376892910000779)
- Gallo, M. F., Walldorf, J., Kolesar, R., Agarwal, A., Kourtis, A. P., Jamieson, D. J. and Finlay, A. 2013. Evaluation of a volunteer community-based health worker program for providing contraceptive services in Madagascar. *Contraception* 88, 5: 657–665. (doi:10.1016/j.contraception.2013.06.008)
- Harris, A. 2007. "To live with the sea": development of the Velondriake community-managed protected area network, southwest Madagascar. *Madagascar Conservation & Development* 2, 1: 43–49. (doi:10.4314/239)
- Harris, A. 2011. Out of sight but no longer out of mind: A climate of change for marine conservation in Madagascar. *Madagascar Conservation & Development* 6, 1: 7–14. (doi:10.4314/mcd.v6i1.68058)
- Harris, A., Mohan, V., Flanagan, M. and Hill, R. 2012. Integrating family planning service provision into community-based marine conservation. *Oryx* 46, 2: 179–186. (doi:10.1017/S0030605311000925)
- INSTAT. 2010. Enquête démographique et de santé: Madagascar 2008–2009. Institut National de la Statistique, Antananarivo, Madagascar. Available at <<http://www.instat.mg/pdf/eds2008-2009.pdf>>
- IRIN News. 2012. Madagascar: A Decaying Health Sector. IRIN News. Available at <<http://www.irinnews.org/report/95533/madagascar-a-decaying-health-sector>>
- IRIN News. 2013. Volunteer Health Workers Filling the Void in Madagascar. IRIN News. Available at <<http://www.irinnews.org/report/98482/volunteer-health-workers-filling-the-void-in-madagascar>>
- L'Haridon, L. 2006. Evolution de la Collecte de Poulpe sur la Côte Sud-ouest de Madagascar: Eléments de Réflexion pour une Meilleure Gestion des Ressources. Blue Ventures Conservation report. Available at <[http://blueventures.org/downloads/bv-research-report-2006-haridon-copefrito-report\\_fr.pdf](http://blueventures.org/downloads/bv-research-report-2006-haridon-copefrito-report_fr.pdf)>
- Le Manach, F., Gough, C., Harris, A., Humber, F., Harper, S. and Zeller, D. 2012. Unreported fishing, hungry people and political turmoil: the recipe for a food security crisis in Madagascar? *Marine Policy* 36, 1: 218–225. (doi:10.1016/j.marpol.2011.05.007)
- Marie Stopes International. 2014. Clinical Outreach. <<http://mariestopes.org/what-we-do/clinical-outreach>> accessed 6 August 2014.
- Mayol, T. 2013. Madagascar's nascent locally managed marine area network. *Madagascar Conservation & Development* 8, 2: 91–95. (doi:10.4314/mcd.v8i2.8)
- Mohan, V. and Shellard, T. 2014. Providing family planning services to remote communities in areas of high biodiversity through a Population-Health-Environment programme in Madagascar. *Reproductive Health Matters* 22, 43: 93–103. (doi:10.1016/S0968-8080(14)43766-2)
- Robinson, G. and Pascal, B. 2009. From hatchery to community: Madagascar's first village-based holothurian mariculture programme. *SPC Beche-de-Mer Information Bulletin* 29: 38–43. Available at <[http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/BDM/29/BDM29\\_38\\_Robinson.pdf](http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/BDM/29/BDM29_38_Robinson.pdf)>
- Rougier, A., Ateweberhan, M. and Harris, A. 2013. Strategies for improving survivorship of hatchery-reared juvenile *Holothuria scabra* in community-managed sea cucumber farms. *SPC Bêche-de-mer Information Bulletin* 33: 14–22. Available at <<http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/BDM/33/BDM33.pdf>>
- Setty-Venugopal, V. and Upadhyay, U. D. 2002. Birth Spacing: Three to Five Saves Lives. *Population Reports Series L*, 13: 1–23. Available at <<http://www.k4health.org/sites/default/files/l13.pdf>>
- Stover, J., Bertrand, J. T. and Shelton, J. D. 2000. Empirically based conversion factors for calculating couple years of protection. *Evaluation Review* 24, 1: 3–46. (doi:10.1177/0193841X0002400101)
- UNFPA. 2011. State of the World's Midwifery Report: Madagascar Overview. Available at <[http://www.unfpa.org/sowmy/resources/docs/country\\_info/profile/en\\_Madagascar\\_SoWMy\\_Profile.pdf](http://www.unfpa.org/sowmy/resources/docs/country_info/profile/en_Madagascar_SoWMy_Profile.pdf)>
- USAID. 2011. Family planning and reproductive health indicators database: updated couple years of protection (CYP) conversion factors. MEASURE Evaluation PRH. Available at <[http://www.cpc.unc.edu/measure/prh/rh\\_indicators/specific/fp/cyp](http://www.cpc.unc.edu/measure/prh/rh_indicators/specific/fp/cyp)>
- USAID, World Health Organization and UNFPA. 2009. Family planning for health and development. Available at <<http://www.fhi360.org/sites/default/files/media/documents/family-planning-health-development-uganda-conference.pdf>>
- Welch, C. and Patel, E. 2013. Marie Stopes International: A new collaboration. Duke Lemur Center's SAVA Conservation Newsletter 2, 3: 2–3. Available at <<http://www.connect-technology.net/Clients/SAVA/Nov2013/index.html>>
- Westerman, K., Oleson, K. L. L. and Harris, A. 2012. Building socio-ecological resilience to climate change through community-based coastal conservation and development: Experiences in southern Madagascar. *Western Indian Ocean Journal of Marine Science* 11, 1: 87–97.
- World Health Organization. 2013. Task Shifting to Improve Access to Contraceptive Methods. World Health Organization report. Available at <[http://apps.who.int/iris/bitstream/10665/94831/1/WHO\\_RHR\\_13.20\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/94831/1/WHO_RHR_13.20_eng.pdf)>

## ARTICLE

<http://dx.doi.org/10.4314/mcd.v10i1.S3>

# Ten years into the marshes – *Hapalemur alaotrensis* conservation, one step forward and two steps back?

Antje Rendigs<sup>I</sup>, Lena M. Reibelt<sup>II</sup>, Fidimalala B. Ralainasolo<sup>III</sup>, Jonah H. Ratsimbazafy<sup>IV</sup>, Patrick O. Waeber<sup>V</sup>

Correspondence:  
Antje Rendigs  
Madagascar Wildlife Conservation  
Ambatondrazaka, Madagascar  
E-mail: antjrendigs@posteo.de

## ABSTRACT

Natural resource management problems typically involve a multitude of stakeholders with diverse sets of needs and interests, and often conflicting worldviews in an environment with growing uncertainty. Such problems are termed “wicked” problems, where there are no right or wrong solutions, only more or less acceptable ones. In the case of Lake Alaotra, growing agricultural pressures have a negative impact on the wetland biodiversity and especially on the Alaotra gentle lemur (*Hapalemur alaotrensis*) restricted to these marshlands. The species survival is highly uncertain because of increased habitat loss caused mainly by marshland fires. The conservation work for this unique lemur is complex and complicated and requires the involvement and collaboration of decision-making institutions, NGOs, universities and riverine communities. From the inception of projects to their implementation phase, all parties need clearly defined responsibilities and transparency in communication in order to run projects successfully. This article describes the approach that Madagascar Wildlife Conservation has been implementing during the past ten years at Lake Alaotra, discussing the plan of action and challenges for environmental education, ecotourism and alternative livelihoods.

## RÉSUMÉ

Les problèmes de gestion des ressources naturelles impliquent généralement une multitude d'intervenants avec divers ensembles de besoins et d'intérêts, et souvent, les visions du monde contradictoires dans un environnement avec une incertitude croissante. Ces problèmes sont appelés problèmes sournois, 'wicked problems' en anglais, où il n'y a pas de bonnes ou de mauvaises solutions, seules plus ou moins acceptables. Dans le cas du lac Alaotra, la croissance des pressions agricoles a un impact négatif sur la biodiversité des zones humides, et en particulier sur l'Alaotra lémurien douce (*Hapalemur alaotrensis*)

limitée à ces marais. La survie de l'espèce est très incertaine en raison de l'augmentation de la perte d'habitat causée principalement par les feux de marais. Les travaux de conservation pour ce lémurien unique sont complexes et compliqués, et nécessitent l'implication et la collaboration sur la prise de décision des institutions, des ONG, des universités et des communautés riveraines. Cela implique que toutes les parties, depuis la création de projets à leur phase de mise en œuvre, partagent un terrain d'entente avec les avantages clairement définis de pouvoir de décision, les responsabilités et la transparence dans la communication. Madagascar Wildlife Conservation a travaillé sur le lac depuis plus de dix ans, y compris l'éducation environnementale, l'écotourisme et les moyens de subsistance alternatifs dans le plan d'action. Cet article met en évidence l'approche adoptée et examine ses défis.

## INTRODUCTION

Madagascar is renowned for its high endemic biological diversity, rich forests and a wealth of natural resources (Ganzhorn et al. 2001, Randriamalala and Liu 2010, Raharimahefa 2012). However, the country is also plagued by environmental degradation, low agricultural productivity and poverty; over 80% of the population lives below the poverty line of \$US 1.25 a day. The country ranks 151 out of 186 in the UNDP Human Development Index (UNDP 2013). Since 2009, political instability has further undermined economic development, amid a global financial crisis that has accentuated impacts on the poor, leading to increased food insecurity (Randrianja 2012). The political instability and the connected break-down in law and order has also directly weakened conservation efforts such as the prevention of rosewood trade (Schuurman and Lowry 2009, Innes 2010, Randriamalala and Liu 2010), or fuelled the crisis in the tortoise trade in the southwest of Madagascar (Hudson 2013). Furthermore, the country is at risk of increased

I Madagascar Wildlife Conservation, Lot 14433 Atsimondrova, Ambatondrazaka, Madagascar

II University of Hildesheim, Ecology and Environmental Education Group, Institute of Biology and Chemistry, Marienburger Platz 22, 31141 Hildesheim, Germany

III Durrell Wildlife Conservation Trust, BP 8511, Antananarivo, Madagascar

IV Groupe d'Etude et de Recherche sur les Primates de Madagascar (GERP), Ankatso, Antananarivo, Madagascar

V ETH Zurich, Ecosystems Management, Forest Management and Development Group, Universitaetstrasse 16, 8092 Zurich, Switzerland

vulnerability and degradation from anticipated climate change (Hannah et al. 2008).

THE 'RICE BOWL' OF MADAGASCAR. Agriculture alone provides around 27% of GDP (gross domestic product), 40% of exports and ensures a living to about 75% of the Malagasy population (Institut National de la Statistique 2011). The primary economic driver in the two Lake Alaotra districts Ambatondrazaka and Amparafaravola is based on fishery and rice production, providing one third of the country's rice output (Andrianandrasana et al. 2005). The area is characterized by terraced, rice-growing valleys lying between grassy, deforested hills. There are three types of rice production: irrigated (surrounding the marsh belt of Lake Alaotra), rain-fed (on the hill slopes of the Alaotra basin), and *contre-saison* (within the marshlands of Lake Alaotra). The two lake districts are the biggest rice producing areas in the Alaotra-Mangoro, totaling 345,265 tons (irrigated production), 20,000 tons (rain fed) and 17,400 tons (*contre-saison*), respectively (Monographie Régionale 2012).

The (agro-) economic importance of the Alaotra-Mangoro (such as rice, fish, artisanal and industrial mining) has encouraged human migration into the region. The population has thus increased from some 110,000 people in the 1960s to nearly 550,000 in 2010 for the regions of Amparafaravola and Ambatondrazaka (Institut National de la Statistique 2012). The growing demand for arable land coupled with a continuously dwindling productivity per unit of agriculture (Bakoariniaina et al. 2006) is leading to increased destruction of marshlands, putting additional pressures on marshland biodiversity. The forests around Lake Alaotra have been replaced, probably post-LGM (last glacial maximum; Waeber et al. 2015a) by open landscapes showing the typical *lavaka* (erosion gully) features widespread in the region (Kusky et al. 2010). Some 250,000 zebu pasture the hill slopes (Ministère de l'Élevage 2013) contributing further to the exposed landscapes (for example, burning for fodder production, or mechanical trampling of soil). Downhill sedimentation and siltation are affecting Lake Alaotra by reducing its size, which ranges between 35–40 km length and 5–9 km width, depending on the season (Bakoariniaina et al. 2006). These erosion effects are accentuating the pressures also felt on the surrounding rice fields, for example reducing its productivity (Raharijaona-Raharison and Randrianarison 1999).

ALIEN PRESSURE. The water hyacinth (*Eichhornia crassipes*) originating from South America, is known as one of the most invasive plant species worldwide (Villamanga and Murphy 2010). Reducing fish stock and diversity (e.g., Gratwicke and Marshall 2001), causing waterway clogging, but also worsening of water quality are some of the effects of *E. crassipes* invasion (see Mangas-Ramirez and Elias-Gutierrez 2004, Villamanga and Murphy 2010), which can cause also economic and social burden for the local population (Gunnarsson and Petersen 2007). Many fishing grounds are not accessible anymore and fishermen either have to invest in clearing waterways or burn further marshland vegetation for better access to fishing grounds. In the Alaotra wetland system, mostly endemic fish species are impacted by *E. crassipes* whereas exotic fish such as *Tilapia spp.* and more so *Channa maculata* can still persist in water with lower oxygen levels (Pidgeon 1996, Courtenay and Williams 2004).

MARSHLANDS AND ITS BIODIVERSITY DISAPPEARING 'IN A PUFF OF SMOKE'. Madagascar's forests have always been the focus of the international conservation community due to its rich biodiversity. That is, the high degree of endemism and level of threat found in these unique forests. Only since the beginning of the 2000s have wetlands begun receiving some conservation attention. Since 2003, Lake Alaotra and its wetlands were designated a Ramsar site (Ramsar site no. 1312), and in 2007 the area also received NAP status (*Nouvelle Aire Protégée*; new protected area; N°381-2007/ MINENVEF/MAEP, 17 January 2007). Lake Alaotra is the largest freshwater lake in Madagascar and with an average depth of 1–2.5 m a shallow water body (Ferry et al. 2009).

The fringing marshland vegetation is dominated by reed (*Phragmites communis*) and cyperus (*Cyperus madagascariensis* and *C. latifolius*). Some unusual, endemic mammals have a narrow range limited to the lake, such as the Durrell mongoose (*Salanoia durrelli*), discovered in 2004 (Durbin et al. 2010) and the Alaotra gentle lemur (*Haplemur alaotrensis*). This is the only swamp-dwelling primate (Mutschler et al. 2001, Waeber et al. 2015b). Genetically a congener of the forest-dwelling *Haplemur griseus*, *H. alaotrensis* is ecologically adapted to marshland conditions (Mutschler and Feistner 1995, Mutschler et al. 2001, Mutschler 2002, Waeber et al. 2015c). However, the future of this primate, classified by the IUCN as Critically Endangered (IUCN 2013a), is highly uncertain given the continuously growing pressures on the marshland ecosystem, mainly in the form of marshland fires (Guillera-Arroita et al. 2010a, b, Ratsimbazafy et al. 2013a); the last population estimations from 2005 reported numbers below 3,000 individuals (Ralainasolo et al. 2006).

This article presents ten years of conservation efforts at Lake Alaotra, analyzing the conservation approach taken by Madagascar Wildlife Conservation (MWC), which is based on a multilayered community involvement. The findings are critically discussed, including which approaches worked and especially which did not, serving to share MWC's experiences in wildlife and conservation management.

## STRATEGIES AND OBJECTIVES

The Alaotra wetlands, important agriculturally and host to unique fauna represent a complex and complicated system (*sensu* Pietronero 2008). The challenge is seeking a balance between conservation and development or as Murphree (2002: 2) states "if conservation and development could be simultaneously achieved, the interest of both could be served (...)". By ensuring the maintenance of marshland ecosystem services and function, both the livelihood of the riverine communities as well as the survival of *Haplemur alaotrensis* could be served. A positive example of achieving this is the temporary fishing closure around Lake Alaotra (15 November–15 January). The result was an increase in fish size and with that corresponded improved prices at the local markets, at least during the period 2002–2008 (J. Randriamahefasoa pers. observ.). Acting in a complex system requires the analysis of various scales and value-dimensions simultaneously in order to avoid the 'one correct perspective' (Berkes 2004). There are many different actors, each with their own value system, needs and agendas. To address this 'wicked problem' (*sensu* Rittel and Webber 1973), MWC pursues a multilayered, multipurpose and transdisciplinary approach (cf. Sayer et al. 2008, Selman 2009), with the following strategies and objectives:

Prioritizing conservation zones: The Park Bandro (local name of the Alaotra gentle lemur) is situated in the marshes of the village Andreba Gare and is classified as *Zone Prioritaire de Conservation* (priority conservation zone; ZPC), which is the highest conservation category within the NAP. Within an area of 85 hectares, it shelters the highest density of *H. alaotrensis* found in the Alaotra region (Ratsimbazafy et al. 2013a). The high population size can be attributed to the protected zone, which allows for continuous reproduction but prevents migration due to its isolation. The objectives of this conservation strategy are to (i) maintain a core sub-population that can act as a source, or population pool, for linking with other sub-populations; (ii) showcase the natural habitat for the people of Andreba and other villages; this park can act as an 'open class-room' for various resource user groups; and, (iii) attract tourists who are interested in a unique primate that thrives in marsh habitat. The ultimate and overall goal of this park is to increase the chances of the survival of the lemur in its natural environment.

Valuing the 'Bandro': By promoting the flagship species *H. alaotrensis*, tourists can visit the region and hence create local value for an intact marshland ecosystem (see Durbin 1999, Feistner 1999, Thalmann 2006, Durbin et al. 2007). The Camp Bandro just outside the village Andreba Gare and close to the lake provides five bungalows, one cafeteria, and sanitation facilities. The ecotourism infrastructure in place allows community members to source additional income (for example, by working as guides, cooks and providing accommodation). This model results in benefits for individual members and has indirect benefits to the entire community.

Increasing environmental awareness: This strategy focuses its efforts on the main future resource users: primary school children who are encouraged to learn, take interest, appreciate and understand their environment. Education is a prerequisite for a better standard of living as well as a founding contributor towards wildlife conservation (UNDP 2013). The school children around Lake Alaotra are motivated to engage actively in the sustainable use of their natural and agricultural resources through educational comic books and posters used in the school lessons, interactive material for group work and excursions onto the lake. Environmental education increases awareness towards environmental issues, raises public sensitivity and appreciation for the importance of an intact lake and preserved marshes and offers ideas for positive action (Ehrlich et al. 2008, MENRS 2008). Teachers naturally play a key role in education delivery and receive regular trainings.

Encouraging new perspectives: A majority of community members sustain their livelihood through different sources. In order to ease the pressure of marshland natural resources, one objective is to identify potential resources (What kind of resources are un-used so far?) and test new resources that are available and accessible to a majority of the community (What is technically and economically feasible? What is socially and culturally acceptable?). The invasive *Eichhornia crassipes* represents a promising option for alternative or supplement sources of income.

## IMPLEMENTATION

LINKING MARSHLAND CONSERVATION AND TOURISM: HOW TO ENGAGE COMMUNITIES? In 2004, 85 hectares of intact and dense marshland vegetation were put under protection by DREF with the support of the Durrell Wildlife Conservation Trust

in the Andreba *fokontany* (village). Park Bandro hosts the biggest *Hapalemur alaotrensis* sub-population with an estimated 170 individuals (Ratsimbazafy et al. 2013a).

The VOI (*vondron' olona ifotony*, community-based natural resource management association), founded in 2001, is responsible for the management of the park, which comprises maintenance of the canals (such as freeing them from *Eichhornia crassipes*, other congestive vegetation and mud) as well as regular patrolling to enforce park boundaries. The park can be accessed by *pirogues* and likely offers the prime viewing location for *H. alaotrensis*.

In 2005, MWC started its ecotourism project. Ecotourism has the potential to increase the acceptance of a protected area, as it offers an alternative source of income to the people of the adjacent villages (Ormsby and Kaplin 2005). The guides who collaborate with MWC have been trained, and collaborative initiative with the local VOI has been established to ensure benefits for villagers. For each boat visiting the park, the VOI receives a portion of income that contributes to park management. In a subsequent phase, Camp Bandro is host to tourists that visit the park in early morning hours. The camp is presented in Sihanaka style (ethnic group from the Alaotra) and run by locals from the Andreba Gare community. Starting with 17 visitors in 2007 the number of tourists has gradually increased to over 50 per year. Additionally, the camp is used as a base for researchers working adjacent to Lake Alaotra as well as for workshops for local organizations. MWC also uses its income to support community-based microprojects. The local MWC Andreba section, together with representatives from the Andreba Gare community, prioritizes which community projects to support using the camp's revenue. Market stalls in Andreba's market place, pirogues (small boats) for the park visit, a soccer tournament, or the World Lemur Festival Andreba have so far been financially supported. During these community celebrations, MWC highlights the link between the intact marshes, Park Bandro, the Camp Bandro and the tourists that come to visit the area to view lemurs.

TARGETING FUTURE RESOURCE USERS. In 2006, MWC started the Comic project *Arovy fa harena* (protecting natural wealth), producing comic books aimed at primary school-aged children in the Alaotra region to increase knowledge, understanding and awareness of the regional characteristics of the ecosystem and ecological relationships. In eight short episodes, the main characters (children and animals) introduce their respective worlds and values to each other in a manner that is accessible to children and culturally adapted to the region. The conservation messages include marsh burning, fishing, *H. alaotrensis* biology, the importance of reed and *Cyperus*, and reforestation (cf. Maminirina et al. 2006). The comic books have been distributed in twelve elementary schools around the lake (Figure 1) and teachers have been trained during annual workshops in ecology, biodiversity, and environmental issues. To date, 100 teachers, school directors and members of the school authorities have been trained and 3,000 of the comic books have been distributed in schools around the lake.

To assess the impact of the comic books on school children's knowledge and understanding of ecosystem-related topics, an evaluation was conducted with structured questionnaires in a control group design with three survey periods; before, immediately following, and one year after introducing the comic

books into the school program. Out of the 540 test pupils, one group per school was equipped with additional material encouraging interactive learning, while another group served as a control. That is, they did not have contact to the environmental education material. Initial analyses confirmed a trend of increased knowledge after the introduction of the comic books into the school lessons (Dolins et al. 2010); this effect has been increased when teachers used the supplementary interactive teaching material. Even after one year, the increased levels of knowledge were sustained, confirming teachers' anecdotal evidence that the comic books are still of utility. Some of the comic classes have been selected to visit Park Bandro during a school excursion to view *H. alaotrensis* in its natural environment; the majority of children in the Alaotra region have never seen a lemur. This is generally the case across Madagascar (Ratsimbazafy 2003).

In order to complement the educational material, MWC developed an educational poster in collaboration with the McCrea Foundation, Durrell, UNICEF and the Ako Project in 2011 on which of Alaotra's biodiversity is presented. The benefits of a healthy environment – such as ecosystem services – for animals and humans are explained in Malagasy and English illustrating the characteristic fauna of the region. These posters have been distributed in all schools that are working with MWC. The latest MWC training in collaboration with ENS Antananarivo (École Normale Supérieure) and the participation of 35 teachers at the end of 2013 addressed, besides ecological and educational topics, how to implement the comic books and the educational posters into different school lessons such as Malagasy, French, geography and mathematics.

Current research carried out within the AMBio project, a collaboration between MWC and University of Hildesheim, Germany, focuses on a long-term and sustainable approach to providing environmental education in Alaotra's primary schools. Interviews and group meetings help assess the status quo of environmental education and identify drivers and barriers for further development (cf. Reibelt et al. 2014). The aim is to create interactive, locally and culturally-adapted teaching tools that will find wide-spread application due to their practicality, convenience and favorable cost-benefit-ratio thereby ensuring long-term utilization of the material.

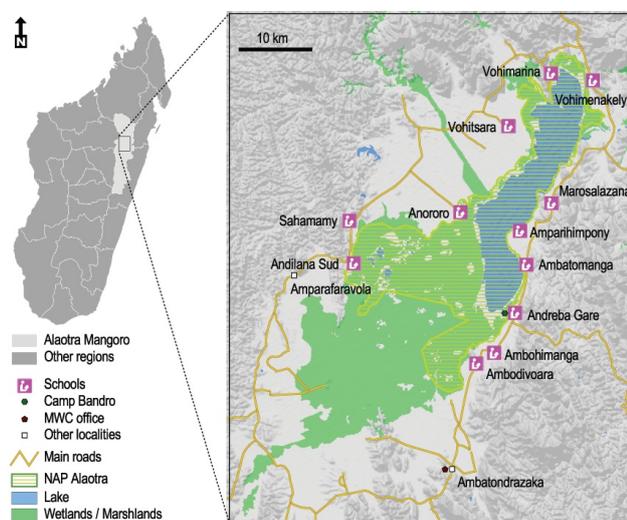


Figure 1. Location of public primary schools around Lake Alaotra engaged in the comic book project.

INVESTIGATING IN ALTERNATIVE RESOURCES USE. The Alaotra marshlands provide a range of important ecosystem services to the communities of adjacent villages. *Zozoro* or cyperus (*Cyperus madagascariensis*) and *vohoaka* (*C. latifolius*) are used for construction purposes and handicrafts; *revaka* or chick weed (*Ageratum conyzoides*) and *tsy hita fototra* or dodder (*Cuscuta sinensis*) are used as medicinal plants (for example, as a remedy for stomach complaints). *Betsimihilana* or water lily (*Nymphaea* sp.) is used in traditional ceremonies (for example, during the *joro*, a metaphisique ceremony to thank or consult with the *zanahary* (God) or the ancestors; S. H. N. H. Rakotoarimanana In lit.). The marshes host the breeding ground for fish, the main source of protein for the local population (Wallace 2012). They also act as natural filter and water reservoir (Andrianandrasana 2005) and play an important role in maintaining the hydrological balance in the Alaotra basin, crucial for rice production (Copsey 2009a).

Worldwide, several studies have dealt with the various options of using *E. crassipes*. The usage of this invasive plant represents a reasonable alternative to the costly and complex efforts to control it (Brendonck et al. 2003). Moreover, it offers an economic benefit. Despite its abundance, *E. crassipes* is only used marginally in the Alaotra. MWC has performed a first feasibility study in 2008 to investigate the potential of this invasive plant as a briquette and alternative to charcoal (Meier 2008). The lack of electricity, infrastructure and technical support make the *E. crassipes* an unrealistic option for charcoal. Using *E. crassipes* as a raw material for woven handicraft products (for example, baskets, place mats) did, however, show promise (ibid). The AMBio research (2012–2015) focuses on approaches that are likely to be successful in the Alaotra. For example, *E. crassipes* is suitable as fodder (Lu et al. 2008), can be used for production of compost (Gajalakshmi et al. 2001a, b, Malik 2006), and for braiding handicraft products (Lindsey and Hirth 2000, Jafari 2010). The ongoing research in AMBio thus focuses on improving and testing of handicraft products (for example, comparing different thicknesses and weaving techniques of *E. crassipes*). Aerobic and anaerobic compost experiments are being performed to assess the economic and technical feasibility and comparing the *E. crassipes* compost with commercially available fertilizers.

## CHALLENGES AND REMEDIATION MEASURES

In this section it is discussed what approaches did not succeed during the ten years of conservation work with the communities, reasons are scrutinized and possible remediation measures are presented. Key to the following review are participation, communication, mutual respect and motivation.

### UNDERSTANDING MARSHLAND FIRES. Since the early 1990s,

Durrell has been engaging mainly in the marshes of Andreba Gare to research the behavior and ecology of *Hapalemur alaotrensis* (Mutschler et al. 1998, Nievergelt et al. 1998, Mutschler et al. 2000, Nievergelt et al. 2002a, b, Waeber and Hemelrijk 2003). Since 2003, MWC and Durrell have been working collaboratively. The presence of researchers (mostly foreigners) and the engagement of locals in the various conservation and research projects have resulted in some effects: no fires for approximately 20 years have been registered in the marshlands of Andreba. However, fire events north and south of Andreba have steadily increased and represent a serious threat for the Park Bandro which is now isolated from other marshland patches

(Ratsimbazafy et al. 2013a). Local explanations to marshland burning include the collection of the invasive fish species *Channa maculata*, the development of new rice fields, lemur hunting and accidental fires (Copsey et al. 2009b). In particular, the establishment of new rice fields poses a serious threat to the ecosystem as no regeneration of the marshland vegetation is possible following this disturbance. Currently, it is unclear whether local or external actors are responsible for initiating these fires. In addition, the presence of conservation bodies such as Durrell or MWC (who are accompanying the DREF, *Direction Régionale des Eaux et Forêts*, during the fire data collection) is not well received in some communities around Lake Alaotra. There is evident mistrust towards, or fear of potential repression from government representatives. Social disruption is also occurring. An example is given by the commune of Vohimarina in the north of the lake. Since April 2013, (coinciding with presidential elections campaign in Madagascar, cf. Waeber and Wilmé 2013) the community is split into a pro-conservation group and, opposingly, a group propagating the free access and redistribution of protected marshland for rice cultivation. In order to understand processes and interactions in the wetland system, the AlaReLa project (collaboration between MWC, École Supérieure des Sciences Agronomiques – ESSA Forêts, ETH Zurich, amongst other partners) addresses the marshland fire system and other changes in the wetlands following participatory action research (*sensu* Whyte 1991). Companion modeling (ComMod) is a community-based scientific approach to facilitate collective action (Bousquet et al. 1999, Barreteau et al. 2003). The first step of the ComMod approach consists in collectively identifying a problem and an associated research question. Then the ARDI (Actors, Resources, Dynamics, Interactions) methodology is often deployed to analyze a problem and the involved components and processes (Etienne et al. 2011). The initial ARDI workshops around the lake have been promising as participants appreciate the opportunity to communicate freely without fearing consequences (Garcia et al. 2015).

**PARK BANDRO MANAGEMENT.** As part of a national target established by former President Ravalomanana to protect 10% of the country's terrestrial surface (Norris et al. 2006), 93 NAPs were identified in 2003 for key areas of biodiversity. The aim was to establish legal frameworks with state-approved management plans for the NAPs prior to May 2015. The creation of NAPs followed a national program of management transfers of natural resources from state control to local communities (GCF, *Gestion Contractualisée des Forêts*, forest management contracts, and GELOSE, *Gestion Locale Sécurisée*, secure local management), which has led to many communities taking over the management of habitat areas most often with extensive external NGO and financial support. In many cases, communities have lacked several of the core skills required to take on the management of these areas, which are official legal contracts between the communities and the government (Ratsimbazafy et al. 2013b, Pollini et al. 2014). To date, Alaotra went through the steps of undertaking environmental and social impact assessments (in 2010). However, a management plan, the most important strategic document towards official ratification, is still outstanding. These events coincided with the 2009 political crisis.

The Park Bandro, a priority conservation zone, represents a source of ongoing conflict between the different actors from the

Andreba Gare community. This is largely due to the lack of transparency and inequity in responsibility and decision-making surrounding management of the park. Anecdotal evidence suggests that the VOI, as the officially recognized steward of the Park Bandro, is having insider knowledge (i.e., being the sole actor involved in park delineation, without informing other stakeholders), and of having an exclusive understanding of how NAP operates. Some of the income generated from park entrance fees that were supposed to be reinvested into park maintenance have been diverted without clear explanation or have simply evaporated. The tourist Park Bandro guides have been switching between different associations, that is between MWC and Zetra Maitso (a local association). This has led to more confusion than clarity. "Equity and empowerment are often more important than monetary incentives for community-based conservation" (Berkes 2004: 629). To avoid competition between different associations in the future, it is envisioned to reorganize the guides under one single umbrella body, the DREF. These guides will be recognized as official and legitimate guides that will be subject to regular training following Madagascar National Park's ethical and structural guidelines. This will ensure that all guides are respectful towards park visitors, towards themselves and to the lemurs.

**SOCIAL ACCEPTANCE AND LONG-TERM IMPACT.** *Hapalemur alaotrensis* is used as a flagship species for MWC's ecotourism project. A community meeting was held with the *tangalamena* (village elder) prior to the onset of the project, to seek consent and approval of the project, but mostly to see whether there was actual interest in such a project. In MWC's environmental education program, targeting public primary schools, the CISCO and teachers have been consulted on potential interest in the comic book project. In both projects, there were strong indications in favor of beginning the respective projects.

A 'community', as stated by Carlsson (2000), consists of dynamic (evolving), cross scale, multi-dimensional and social-political networks. The *fokonolona* (this is known as the community where all residents register at the administrative subdivision within the village, aged eighteen years and older and residing in the district and territorial base of the village) is not a fixed or consistent entity for residents (cf. Pollini and Lassoie 2011). There is confusion and disagreement among members of the Andreba Gare community regarding decision-making and benefit-sharing in the ecotourism project. The camp has been established and funded by MWC. Some of the locals have found permanent salary positions, while others benefit by guiding occasional tourists. A majority, however, sees no benefit in having an ecotourism facility such as the Camp Bandro in the community, or they are indifferent to the initiative. Becoming part of the 'social landscape' is a process that will take time (cf. Richard and Ratsirarson 2013), meanwhile MWC is engaging different community groups to participate in a variety of activities in and around the Camp Bandro.

According to UNESCO's definition, 'environmental education' aims to increase awareness of the environment and the challenges it faces. Core to facilitating environmental education, knowledge, positive attitudes, motivation and skills are crucial (UNESCO 1975). In MWC's environmental education program, material such as comic books, teacher training and monitoring are sourced from outside of the system. This bares the risk that the

project will cease when funding ends or any other external factor influences or disrupts education delivery. For the sustainable implementation of environmental education into the school program of the region, that is, to have a long-term impact on the future resource users, it is unavoidable to do a cost-benefit analysis. Within the realms of the AMBio project, research focuses on the CISCO institutional arrangement and the director and teacher level: using a participatory approach, tools are identified which are (i) replicable with locally available material at a low cost; (ii) complement or replace previous teaching material; (iii) are adapted to social and cultural conditions and teachers' needs.

## CONCLUSION

One step forward and two steps back? The challenge in the conservation of *Hapalemur alaotrensis* lies in the complexity of the marshland social and local political systems. The conservation of the lemur species represents a typical 'wicked problem' with no singularly true or wrong solutions, only solutions that are better or worse, or more or less acceptable. An adaptive approach, or sometimes even a 'muddling through' (cf. Sayer et al. 2008) seems the likely and realistic approach for learning and bringing conservation efforts forward. This requires a holistic view of the system that targets problem areas in order to manage its inherent connectedness. To ensure success, conservation efforts are required to be scaled up to the entire marshland area and not center on few isolated communes. A concerted effort is hence required shouldered by a broad partnership of many different and diverse institutions and actors; the most important of which is the community. In this context, it is key that (i) management power and responsibilities are shared continuously and consistently, and (ii) a collaborative environment between the different actors is created that promotes learning and stewardship to ease mutual respect and trust.

Madagascar Wildlife Conservation's (MWC) attention in its early years concentrated exclusively around the promotion of awareness and appreciation of the Critically Endangered *H. alaotrensis*. In retrospect, MWC missed an opportunity to emphasize the need to fully comprehend the perspective of the community. In order to ground the conservation efforts, MWC is progressively acquiring a broad understanding of the various existing stakeholders and mapping and understanding their respective needs, values and power relations. Understanding the latter can help avoid misunderstandings and reduce the likelihood of friction between the various actors. Research projects like the AMBio or AlaRela allow both sides, MWC and the communities, to listen and learn from and understand each other better. In complex management problems, different knowledge systems come with different value perspectives; Berkes (2009) suggests using both knowledge systems, academic and local as complementary, in 'dialogue and partnership'. In order to develop conservation strategies that find the support of the entire community for the long-run, continuous and transparent communication is key. The community should be involved at all project stages, from inception of a project (such as the conceptualization phase) through to the final stages. Using this approach, it is likelier that the community views their ownership within the process and sees tangible benefits in a project. However, it is of utmost importance to engage various segments of a community (acknowledging that the actor 'community' itself is a complex structure) within a project to circumvent perceptions

of inequity in decision-involvement.

By using the 'ingredients' of mutual respect, shared and clearly defined responsibilities, transparent communication, in addition to ensuring the various incentives of shared decision making and benefits, all parties involved can be supportive of continued efforts to conserve *H. alaotrensis*.

## ACKNOWLEDGMENTS

The authorities, CISCOs, primary school directors and teachers, and all the community members in the Alaotra region are acknowledged for supporting MWC's projects ([www.madagascar-wildlife-conservation.org](http://www.madagascar-wildlife-conservation.org)). We thank Durrell for their collaboration on the ground, and numerous volunteers for their time and commitment to realize our projects. Our acknowledgements are extended to funding partners and our members for financial support of our projects on the ground, and to MCD's anonymous reviewers and the editors for their comments on a previous version of this manuscript.

## REFERENCES

- Andrianandrasana, H. T., Randriamahefasoa, J., Durbin, J., Lewis, R. E. and Ratsimbazafy, J. H. 2005. Participatory ecological monitoring of the Alaotra wetlands in Madagascar. *Biodiversity and Conservation* 14, 11: 2757–2774. (doi:10.1007/s10531-005-8413-y)
- Bakoariniaina, L. N., Kusky, T. and Raharimahefa, T. 2006. Disappearing Lake Alaotra: Monitoring catastrophic erosion, waterway silting, and land degradation hazards in Madagascar using Landsat imagery. *Journal of African Earth Sciences* 44, 2: 241–252. (doi:10.1016/j.jafrearsci.2005.10.013)
- Barreteau, O., Antona, M., D'Aquino, P., Aubert, S., Boissau, S. et al. (Collectif ComMod). 2003. Our companion modelling approach. *Journal of Artificial Societies and Social Simulation* 6, 1: <<http://jasss.soc.surrey.ac.uk/6/2/1.html>>
- Berkes, F. 2004. Rethinking community-based conservation. *Conservation Biology* 18, 3: 621–630. (doi:10.1111/j.1523-1739.2004.00077.x)
- Berkes, F. 2009. Indigenous ways of knowing and the study of environmental change. *Journal of the Royal Society of New Zealand* 39, 4:151–156. (doi:10.1080/03014220909510568)
- Bousquet, F., Barreteau, O., Le Page, C., Mullon, C. and Weber, J., 1999. An environmental modelling approach: the use of multi-agent simulations. In: *Advances in Environmental Modelling*. F. Blasco and A. Weill (eds.), pp 113–122. Elsevier, Paris.
- Brendonck, L., Maes, J., Rommens, W., Dekeza, N., Nihwatiwa, T., et al. 2003. The impact of water hyacinth (*Eichhornia crassipes*) in a eutrophic subtropical impoundment (Lake Chivero, Zimbabwe). II. Species diversity. *Fundamental and Applied Limnology* 158, 3: 389–405. (doi:10.1127/0003-9136/2003/0158-0389)
- Carlsson, L. 2000. Policy networks as collective action. *Policy Studies Journal* 28, 3: 502–520. (doi:10.1111/j.1541-0072.2000.tb02045.x)
- Copsey, J. A., Rajaonarison, L. H., Randriamihamina, R. and Rakotoniaina, L. J. 2009a. Voices from the marsh: Livelihood concerns of fishers and rice cultivators in the Alaotra wetland. *Madagascar Conservation & Development* 4, 1: 25–30. (doi:10.4314/mcd.v4i1.44008)
- Copsey, J. A., Jones, J. P. G., Andrianandrasana, H., Rajaonarison, L. H., and Fa, J. E. 2009b. Burning to fish: local explanations for wetland burning in Lac Alaotra, Madagascar. *Oryx* 43, 3: 403–406. (doi:10.1017/S0030605309000520)
- Courtenay, W. R. and Williams, J. D. 2004 (eds.). *Snakeheads (Pisces, Channidae): a biological synopsis and risk assessment*. US Geological Survey Circular 1251, Denver, Colorado, USA.
- Dolins, F. L., Jolly, A., Rasamimanana, H., Ratsimbazafy, J. H., Feistner, A. T. C. and Ravoavy, F. 2010. Conservation education in Madagascar: three case studies in the biologically diverse island! continent. *American Journal of Primatology* 72, 5: 391–406. (doi:10.1002/ajp.20779)

- Durbin, J. C. 1999. Lemurs as flagships for conservation in Madagascar. In: *New Directions in Lemur Studies*. B. Rakotosamimanana, H. Rasamimanana, J. Ganzhorn and S. Goodman (eds.), pp 269–281. Springer, USA.
- Durbin, J. C., Rakotoniaina, L. J., Andrianandrasana, H. T. & Randriamahefasoa, J. 2007. Projet Alaotra, utilisation d'espèces menacées en tant que porte-étendard de la protection d'une zone humide avec les communautés locales. In: *Paysages Naturels et Biodiversité de Madagascar*. S. M. Goodman (ed.), pp 627–637. Muséum national d'Histoire naturelle, Paris.
- Durbin, J., Funk, S. M., Hawkins, F., Hills, D. M., et al. 2010. Investigations into the status of a new taxon of *Salanoia* (Mammalia: Carnivora: Eupleridae) from the marshes of Lac Alaotra, Madagascar. *Systematics and Biodiversity* 8, 3: 341–355. (doi:10.1080/14772001003756751)
- Ehrlich, P. R. and Pringle, R. M. 2008. Where does biodiversity go from here? A grim business-as-usual forecast and a hopeful portfolio of partial solutions. *Proceedings of the National Academy of Sciences of the United States of America* 105, Supplement 1: 11579–11586. (doi:10.1073/pnas.0801911105)
- Etienne, M., Du Toit, D. R. and Pollard, S. 2011. ARDI: a co-construction method for participatory modeling in natural resources management. *Ecology and Society* 16, 1: 44. <<http://www.ecologyandsociety.org/vol16/iss1/art44/>>
- Feistner, A. T. C. 1999. Conservation of the Alaotran gentle lemur, a multidisciplinary approach. In: *New Directions in Lemur Studies*. B. Rakotosamimanana, H. Rasamimanana, J. Ganzhorn and S. Goodman (eds.), pp 241–248. Springer, USA.
- Ferry, L., Mietton, M., Robison, L. & Erisman, L. 2009. Le lac Alaotra à Madagascar – passé, présent et futur. *Zeitschrift für Geomorphologie* 53, 3: 299–318. (doi:10.1127/0372-8854/2009/0053-0299)
- Gajalakshmi, E. V., Ramasamy, S. A. and Abbasi, S. A. 2001a. Assessment of suitable vermicomposition of water hyacinth at different reactor efficiencies employing *Eudrilus eugeniae* Kingberg. *Bioresources Technology* 80, 2: 131–135. (doi:10.1016/S0960-8524(01)00077-3)
- Gajalakshmi, E. V., Ramasamy, S. A. and Abbasi, S. A. 2001b. Potential of two epigeic and two anecic earthworm species in vermicomposting of water hyacinth. *Bioresources Technology* 76, 3: 177–181. (doi:10.1016/S0960-8524(00)00133-4)
- Ganzhorn, J. U., Lowry II, P. P., Schatz, G. E. and Sommer, S. 2001. The biodiversity of Madagascar: one of the world's hottest hotspots on its way out. *Oryx* 35, 4: 346–348. (doi:10.1046/j.1365-3008.2001.00201.x)
- Garcia, C., Dray, A., Aubert, S., Reibelt, L. M. and Waeber, P. O. 2014 (In press). Scenarios of biodiversity exploring possible futures for management. *Akon'ny Ala*.
- Gratwicke, B. and Marshall, B. E. 2001. The impact of *Azolla filiculoides* Lam. on animal biodiversity in streams in Zimbabwe. *African Journal of Ecology* 39, 2: 216–218. (doi:10.1046/j.0141-6707.2000.00284.x)
- Guillera-Arroita, G., Lahoz-Monfort, J. J., Milner-Gulland, E. J., Young, R. P. and Nicholson, E. 2010a. Monitoring and conservation of the critically endangered Alaotran gentle lemur *Hapalemur alaotrensis*. *Madagascar Conservation & Development* 5, 2: 103–109. (doi:10.4314/mcd.v5i2.63140)
- Guillera-Arroita, G., Lahoz-Monfort, J. J., Milner-Gulland, E. J., Young, R. P. and Nicholson, E. 2010b. Using occupancy as a state variable for monitoring the Critically Endangered Alaotran gentle lemur *Hapalemur alaotrensis*. *Endangered Species Research* 11, 2: 157–166.
- Gunnarsson, C. C. and Petersen, C. M. 2007. Water hyacinths as a resource in agriculture and energy production: A literature review. *Waste Management* 27, 1: 117–129. (doi:10.1016/j.wasman.2005.12.011)
- Hannah, L., Dave, R., Lowry II, P. P., Andelman, S., Andrianarisata, M., et al. 2008. Climate change adaptation for conservation in Madagascar. *Biology Letters* 4, 5: 590–594. (doi:10.1098/rsbl.2008.0270)
- Hudson, R. 2013. Troubled times for the radiated tortoise (*Astrochelys radiata*). *Chelonian Research Monographs* 6: 67–74. (doi:10.3854/crm.6.a13p67)
- Innes, J. L. 2010. Madagascar rosewood, illegal logging and the tropical timber trade. *Madagascar Conservation & Development* 5, 1: 6–10. (doi:10.4314/mcd.v5i1.57335)
- Institut National de la Statistique 2011. <<http://www.instat.mg/>> accessed 10 January 2012.
- Institut National de la Statistique. 2012. <[http://www.instat.mg/index.php?option=com\\_content&view=article&id=33&Itemid=56](http://www.instat.mg/index.php?option=com_content&view=article&id=33&Itemid=56)> accessed 18 January 2014.
- IUCN. 2013. The IUCN Red List. <<http://www.iucnredlist.org/details/9676/0>> accessed 18 January 2014.
- Jafari, N. 2010. Ecological and socio-economic utilization of water hyacinth (*Eichhornia crassipes* Mart Solms). *Journal of Applied Sciences and Environmental Management* 14, 2: 43–49. (doi:10.4314/jasem.v14i2.57834)
- Kusky, T. M., Toraman, E., Raharimahefa, T. and Rasoazanamparany, C., 2010. Active tectonics of the Alaotra-Ankay Graben System, Madagascar: Possible extension of Somalian-African diffuse plate boundary? *Gondwana Research* 18, 2–3: 274–294. (doi:10.1016/j.gr.2010.02.003)
- Lindsey, K. and Hirth, H.-M. 2000. *Use Water Hyacinth! A Practical Handbook of Uses for the Water Hyacinth from Across the World*. Anamed, Winnenden.
- Lu, J., Fu, Z. and Yin, Z. 2008. Performance of a water hyacinth (*Eichhornia crassipes*) system in the treatment of wastewater from duck farm and the effects of using water hyacinth as duck feed. *Journal of Environmental Sciences* 20, 5: 513–519. (doi:10.1016/S1001-0742(08)62088-4)
- Malik, A. 2006. Environmental challenge vis-à-vis opportunity: The case of water hyacinth. *Environmental International* 33, 1: 122–138. (doi:10.1016/j.envint.2006.08.004)
- Maminirina, C. P., Girod, P. and Waeber, P. O. 2006. Comic strips as environmental educative tools for the Alaotra Region. *Madagascar Conservation & Development* 1, 1: 11–14. (doi:10.4314/mcd.v1i1.44045)
- Mangas-Ramirez, E. and Elias-Gutierrez, M. 2004. Effect of mechanical removal of water hyacinth (*Eichhornia crassipes*) on the water quality and biological communities in a Mexican reservoir. *Journal of Aquatic Health and Management* 7, 1: 161–168. (doi:10.1080/14634980490281597)
- Meier, L. 2008. Bericht Machbarkeitsstudie Wasserhyazinthe. Unpublished Report. Madagascar Wildlife Conservation.
- MENRS. 2008. Ministère de l'Éducation Nationale et de la Recherche Scientifique : Éducation pour Tous – Madagascar.
- Ministère de l'Élevage. 2013. Effectif du Cheptel dans la Région Alaotra-Mangoro: année 2010–2011. Unpub. Report. Direction Régionale de l'Élevage Alaotra-Mangoro.
- Monographie Régionale. 2012. Monographie régionale Alaotra-Mangoro. Unpublished Report. Direction Régionale de l'Économie Alaotra-Mangoro.
- Murphree, M. W. 2002. Protected area and the commons. *Common Property Resource Digest* 60: 1–3.
- Mutschler, T. 2002. Alaotran gentle lemur: some aspects of its behavioral ecology. *Evolutionary Anthropology: Issues, News, and Reviews* 11, S1: 101–104. (doi:10.1002/evan.10068)
- Mutschler, T. and Feistner, A. T. C. 1995. Conservation status and distribution of the Alaotran gentle lemur *Hapalemur griseus alaotrensis*. *Oryx* 29, 4: 267–274. (doi:10.1017/S0030605300021268)
- Mutschler, T., Feistner, A. T. C. and Nievergelt, C. M. 1998. Preliminary field data on group size, diet and activity in the Alaotran gentle Lemur *Hapalemur griseus alaotrensis*. *Folia Primatologica* 69, 5: 325–330. (doi:10.1159/000021647)
- Mutschler, T., Nievergelt, C. M. and Feistner, A. T. 2000. Social organization of the Alaotran gentle lemur (*Hapalemur griseus alaotrensis*). *American Journal of Primatology* 50, 1: 9–24. (doi:10.1002/(SICI)1098-2345(200001)50:1<9::AID-AJP2>3.0.CO;2-2)
- Mutschler, T., Randrianarisoa, A. J. and Feistner, A. T. C. 2001. Population status of the Alaotran gentle lemur *Hapalemur griseus alaotrensis*. *Oryx* 35, 2: 152–157. (doi:10.1046/j.1365-3008.2001.00167.x)
- Nievergelt, C. M., Mutschler, T. and Feistner, A. T. C. 1998. Group encounters and territoriality in wild Alaotran gentle lemurs (*Hapalemur griseus alaotrensis*). *American Journal of Primatology* 46, 3: 251–258. (doi:10.1002/(SICI)1098-2345(1998)46:3<251::AID-AJP5>3.0.CO;2-H)
- Nievergelt, C. M., Pastorini, J. and Woodruff, D. S. 2002a. Genetic variability and phylogeography in the wild Alaotran gentle lemur population. *Evolutionary Anthropology* 11, S1: 175–179. (doi:10.1002/evan.10085)

- Nievergelt, C. M., Mutschler, T., Feistner, A. T. C. and Woodruff, D. S. 2002b. Social system of the Alaotran gentle lemur (*Hapalemur griseus alaotrensis*): genetic characterization of group composition and mating system. *American Journal of Primatology* 57, 4: 157–176. (doi:10.1002/ajp.10046)
- Norris, S. 2006. Madagascar defiant. *BioScience* 56, 12: 960–965. (doi:10.1641/0006-3568(2006)56[960:MD]2.0.CO;2)
- Ormsby, A. and Kaplin, B. A. 2005. A framework for understanding community resident perceptions of Masoala National Park, Madagascar. *Environmental Conservation* 32, 2: 156–164. (doi:10.1017/S0376892905002146)
- Pidgeon, M. 1996. An Ecological Survey of Lake Alaotra and Selected Wetlands of Central and Eastern Madagascar in Analyzing the Demise of Madagascar Pochard *Aythya innotata*. WWF/Missouri Botanical Garden, Antananarivo, Madagascar.
- Pietronero, L. 2008. Complexity ideas from condensed matter and statistical physics. *Europhysics News* 39, 6: 26–29. (doi:10.1051/eprn:2008603)
- Pollini, J. and Lassoie, J. P. 2011. Trapping farmer communities within global environmental regimes: the case of the GELOSE legislation in Madagascar. *Society and Natural Resources* 24, 8: 814–830. (doi:10.1080/08941921003782218)
- Pollini, J., Hockley, N., Muttenter, F. D. and Ramamonjisoa, B. S. 2014. The transfer of natural resource management rights to local communities. In: *Conservation and Environmental Management in Madagascar*. I. Scales (ed.), pp172–192. Routledge, London and New York.
- Raharijaona-Raharison, L. J. & Randrianarison, J. 1999. Facteurs géologiques et climatiques influençant l'érosion en lavaka et ensablement des rizières: le cas du massif d'Ambohitrandriampotsy du sud du Lac Alaotra. In: *Actes du 4e colloque international organisé par l'Association pour les Montagnes Africaines (AMA)*. H. Hurni & J. Ramamonjisoa (eds.), pp 159–172. Association pour les Montagnes Africaines, Antananarivo.
- Raharimahefa, T. 2012. Geoconservation and geodiversity for sustainable development in Madagascar. *Madagascar Conservation & Development* 7, 3: 126–134. (doi:10.4314/mcd.v7i3.5)
- Ralainasolo, F. B., Waeber, P. O., Ratsimbazafy, J., Durbin, J. and Lewis, R. 2006. The Alaotra gentle lemur: Population estimation and subsequent implications. *Madagascar Conservation & Development* 1, 1: 9–10. (doi:10.4314/mcd.v1i1.44044)
- Randriamalala, H. and Liu, Z. 2010. Rosewood of Madagascar: Between democracy and conservation. *Madagascar Conservation & Development* 5, 1: 11–22. (doi:10.4314/mcd.v5i1.57336)
- Randrianja, S. (ed.) 2012. *Madagascar, le coup d'État de mars 2009*. Éditions Karthala, Paris.
- Ratsimbazafy, J. H. 2003. Lemurs as the most appropriate and best didactic tool for teaching. *Lemur News* 8: 19–21.
- Ratsimbazafy, J. H., Ralainasolo, F. B., Rendigs, A., Mantilla Contreras, J., Andrianandrasana, H., et al. 2013a. Gone in a puff of smoke? *Hapalemur alaotrensis* at great risk of extinction. *Lemur News* 17: 14–18.
- Ratsimbazafy, J. H., Gore, M. L. and Rakotoniaina, L. J. 2013b. Madagascar. In: *Community Policing in Indigenous Communities*. M. K. Nalla and G. R. Newman (eds.), pp 31–39. CRC Press, Taylor & Francis Group, Boca Raton, Florida.
- Reibelt, L. M., Richter, T., Waeber, P. O., Rakotoarimanana, S. H. N. H. and Mantilla Contreras, J. 2014. Environmental education in its infancy at Lake Alaotra, Madagascar. *Madagascar Conservation and Development* 9, 2: 71–82. (doi:10.4314/mcd.v9i2.3)
- Richard, A. F. and Ratsirarson, J. 2013. Partnership in practice: making conservation work at Beza Mahafaly, southwest Madagascar. *Madagascar Conservation & Development* 8, 1: 12–20. (doi:10.4314/mcd.v8i1.3)
- Rittel, H. W. J. and Webber, M. M. 1973. Dilemmas in a general theory of planning. *Policy Sciences* 4, 2: 155–169. (doi:10.1007/BF01405730)
- Sayer, J., Bull, G. and Elliott, C. 2008. Mediating forest transitions: 'Grand design' or 'muddling through'. *Conservation and Society* 6, 4: 320–327. (doi:10.4103/0972-4923.49195)
- Schuurman, D. and Lowry II, P. P. 2009. The Madagascar rosewood massacre. *Madagascar Conservation & Development* 4, 2: 98–102. (doi:10.4314/mcd.v4i2.48649)
- Selman, P. 2009. Planning for landscape multifunctionality. *Sustainability: Science, Practice & Policy* 5, 2: 45–52.
- Thalmann, U. 2006. Lemurs – ambassadors for Madagascar. *Madagascar Conservation & Development* 1, 1: 4–8. (doi:10.4314/mcd.v1i1.44043)
- UNDP. 2013. Human Development Report. 2013. The Rise of the South: Human Progress in a Diverse World. United Nations Development Program. Available at <http://hdr.undp.org/en/2013-report>
- UNESCO-UNEP. 1975. The Belgrade Charter: A framework for environmental education. Available at <unesdoc.unesco.org/images/0001/000177/017772eb.pdf>
- Villamanga, A. M. and Murphy, B. R. 2010. Ecological and socio-economic impacts of invasive water hyacinth (*Eichhornia crassipes*): a review. *Freshwater Biology* 55, 2: 282–298. (doi:10.1111/j.1365-2427.2009.02294.x)
- Waeber, P. O. and Hemelrijk, C. K. 2003. Female dominance and social structure in Alaotran gentle lemurs. *Behaviour* 140, 10: 1235–1246. (doi:10.1163/156853903771980576)
- Waeber, P. O. and Wilmé, L. Madagascar rich and intransparent. 2013. *Madagascar Conservation & Development* 8, 2: 52–54. (doi:10.4314/mcd.v8i2.1)
- Waeber, P. O., Wilmé, L., Mercier, J.-L., Rakotozafy, L. M. A., Garcia, C. and Sorg, J.-P. 2015a (In press). The role of lakes in the context of the centers of endemism. Akon'ny Ala.
- Waeber, P. O., Ratsimbazafy, J. H., Andrianandrasana, H., Ralainasolo, F. B., Nievergelt, C. M. 2015b (In press). *Hapalemur alaotrensis*, a conservation case study from the swamps of Alaotra, Madagascar. In: *Primates in Flooded Habitats: Ecology and Conservation*. A. Barnett, I. Matsuda and K. Nowak (eds.). Cambridge University Press.
- Waeber, P. O., Ralainasolo, F. B., Ratsimbazafy, J. H., Nievergelt, C. M. 2015c (In press). Consequences of lakeside living for the diet and social ecology of the lake Alaotran gentle lemur. In: *Primates in Flooded Habitats: Ecology and Conservation*. A. Barnett, I. Matsuda and K. Nowak (eds.). Cambridge University Press.
- Wallace, A. P. C. 2012. Understanding Fishers' Spatial Behavior to Estimate Social Costs in Local Conservation Planning. Unpubl. Ph.D. thesis. Department of Ecology and Evolution, Imperial College London, UK.
- Whyte, W. F. E. 1991. *Participatory Action Research*. Sage Publications, Inc.

## ARTICLE

<http://dx.doi.org/10.4314/mcd.v10i1.S4>

# Improving livelihoods, training para-ecologists, enthralling children: Earning trust for effective community-based biodiversity conservation in Andasibe, eastern Madagascar

Rainer Dolch, Jean-Noël Ndriamiary, Tianasoa Ratolojanahary, Mad Randrianasolo, Irène Augustine Ramanantenaso

Correspondence:  
Rainer Dolch  
Association Mitsinjo, Andasibe, Madagascar  
E-mail: [rainer@mitsinjo.org](mailto:rainer@mitsinjo.org)

## ABSTRACT

The rainforests of eastern Madagascar are shrinking due to population growth, poverty-driven land degradation and widespread ignorance of ecological dynamics. This has resulted in large-scale transformation and fragmentation of these forests, threatening their unique biodiversity. Many of these problems are also manifest in and around the village of Andasibe. Based on the example of Association Mitsinjo, and drawing from more than a decade of experience of community-based natural resource management in Andasibe, we highlight the challenges and successes of a community-run conservation organization that builds trust through a holistic approach resting on five building blocks: (i) management transfer of natural resources to the local community, (ii) community-based nature tourism, (iii) training of para-scientists, (iv) rainforest restoration and improving local livelihoods, and (v) environmental education. This has resulted in the creation and legal protection of two community-run reserves, Analamazaotra and Torotorofotsy, accompanied by ecological monitoring programs. We illustrate how handing over responsibilities to local communities can be a promising approach to conserving natural resources and biodiversity in Madagascar and elsewhere.

## RÉSUMÉ

La superficie des forêts tropicales de l'est de Madagascar diminue avec la croissance démographique, la dégradation des terres par effet de la pauvreté, ainsi que par l'ignorance générale des interrelations écologiques. Tout cela a abouti à une transformation profonde et étendue ainsi qu'à la fragmentation de ces forêts qui menacent leur biodiversité. Ces problèmes globaux sont pour la plupart rencontrés à la périphérie du village d'Andasibe. Ici, l'exemple de l'Association Mitsinjo est présenté avec plus d'une décennie d'expérience en gestion communautaire des ressources naturelles à Andasibe. Sont ainsi exposés les défis et les succès d'une organisation de conservation gérée par la communauté qui gagne la confiance à travers une approche posée sur cinq piliers : (i) le transfert de gestion des ressources naturelles à la communauté locale, (ii) l'écotourisme à base communautaire, (iii) la formation de para-scientifiques, (iv) la restauration de la forêt tropicale humide en augmentant les moyens de subsistance des

gens vivant sur la périphérie, et (v) l'éducation environnementale. Les actions entreprises ont abouti à la création et la protection efficace de deux réserves gérées par la communauté, accompagnées de programmes de surveillance écologique. Grâce à la responsabilisation des collectivités locales dans la protection de la biodiversité, elles montrent une fierté des actions entreprises qui est un indice prometteur pour la conservation des ressources naturelles et de la biodiversité à Madagascar et ailleurs.

## INTRODUCTION

Community-based natural resource management (CBNRM) is a concept that attempts to integrate conservation objectives with improved livelihoods for rural communities (Salafsky and Wollenberg 2000). About 20 years ago, Madagascar endorsed this concept through a legal mechanism called *transfert de gestion*, which was designed to allow local communities to manage their own natural resources sustainably. However, patterns of natural resource use by local communities often appear difficult to reconcile with positive outcomes for biodiversity (Kellert et al. 2000, Hockley and Andriamarivololona 2007). Many CBNRM initiatives seem to lack true empowerment of local communities, while local communities tend to only conserve resources if the immediate benefits from conserving them exceed the cost of their conservation (Toillier et al. 2011). Differing interests between local communities and conservation organizations involved in CBNRM may result in conflict over time (Raik and Decker 2007, Scales 2012).

Here we present a case study focusing on CBNRM activities implemented by Association Mitsinjo, a community-based conservation organization working in the region of Andasibe in central eastern Madagascar. Association Mitsinjo came into being in 1999 as a grass-roots initiative from Andasibe village. Originally founded as a union of local wildlife guides, the association's members focused on guiding wildlife tourists. Conscious of the fact that wildlife tourism requires effective protection of wildlife, Mitsinjo soon began to expand the scope of its activities, ultimately transforming the association into a local conservation organization.

Governed by Malagasy law (Ordonnance 60-133), all executive duties and responsibilities are entirely assumed by Mitsinjo's members, who are all members of the local community and live in Andasibe. In 2002, they actively sought support for the coordination of their CBNRM activities, which has since been assumed by one (later two) non-Malagasy inhabitant(s) of Andasibe, after having been an integral part of the community for several years. Having grown to more than 50 members over the 15 years of its existence, Mitsinjo's management board is exclusively Malagasy. Decisions within Mitsinjo are taken by a majority vote of the management board. The management board consists of a president, vice-president, secretary, treasurer and three advisors. The role of Mitsinjo's non-Malagasy coordinator is to maintain contact with partners and potential donors, as well as to propose new projects and/or funding opportunities to the association's management board, which will decide on projects to pursue. The president, treasurer and coordinator collaborate on proposal and grant writing. While the coordinator has a supervising role, the president takes the lead for implementing any projects. Strategic decisions and the budget are approved or rejected through democratic vote by the bi-annual general assembly.

Mitsinjo's activities focus on Andasibe's areas of high biological value and the local communities living in and around them. Most members of these communities are disadvantaged and highly dependent on natural resources. Mitsinjo promotes conservation activities (e.g., rainforest restoration, ecological monitoring) and provides basic social services (income, food, health) for the local community, highlighting alternative livelihoods and strategies for long-term sustainable development. At the same time, educating people about basic ecological concepts and raising awareness about both the spiritual and economic values of nature and biodiversity will hopefully further reduce pressure on natural resources. Activities mainly concentrate on two sites of conservation importance in Andasibe Commune, Station Forestière Analamazaotra and Torotorofotsy Ramsar site. While the former is immediately adjacent to Andasibe-Mantadia National Park, the latter is proposed as a new protected area within Madagascar's Protected Area system or *Système des Aires Protégées de Madagascar* (SAPM).

## STUDY SITE

The village of Andasibe in central eastern Madagascar lies a three-hour drive east of the country's capital, Antananarivo. Situated in one of Madagascar's conservation priority areas (e.g., Kremen et al. 2008), Andasibe's forests are exceptionally rich in biodiversity, from plants, to arthropods and vertebrates. Apart from several dozen species of ferns, the flora of Andasibe comprises about 800 species of angiosperms (ANGAP 1995), including the extremely rare palm *Ravenea louvelii*, a local endemic species that does not occur anywhere else (Dransfield and Beentje 1995). The vertebrates are represented by 70 species of reptiles, 90 species of birds, and a diverse assemblage of carnivores (Dolch 2012). Two groups, the lemurs and frogs, are exceptionally diverse. The forests of Andasibe are home to 13 species of lemurs (Dolch et al. 2013, IUCN 2014), four of which are Critically Endangered: the greater bamboo lemur (*Prolemur simus*), the black-and-white-ruffed lemur (*Varecia variegata*), the diademed sifaka (*Propithecus diadema*), and the indri (*Indri indri*). With its impressive and loud territorial songs (Giacoma et al. 2010), the indri is surely the most

spectacular of all and has consequently become an icon for the Andasibe region. Less known, Andasibe also hosts one of the most species-rich amphibian assemblages of the world. More than a hundred species occur here (Glaw and Vences 2007), including the Critically Endangered *Mantella aurantiaca*, as well as a plethora of other charismatic species exhibiting exceptional ecological, morphological, and reproductive diversity (Andreone et al. 2008).

Andasibe has become one of Madagascar's most popular tourist destinations early on, mainly because of its exceptional wildlife viewing opportunities close to the country's capital. Numbers of both foreign and Malagasy visitors steadily increase, and Andasibe has become one of the most visited destinations of the country (Newsome and Hassell 2014). As a consequence, numerous hotels and lodges have sprung up in the vicinity, accommodating approximately 30,000 visitors annually.

Unfortunately, only a minority of Andasibe's inhabitants (hotel staff, guides) benefits from the tourism boom, despite considerable revenue generated from it (pers. observ.). Only little money actually trickles down to the rest of the population, since most items needed by the local hotels (construction materials, machinery and even most foodstuffs) are not sourced from within the community but from Moramanga or even Antananarivo. Moreover, villagers have long expressed and continue to express discontent about the allocation of visitors' entrance fees, which, in their view, appear to be used up by the national park's administration, rather than being reinvested into the local community.

As a consequence, most inhabitants of Andasibe are obliged to generate their income from other sources than tourism. The timber industry (together with the mining industry that began to exploit the area's graphite deposits in the 1940s), remained the principal employer well after independence (Ballet et al. 2011). Continuous and short-sighted exploitation of forest resources finally led to the decline of the last industrial sawmill, the *Complexe Industriel de Bois d'Andasibe* (CIBA), which ceased to operate in the early 1990s. Shortly afterwards, the near-surface graphite deposits were depleted and most of Andasibe's workforce became unemployed. Given the loss of employment opportunities, as well as the unequal distribution of income generated through tourism, many of Andasibe's inhabitants remain desperately poor, subsisting on meager forms of agriculture for a living (such as hill rice production after slash-and-burn), or the extraction of natural resources from Andasibe's ever-dwindling forests, such as through charcoal production, logging, hunting and artisanal mining. All these activities are not only detrimental to the environment, having contributed to the loss of vast tracts of rainforest and the resultant loss of biodiversity over the years (Irwin et al. 2010), but are also unable to help break the vicious circle of poverty and the degradation of natural resources. Poor households at the forest boundary can only cultivate small areas of land. This appears to favor patterns of land use that perpetuate low agricultural productivity and trap households in poverty (Angelsen and Wunder 2003, Coomes et al. 2011).

## OBJECTIVE AND APPROACH

The principal objective of Mitsinjo is to integrate biodiversity conservation with rural development in order to improve livelihoods. Working to achieve this goal, Mitsinjo's holistic approach is based on five building blocks: (i) management transfer

of natural resources to the local community; (ii) community-based nature tourism; (iii) training of para-scientists; (iv) rainforest restoration and improved local livelihoods; and (v) environmental education.

**MANAGEMENT TRANSFER OF NATURAL RESOURCES.** Entitling the local community to their natural resources is a prerequisite for successful community-based natural resource management. According to national law, management of natural resources can be transferred to local communities if they are organized in associations (Toillier et al. 2009, King et al. 2013), usually referred to in Malagasy as *vondron'olona ifotony* (VOI). The respective French acronyms are CLB (*communauté locale de base*) or COBA (*communaute de base*), depending on the two types of natural resource management transfer. The former are beneficiaries of GELOSE (*gestion locale sécurisée*), while the latter are beneficiaries of GCF (*gestion contractualisée des forêts*). GCF is a more straightforward way of transferring natural resources to local communities and can also be applied to forests under the control of the Ministère de l'Environnement, de l'Ecologie, de la Mer et des Forêts (MEEMF) (Pollini et al. 2014). In 2002, Mitsinjo signed a GCF contract and took over the management of the Station Forestière Analamazaotra (Dolch 2008). After evaluation by MEEMF, the initial contract has subsequently been changed into a lease contract (*location de gérance*) in 2007, with a validity period of 30 years.

Experience gathered by Mitsinjo's members in community-based management of SF Analamazaotra has extensively been shared with VOI Taratra of Torotorofotsy, resulting in a GELOSE contract for the latter with respect to the management of the natural resources of the area and, ultimately, the designation of Torotorofotsy as a Ramsar site in 2005 (Ramsar Convention 2012). Mitsinjo has been supporting community-based management efforts in Torotorofotsy ever since and has subsequently been appointed as the entity responsible for the implementation of the management plan of the Ramsar site by the MEEMF.

**COMMUNITY-BASED NATURE TOURISM.** It has been shown that only very few VOIs - due to insufficient external support needed to help secure a sustainable source of revenue - are economically viable (Hockley and Andriamaravololona 2007). One sustainable economic activity that is likely to fetch considerably higher income than conventional (i.e., destructive) practices is nature tourism. If well designed, it is an environmentally-friendly source of income with the greatest potential for significant returns to local communities in Madagascar (Pawliczek and Mehta 2008, Jensen 2010). Given its roots as a union of wildlife guides, Association Mitsinjo has embraced nature tourism as a source of income from the beginning. A network of nature trails has been established in the SF Analamazaotra and several circuits - both diurnal and nocturnal - are offered to visitors. Proceeds from visitors' fees benefit both the individual guide and the association itself, according to a jointly-defined ratio. Regular training sessions are provided for both senior and junior guides in collaboration with the national guide association or similar organizations. Through regular exchange of experience with fellow guides and critical reflections by their peers, guides are constantly trained while executing their duties - a recommended practice to maintain and improve the quality level of services provided.

About a third of Mitsinjo's annual budget is generated through income from nature-based tourism. This has enabled the association to maintain and improve tourism infrastructure through the construction of various facilities, including a reception, a restroom, several shelters for camping and a handicraft shop. The resultant income is also used to employ and pay additional staff, such as receptionists, handicraft vendors, housecleaners, carpenters, and patrolling/monitoring agents.

Moreover, income for guides and other staff benefits the local community both directly through money for their families, and indirectly through their increased purchasing power. This also helps to create a sense of pride in the natural environment among local people who recognize the attractive uniqueness of their forest and realize the fundamental importance of preserving it as a viable source of income. The local community further benefits from the possibility to produce and sell high-quality handicraft through the association's curio shop, thus also providing income for members of the local community who are not members of the association.

Experience gathered in community-based nature tourism is widely shared with other local communities, mainly with the aforementioned VOI Taratra of Torotorofotsy, who have benefitted from the construction of nature trails and bungalows in the area managed by them. Mitsinjo has provided training to other guides in the Andasibe region and elsewhere in Madagascar, from Fetraomby to Vohibola to Anjajavy.

**TRAINING PARA-SCIENTISTS IN COMMUNITY-BASED MONITORING.** When the association embraced nature tourism as a major income provider, particular attention was given to permit unobstructed observation of Andasibe's iconic flagship species, the indri, in the two managed sites. Habituating wild groups of indri to frequent visitors was a major challenge, given the animals' initial fear of humans and associated flight distance. In order to achieve this, the association relied on a couple of community members with an exceptional knowledge of the forest and its animals. Interestingly, some of these people were formerly required to earn their living through hunting lemurs and other animals out of economic necessity. It has provided them with an enormous sense of appreciation that the project now enables them to use their vast understanding of nature for conservation purposes.

The intimate knowledge of the forest has also caused them to be sought after by both Malagasy and foreign scientists, although none of them have a scientific academic background. Assisting visiting scientists from all over the world, they have essentially contributed to research on a plethora of taxa, including primates (Giacoma et al. 2010, Junge et al. 2011, Torti et al. 2013), reptiles (Wallach and Glaw 2009), amphibians (Woodhead et al. 2007), invertebrates (Cliquennois 2007, Wesener and Schütte 2010), plants (Janssen and Rakotondrainibe 2008), and mushrooms (Pirot 2006), to name but a few. In this process of mutual learning, they have become acquainted with almost all aspects of the natural sciences, and comprehensively trained in related scientific methodology. While merging traditional and scientific knowledge, these community members have become invaluable para-scientists, and some of them have embarked on their own research projects (e.g., Fiely 2010, Ratolojanahary 2011).

The association's local knowledge is not only used for monitoring indri populations, but was also crucial in the remarkable discovery of new populations of the greater bamboo lemur (*Prolemur simus*) in the area (Dolch et al. 2008, Ravaloharimanitra et al. 2011). The association's para-scientists started gathering baseline scientific data and monitoring the Torotorofotsy population and ecology of this Critically Endangered species, which resulted in attracting considerable funding from conservation donors. It is a prime example of how including local communities in research and monitoring programs contribute to both conservation and the generation of revenue.

Community-based ecological monitoring led by the association's para-scientists is currently focusing on lemurs, birds and frogs in the Torotorofotsy Ramsar site. This helps improve management decisions as well as the livelihoods of community members that are employed as monitoring agents. Moreover, the association's para-scientists share their experience and have contributed through training other local communities to monitor their animal populations and eventual threats to them (e.g., Randrianarimanana et al. 2012).

We believe that delegating responsibility for monitoring and research to community members has created a feeling of pride and appreciation. Based on local capacities and in compliance with the national strategy for amphibian conservation (known as the Sahonagasy Action Plan), Mitsinjo has spearheaded the construction and operation of Madagascar's first captive breeding center for endemic amphibians (Edmonds et al. 2012). Executed in collaboration with governmental institutions and the IUCN, it is entirely community-based and run by Mitsinjo's technicians. The goal is to gather knowledge of local frog species' reproduction practices from various ecological guilds, and to establish captive assurance colonies of threatened frog species from the Andasibe region. Frogs and their insect food sources are maintained and bred in a bio-secure facility. It is hoped that it will serve as a model for similar facilities and become a center for training and education to share knowledge and expertise gained from other organizations and institutions in Madagascar.

**RAINFOREST RESTORATION AND IMPROVED LOCAL LIVELIHOODS.** Empowerment, increased experience and accumulated scientific knowledge have also been crucial in successfully implementing Mitsinjo's rainforest restoration activities. Mitsinjo members have planned and established the first tree nursery in 2002 with the goal to produce seedlings of native rainforest trees in order to restore areas of Analamazaotra forest previously destroyed through charcoal burning and swidden agriculture. In-training experience acquired during that period (e.g., seed collection, nursery and planting techniques) could subsequently be used for the ambitious TAMS Project (*tetik'asa mampody savoka*), a flagship project incorporating rainforest restoration, re-establishing habitat connectivity, and effecting carbon sequestration (Paiva and Randrianarisoa 2010). Mitsinjo spurred the ground work through the identification of suitable land for reforestation while negotiating with local farmers willing to set aside part of their land for rainforest restoration. This led to the establishment of five community-run tree nurseries which produced tens of thousands of native rainforest trees in up to 150 different species during peak production. The local community has benefitted from training in nursery and planting techniques provided by Mitsinjo staff. Although the TAMS Project

was unfortunately hampered by an plethora of stakeholders and internal turf wars (Pollini 2009), the number of native rainforest trees planted (more than one million) was nevertheless impressive. This corresponds to slightly more than 1,000 ha of restored rainforest, with about 350 ha restored by Mitsinjo alone. It was hoped that carbon credits generated through photosynthetic carbon sequestration would be traded in order to provide for sustainable direct payments to farmers having set aside parts of their land for forest restoration, but the original Emission Reductions Payment Agreement with the World Bank's BioCarbon Fund has subsequently been suspended.

Restoring rainforest also contributes to reduced erosion, improved water retention, promotion of pollinators, and microclimatic equilibrium. These ecological services all have the potential to contribute to increasing agricultural performance and livelihoods of the local community in the long term. Indirect benefits from reforestation are accompanied by other activities designed to directly improve local livelihoods. In order to achieve this, Mitsinjo is particularly focusing on improved agriculture and community health, as well as the social infrastructure associated with it.

Mitsinjo has supported the establishment of organized farmer groups throughout Andasibe commune, with a special focus on the remote hamlets and deprived scattered settlements in Torotorofotsy to build both the capacity and the production potential of the local community. Collaboration with farmer groups and village associations was strengthened through the Sustainable Livelihood Activities (SLA) component of the TAMS Project. The objective was to provide economically viable alternatives to the traditional practice of slash-and-burn agriculture or *tavy* (Coutinho 2007). Various micro-projects were implemented, aimed at improving agricultural diversity, production and income. They have been developed along the establishment of relevant demonstration plots focusing on agroforestry, fruit trees, mixed plantations, and permaculture. Several plots have been established in the vicinity of reforested land in order to reward farmers for having set aside part of their land for rainforest restoration. Moreover, Mitsinjo's community-based trainers have freely distributed seeds (rice, beans, sorghum, potatoes) and agricultural materials (plows, shovels, rakes), and regularly provide trainings for local farmers (every six months on average) on rice cultivation, vegetable gardens, agroforestry, cattle breeding and apiculture, among others. In collaboration with the US Peace Corps, emphasis was placed on increasing sustainable rice production through the extension of the so-called *système de riziculture intensif* (SRI). As this technique usually provides higher yields from the same area of plowed land, Mitsinjo chose to promote it as a way to reduce the demand for conversion of wetlands to rice paddies, while increasing food security. Since all households involved in this program barely produce enough rice for subsistence (let alone for sale), we assume that the risk of converting more natural vegetation into arable land due to increased revenues (e.g., Gorenflo et al. 2011, Pollini 2012) would be limited.

Several projects focusing on community health were implemented thanks to Mitsinjo's adhesion to Voahary Salama, a network of Malagasy organizations sharing the philosophy of a Population, Health, and Environment (PHE) approach. These projects have led to the formation of a dozen community-based *agents de sante à base communautaire* (ASBC). The ASBC have

since advised and informed the local community on a plethora of urgent and critical health issues. They have freely distributed hundreds of insecticide-treated mosquito nets to help fight malaria, chemical water purification kits to help combat diarrheal diseases, and free condoms to prevent sexually transmitted diseases (STDs) with special emphasis on HIV/AIDS. Raising awareness on STDs was coupled with raising awareness on family planning, offering women a variety of contraceptive methods, thus providing them with the choice of how many children they want to have. Sanitary infrastructure erected by Mitsinjo for the local community comprises numerous latrines and drinking water wells throughout Andasibe commune and beyond, as well as a dispensary at Torotorofotsy. This small clinic was inaugurated in 2013 by the Service Sanitaire de District (SSD), and will be operated by a professional nurse, assisted by the ASBC. Minor ailments and illness can now be treated on site due to having a dispensary, and people no longer need to travel to the clinics in Andasibe or even Moramanga, the district capital.

**ENVIRONMENTAL EDUCATION.** In order to raise environmental awareness and disseminate knowledge among the local community that would sustainably embed environmental thinking in the next generation, Mitsinjo has set up a comprehensive environmental education program for schoolchildren of the Andasibe region. In collaboration with the School District or *circonscription scolaire* (CISCO) and the superintendent of schools in the region or *chef de la zone d'action pédagogique* (Chef ZAP), Mitsinjo's environmental education program covers all seven elementary schools in Andasibe Commune, including six public primary schools or *écoles primaires publiques* (EPPs) and the private school St. Pierre et Paul of the Catholic Mission.

The person leading Mitsinjo's environmental education program is a local experienced teacher who has worked for various private primary schools as well as for the Alliance Française. She has been pedagogically trained and put together a team of twelve community-based voluntary teachers and developed an environmental curriculum together with the head teachers of all seven primary schools. Mitsinjo's voluntary teachers visit each primary school every week, teaching schoolchildren about the environment in a playful and interest-generating way, carrying out activities that encourage them to have fun engaging with their environment, and to think critically about the importance of natural resources and biodiversity. At present, more than 300 schoolchildren (age 8–10) are enrolled in the program, which is the first of its kind implemented in the Andasibe area.

Additionally, schoolchildren are taken on theme-based excursions into the forests managed by Mitsinjo every two months, providing a hands-on fun activity for the children and enabling volunteers to explain things more vividly than it would be possible in a classroom. During these excursions, many of the children see lemurs such as indri for the first time in their life. Children are also taken out to participate at events like World Wetlands Day, World Biodiversity Day or World Environment Day. They most enjoy the reforestation activities, and tree-planting is embraced by schoolchildren as both a fun event and a way to manage the forest for their own futures. At the end of the school year, all seven schools take part in a casual competition to find out which class can best summarize what they have learned

about the environment through song, dance, or acting. The competition is followed by concluding festivities.

Both teachers and schoolchildren appear to appreciate the program, as indicated through feedback. The children are enthusiastic, inquisitive, and eager to learn new things, which is crucial for them to explore the unique biodiversity of Andasibe and appreciate its importance. With continuous support from the Chef ZAP, the program will hopefully expand from the local primary schools to the middle school level, possibly benefitting from Mitsinjo's collaboration with the Madagascar Fauna & Flora Group and their experienced educators from Parc Ivoloïna in Toamasina. Currently, Mitsinjo provides environmental features in collaboration with Andasibe's local radio, Radio Vahinala, to reach a wider audience and raise environmental awareness among parts of the population previously unreached.

## RESULTS AND LESSONS LEARNED

In summary, community-based natural resource management coordinated by Mitsinjo has led to the legal protection and management of two sites of conservation importance (SF Analamazaotra, Torotorofotsy Ramsar site) that cover more than 10,000 ha in total. Thanks to Mitsinjo's regular patrols and assistance to local communities living adjacent to it, illegal logging and snare hunting virtually ceased since the association has taken over management for SF Analamazaotra. Although the situation at the Torotorofotsy Ramsar site is much more challenging (with about 2,000 people living within the site and additional immigrants because of the pipeline road of the Ambatovy nickel mine to the northwest), the regulations to use natural resources have improved thanks to a management plan that defines areas of conservation and areas of usage rights which are supervised and governed by local law (*dina*). At both sites, income generated from nature tourism directly provides for some 50 families of community members. Additionally, some 500 families, about a seventh of the population, benefit from projects focusing on rainforest restoration, agriculture and community health to improve their livelihoods. Based on feedback from farmers, the adoption of new agricultural techniques appears to have led to increased rice yields and a reduction of slash-and-burn practices. Training members of the community as para-scientists has led to community-run monitoring schemes, aimed at estimating population dynamics of certain vertebrate taxa (lemurs, birds, frogs) and identifying threats in a timely manner. Building science-based technical capacity has resulted in the creation of Madagascar's first captive breeding facility for amphibians and the restoration of habitat connectivity through the plantation of a million native rainforest trees. About 300 schoolchildren from all primary schools of the region are enrolled in an environmental education program, promoting conservation of biodiversity and sustainable use of natural resources. There is no doubt that such a holistic approach is absolutely essential for successful community-based natural resource management and conservation (Gruber 2010, but see also Rendigs et al. 2015). The Mitsinjo experience has shown that sustainable income generated from nature tourism, rainforest restoration, improved livelihoods through agriculture and health services, empowerment through training and experience and environmental education, were all helpful components to boost local conservation initiatives.

However, although Mitsinjo's activities benefit several hundred families, they still reach only a fraction of Andasibe's

entire community (ca. 14,000 inhabitants). As a consequence, some community members feel marginalized and often perceive those community members that work for, or benefit from, Mitsinjo's activities as elitists. The feeling of not being able to have a share in the benefits can turn into frustration and even opposition. Moreover, a large percentage of the income generated in Andasibe traditionally comes from logging, which once provided most employment opportunities to the community. It continues to be a vital part of the local economy which individual timber traders now dominate, especially after the disintegration of the CIBA. These entrepreneurs (as well as their workers) naturally feel threatened by any activity that might negatively affect their business. They also do not appear to be interested in improving local livelihoods, since they benefit through the availability of cheap labor when people are unemployed. Empowering community members and providing economic alternatives is therefore crucial. Legally entitling them to manage their own resources is a prerequisite, although timber and charcoal remain the primary source of income of many community-managed forests in Madagascar, thus often contradicting conservation objectives (Hockley and Andriamaravololona 2007).

Even among community members that engage in Mitsinjo's conservation activities in Andasibe, conservation is not usually seen as a vital requirement for maintaining ecosystem services or supplying the community with renewable natural resources. For most community members it is an alternative but interchangeable way of earning their income. If conservation-related activities provide more income through direct employment or revenue otherwise generated, people are likely to engage in them. Since only a part of Mitsinjo's annual budget is self-financed, many conservation-oriented jobs other than wildlife guiding (such as tree planting or ecological monitoring) are still strongly dependent on temporary third-party funding. However, any disruption in a regular salary can result in people looking for other paid jobs again. If there is no sufficient income from conservation activities, community members might switch to something more promising, which in most cases is linked to extractive and environmentally harmful businesses. As a consequence, some members of the community have alternated between tree planting and logging, and others between handicraft production and charcoal burning. Some of them would even engage in both environmentally-friendly and environmentally-harmful activities at the same time.

A vital and sustainable source of income could and should be capturing the value of ecosystem services. Direct payments for ecosystem services, including through maintaining biodiversity and carbon sequestration, offer considerable promise for local communities in Madagascar (Wendland et al. 2010). It was hoped that carbon credits generated through photosynthetic carbon sequestration of the TAMS Project would be traded via the BioCarbon Fund of the World Bank (Martin et al. 2004, Aquino 2008, Ferguson 2009). These hopes were unfortunately stifled by the cancellation of the contract at the exact time when local communities should have reaped the fruit in form of payments for trees planted and carbon credits generated. Frustration caused among local communities by such donor-driven short-sighted decisions should not be underestimated. Unrealized expectations could eliminate previous achievements since it betrays trust. Yet, earning the trust of local communities and not letting them down is probably the most important prerequisite for successful community-based natural resource management in the first place.

In order to alter people's attitudes, it would be important to focus on increasing their understanding about, and appreciation for, the beauty and importance of the natural world. In order to anchor conservation in the minds of people, empowering them as parascientists and enthraling them in environmental education programs has been demonstrated to be particularly rewarding.

Finally, it should also not be forgotten that environmental degradation caused by local communities might not be exclusively driven by economic necessities. Alternatively, it is often considerably shaped by social and cultural dynamics within those communities (Hume 2006, Scales 2012). If natural resource management by local communities is to be successful, socio-cultural contexts must therefore be considered. This is best assured by partners who support local communities in a long-term commitment, empowering them by giving them responsibility and a sense of pride.

## ACKNOWLEDGEMENTS

Apart from the numerous donors that have supported our activities over the years, we would like to thank the Ministère de l'Environnement, de l'Ecologie, de la Mer et des Forêts (MEEMF) for continuous institutional support. We would also like to thank the local administrative representatives, including the Mayor of Andasibe and the présidents des *fokontany*. We are most grateful to the local community of Andasibe for their trust and companionship.

## REFERENCES

- Andreone, F., Carpenter, A.I., Cox, N., du Preez, L., Freeman, K., et al. 2008. The challenge of conserving amphibian megadiversity in Madagascar. *PLoS Biology* 6(5): e118:1–4. (doi:10.1371/journal.pbio.0060118)
- ANGAP. 1995. Liste des plantes d'Andasibe. Association Nationale pour la Gestion des Aires Protégées. Unpubl. Report.
- Angelsen, A. and Wunder, S. 2003. Exploring the forest-poverty link: key concepts, issues and research implications. CIFOR Occasional Paper No.40. Bogor, Indonesia, CIFOR. (doi:10.17528/cifor/001211)
- Aquino, A. 2008. Madagascar: the Mantadia Biological Corridor REDD/AR project, BioCarbonFund Training, February, 8th 2008. Available at <<http://goo.gl/HCRSna>>
- Ballet, J., Rakotohariniaina, B., Ramarolison, S., Randrianalijaona, M. & Tolizara, C. 2011. Vulne# rabilite# e# conomique des populations et vulne# rabilite# des ressources forestie# res: le cas d' Andasibe. In: Vulne# rabilite# , Inse# curite# Alimentaire et Environnement a# Madagascar. J. Ballet & M. Randrianalijaona (eds.), pp. 159–190. Editions L'Harmattan, Paris.
- Cliquennois, N. 2007. Aperç# u ge# ne# ral de la diversite# des phasmes de Madagascar (Insecta, Phasmatodea). *Le bulletin d' Arthropoda* 32: 3–16.
- Coomes, O. T., Takasaki, Y. and Rhemtulla, J. M. 2011. Land-use poverty traps identified in shifting cultivation systems shape long-term tropical forest cover. *Proceedings of the National Academy of Sciences of the United States of America* 108, 34: 13925–13930. (doi:10.1073/pnas.1012973108)
- Coutinho, J. B. 2007. Livelihoods, Conservation and Ethical Trade: A Baseline Study of Forest Margin Communities in the Commune of Andasibe, Eastern Madagascar. Unpubl. M.Sc. Thesis. School of the Environment and Natural Resources, University of Wales, Bangor.

- Dolch, R. 2008. Sustainable natural resource management. The case of the Analamazaotra Forest Station, Andasibe, Madagascar. *Monografie del Museo Regionale di Scienze Naturali di Torino* 45: 377–384.
- Dolch, R. 2012. Species composition and relative sighting frequency of carnivores in the Analamazaotra rainforest, eastern Madagascar. *Small Carnivore Conservation* 44: 44–47.
- Dolch, R., Ratolojanahary, T., Randrianasolo, H., Rasolofoharivelo, T., King, T. and Randrianarimanana, L. 2013. Torotorofotsy-Ihofa. In: *Lemurs of Madagascar: A Strategy for Their Conservation 2013–2016*. C. Schwitzer, R. A. Mittermeier, N. Davies, S. Johnson, J. Ratsimbazafy, J. Razafindramanana, et al. (eds.), pp 71–73. IUCN/SSC Primate Specialist Group, Bristol Conservation and Science Foundation, Conservation International, Bristol, UK.
- Dolch, R., Fiely, J. L., Ndriamiary, J. N., Rafalimandimby, J., Randriamampionona, R., Engberg, S. E. and Louis Jr., E. E. 2008. Confirmation of the greater bamboo lemur, *Prolemur simus*, north of the Torotorofotsy wetlands, eastern Madagascar. *Lemur News* 13: 14–17.
- Dransfield, J. and Beentje, H. 1995. *The Palms of Madagascar*. Royal Botanic Gardens, Kew and The International Palm Society, Surrey, UK.
- Dressler, W., Büscher, B., Schoon, M., Brockington, D., Hayes, T., et al. 2010. From hope to crisis and back again? A critical history of the global CBNRM narrative. *Environmental Conservation* 37, 1: 5–15. (doi:10.1017/S0376892910000044)
- Edmonds, D., Rakotoarisoa, J. C., Dolch, R., Pramuk, J., Gagliardo, R., et al. 2012. Building capacity to implement conservation breeding programs for frogs in Madagascar: Results from year one of Mitsinjo's amphibian husbandry research and captive breeding facility. *Amphibian and Reptile Conservation* 5, 3: 57–69.
- Ferguson, B. 2009. REDD comes into fashion in Madagascar. *Madagascar Conservation & Development* 4, 2: 132–137. (doi:10.4314/mcd.v4i2.48654)
- Fiely, J. L. 2010. Teaching and Leading through Science Research Education in Andasibe, Madagascar. Final Report to the Rufford Small Grants Foundation. Available at <[http://www.rufford.org/rsg/projects/jonathan\\_fiely](http://www.rufford.org/rsg/projects/jonathan_fiely)>
- Giacoma, C., Sorrentino, V., Rabarivola, C. and Gamba, M. 2010. Sex differences in the song of *Indri indri*. *International Journal of Primatology* 31, 4: 539–551. (doi:10.1007/s10764-010-9412-8)
- Glaw, F. and Vences, M. 2007. *A Field Guide to the Amphibians and Reptiles of Madagascar*. Frosch-Verlag, Köln, Germany.
- Gorenflo, L. J., Corson, C., Chomitz, K. M., Harper, G., Honzák, M. and Özler, B. 2011. Exploring the association between people and deforestation in Madagascar. In: *Human Population: Its Influences on Biological Diversity*. R. P. Cincotta and L. J. Gorenflo (eds.), pp 197–221. Springer Ecological Studies 214, Berlin & Heidelberg, Germany. (doi:10.1007/978-3-642-16707-2\_11)
- Gruber, J. S. 2010. Key principles of community-based natural resource management: a synthesis and interpretation of identified effective approaches for managing the commons. *Environmental Management* 45: 52–66. (doi:10.1007/s00267-008-9235-y)
- Hockley, N. J. and Andriamarivololona, M. M. 2007. The economics of community forest management in Madagascar: is there a free lunch? USAID, Washington, D.C. <<http://ow.ly/KW4gK>> accessed 29 March 2015.
- Hume D. 2006. Swidden agriculture and conservation in eastern Madagascar – stakeholder perspectives and cultural belief systems. *Conservation and Society* 4: 287–303.
- Irwin, M. T., Wright, P. C., Birkinshaw, C., Fisher, B. L., Gardner, C. J., et al. 2010. Patterns of species change in anthropogenically disturbed forests of Madagascar. *Biological Conservation* 143, 10: 2351–2362. (doi:10.1016/j.biocon.2010.01.023)
- IUCN. 2014. The IUCN Red List of Threatened Species. 2014.2. Available at <<http://www.iucnredlist.org>>
- Janssen, T. and Rakotondrainibe, F. 2008. A revision of the indusiate scaly tree ferns (Cyatheaaceae, *Cyathea* subgen. *Alsophila* sect. *Alsophila*) in Madagascar, the Comoros and the Seychelles. *Adansonia* 30, 2: 221–376.
- Jensen, O. 2010. Social mediation in remote developing world tourism locations – the significance of social ties between local guides and host communities in sustainable tourism development. *Journal of Sustainable Tourism* 18, 5: 615–633. (doi:10.1080/09669581003615590)
- Junge, R. E., Barrett, M. A. and Yoder, A. D. 2011. Effects of anthropogenic disturbance on Indri (*Indri indri*) health in Madagascar. *American Journal of Primatology* 73, 7: 632–642. (doi:10.1002/ajp.20938)
- Kellert, S. R., Mehta, J. N., Ebbin, S. A. and Litchtenfeld, L. L. 2000. Community natural resource management: promise, rhetoric, and reality. *Society and Natural Resources* 13, 8: 705–715. (doi:10.1080/089419200750035575)
- King, T., Ravaloharimanitra, M., Randrianarimanana, H. L., Rasolofoharivelo, M. T. and Chamberlan, C. 2013. Community-based conservation of critically endangered lemurs at the Sakalava and Ranomainty sites within the Ankeniheny-Zahamena rainforest corridor, eastern Madagascar. *Lemur News* 17: 63–70.
- Kremen, C., Cameron, A., Moilanen, A., Phillips, S. J., Thomas, C. D., et al. 2008. Aligning conservation priorities across taxa in Madagascar with high-resolution planning tools. *Science* 320, 5873: 222–226. (doi:10.1126/science.1155193)
- Louvel, M. 1909. La forêt d'Analamazaotra. *Bulletin Economique de Madagascar* 9: 313–349. Available at <<http://goo.gl/BcCvmD>>
- Martin, N., Shoch, D., Dushku, A., Pearson, T. and Grimland, S. 2004. Measurement and Monitoring Plan for the Mantadia-Andasibe Corridor Restoration and Conservation Carbon Project, Madagascar. Unpubl. Report. Winrock International Report to CELB of Conservation International, Arlington, VA, USA.
- Newsome, D. and Hassell, S. 2014. Tourism and conservation in Madagascar: The importance of Andasibe National Park. *Koedoe* 56, 2: Art. #1144. (doi:10.4102/koedoe.v56i2.1144)
- Paiva, A. and Randrianarisoa, J. 2010. Partnership structures and project management in two reforestation initiatives: Emas, Brazil and TAMS, Madagascar. In: *What is Needed to Make REDD+ Work on the Ground? Lessons Learned from Pilot Forest Carbon Initiatives*. C. A. Harvey, O. Zerbock, S. Papageorgiou and A. Parra (eds.) p 32. Conservation International, Arlington, VA, USA.
- Pawliczek, M. and Mehta, H. 2008. Ecotourism in Madagascar: How a sleeping beauty is finally awakening. In: *Responsible Tourism – Critical Issues for Conservation and Development*. A. Spenceley (ed.), pp 41–68. Earthscan, London.
- Pirot, P. 2006. Olatra – Champignons d'Andasibe (Madagascar). Association Mitsinjo. Série Biodiversité d'Andasibe-Périnet (Madagascar) 1. Available at <<http://goo.gl/mN2LEF>>
- Pollini J. 2009. Carbon sequestration for linking conservation and rural development in Madagascar: The case of the Vohidrazana-Mantadia Corridor Restoration and Conservation Carbon Project. *Journal of Sustainable Forestry* 28, 3–5: 322–342. (doi:10.1080/10549810902791507)

- Pollini, J. 2012. Understanding agricultural intensification on a forest frontier in Madagascar: elements for a Malthusian / Boserupian synthesis. In: *Contested Agronomy: The Politics of Agricultural Research in a Changing World*. J. Sumberg and J. Thompson (eds.), pp 116–130, Earthscan, Oxford.
- Pollini, J., Hockley, N., Muttenter, F. D., Ramamonjisoa, B. S. 2014. The transfer of natural resource management rights to local communities. In: *Conservation and Environmental Management in Madagascar*. I. R. Scales (ed.), pp 172–192, Routledge, New York.
- Raik, D. B. and Decker, D. J. 2007. A multisector framework for assessing community-based forest management: Lessons from Madagascar. *Ecology and Society* 12, 1: 14. Available online at <<http://www.ecologyandsociety.org/vol12/iss1/art14/>>
- Ramsar Convention. 2012. The Annotated Ramsar List: Madagascar. Available at <<http://goo.gl/6Vx860>>
- Randrianarimanana, L., Ravaloharimanitra, M., Ratolojanahary, T., Rafalimandimby, J., Rasolofoharivelo, T., et al. 2012. Statut et conservation de *Prolemur simus* dans les sites de Ranomainty et Sakalava du Corridor Ankeniheny-Zahamena. *Lemur News* 16: 2–7.
- Ratolojanahary, T. H. 2011. Para-ecologist profile. Available at <<http://goo.gl/jrkLnh>>
- Ravaloharimanitra, M., Ratolojanahary, T., Rafalimandimby, J., Rajaonson, A., Rakotonirina, L., et al. 2011. Gathering local knowledge in Madagascar results in a major increase in the known range and number of sites for Critically Endangered Greater bamboo lemurs (*Prolemur simus*). *International Journal of Primatology* 32, 3: 776–792. (doi:10.1007/s10764-011-9500-4)
- Rendigs, A., Reibelt, L. M., Fidimalala, B. R., Ratsimbazafy, J. H. and Waeber, P. O. 2015. Ten years into the marshes – *Hapalemur alaotrensis* conservation, one step forward and two steps back? *Madagascar Conservation & Development* 10, 1S: 13–20. (doi:10.4314/mcd.v10i1.S3)
- Salafsky, N. and Wollenberg, E. 2000. Linking livelihoods and conservation: A conceptual framework and scale for assessing the integration of human needs and biodiversity. *World Development* 28, 8: 1421–1438.
- Scales, I. R. 2012. Lost in translation: conflicting views of deforestation, land use and identity in western Madagascar. *The Geographical Journal* 178, 1: 67–79. (doi:10.1111/j.1475-4959.2011.00432.x)
- Toillier, A., Lardon, S. and Herve, D. 2009. An environmental governance support tool: community-based forest management contracts (Madagascar). *International Journal of Sustainable Development* 11: 187–205.
- Toillier, A., Serpantié, G., Hervé, D. and Lardon, S. 2011. Livelihood strategies and land use changes in response to conservation: Pitfalls of community-based forest management in Madagascar. *Journal of Sustainable Forestry* 30, 1–2: 20–56. (doi:10.1080/10549811003742357)
- Torti, V., Gamba, M., Rabemananjara, Z. H. and Giacoma, C. 2013. The songs of the indris (Mammalia: Primates: Indridae): contextual variation in the long-distance calls of a lemur. *Italian Journal of Zoology* 80, 4: 596–607. (doi:10.1080/11250003.2013.845261)
- Wallach, V. and Glaw, F. 2009. A new mid-altitude rainforest species of *Typhlops* (Serpentes: Typhlopidae) from Madagascar with notes on the taxonomic status of *T. boettgeri* Boulenger, *T. microcephalus* Werner, and *T. capensis* Rendahl. *Zootaxa* 2294: 23–38.
- Wendland, K. J., Honzák, M., Portela, R., Vitale, B., Rubinoff, S. and Randrianarisoa, J. 2010. Targeting and implementing payments for ecosystem services: Opportunities for bundling biodiversity conservation with carbon and water services in Madagascar. *Ecological Economics* 69, 11: 2093–2107. (doi:10.1016/j.ecolecon.2009.01.002)
- Wesener, T. and Schütte, K. 2010. Swarming behaviour and mass occurrences in the world's largest giant pill-millipede species, *Zoosphaerium neptunus*, on Madagascar and its implication for conservation efforts (Diplopoda: Sphaerotheriida). *Madagascar Conservation & Development* 5, 2: 89–94. (doi:10.4314/mcd.v5i2.63137)
- Woodhead, C., Vences, M., Vieites, D., Gamboni, I., Fisher, B. L. and Griffiths, R. A. 2007. Specialist or generalist? Feeding ecology of the Malagasy poison frog *Mantella aurantiaca*. *The Herpetological Journal* 17, 4: 225–236.

## SUPPLEMENTARY MATERIAL

AVAILABLE ONLINE ONLY.

Andasibe, a short history of the study site.

## ARTICLE

<http://dx.doi.org/10.4314/mcd.v10i1.S5>

# Conservation communautaire de la forêt humide de basse altitude d'Andriantantely, Madagascar

Maholy Ravaloharimanitra, Hery Nirina Théophile  
Randriahaingo, Lova Harilala Ranaivosoa, Christelle  
Chamberlan, Tony King

Correspondence:  
Maholy Ravaloharimanitra  
The Aspinall Foundation Programme Madagascar  
Lot III R 49 Tsimbazaza, 41 Rue Kasanga Fernand  
Antananarivo 101 - Madagascar  
E-mail: rrmahooly@gmail.com

## ABSTRACT

Andriantantely is a lowland rainforest fragment situated in the Brickaville District of eastern Madagascar, to the south-east of the Ankeniheny-Zahamena forest Corridor. Andriantantely is recognised as a priority site for the conservation of biodiversity in general, and of four species of Critically Endangered lemurs: *Prolemur simus*, *Varecia variegata*, *Indri indri*, and *Propithecus diadema*. Approximately 4,000 ha in size, the forest extends into five different rural communes, and is impacted by many villages and hamlets, some of which are found within the forest itself. Eight VOI (local community associations) from three communes (Lohariandava, Fanasanagare and Fetraomby) are interested in management transfer contracts for parts of Andriantantely. Since 2010, The Aspinall Foundation works with the VOIs for the conservation of *Prolemur simus*, other lemurs, and their habitats, which helped lead to the removal of *P. simus* from the 25 most endangered primates list in 2012. The conservation strategy was developed following a socio-economic survey undertaken in 2010 which aimed to identify the factors limiting the conservation of the species and its habitat. The main issues identified were poverty of local people and lack of awareness of the value of biodiversity. The first conservation action undertaken was the initiation of a patrol system with local community rangers which increased understanding and protection of the monitored *P. simus* groups. Simultaneously, awareness-raising missions were organised within the communities living close to the *P. simus* sites, aimed at changing local attitudes to natural resources, and particularly lemurs. These initial activities led to the VOIs asking the Foundation for assistance in obtaining their management transfer contracts. The first contract was signed in January 2014, but several others need completion, and the development of a long-term conservation strategy for the entire Andriantantely forest, implicating local communities in a true and effective manner, is still required. Environmental education activities have followed the initial awareness-raising missions, to instill practices of rational natural resource use to assure rural development that is respectful of the environment. Much work is still required over a long time period before this rational use might be adopted by the local population in general, by VOI members and non-members alike.

## RÉSUMÉ

La forêt humide de basse altitude d'Andriantantely est située dans le district de Brickaville, au sud-est du corridor Ankeniheny-Zahamena dans l'est de Madagascar. Andriantantely est reconnu comme site prioritaire pour la conservation de la biodiversité en général, mais également pour celle de quatre espèces de lémurien en Danger Critique d'Extinction, à savoir *Prolemur simus*, *Varecia variegata*, *Indri indri* et *Propithecus diadema*. Avec une superficie d'environ 4 000 ha, la forêt d'Andriantantely s'étend sur cinq communes rurales et concerne plusieurs villages et habitations éparses dont certaines se trouvent en son cœur même. Huit groupements communautaires *Vondron'Olonafotony* (VOI), réparties dans six *fokontany* appartenant à trois communes rurales du bloc forestier regroupant ces villages, à savoir Lohariandava, Fanasana gare et Fetraomby, sont intéressées par la gestion de la forêt d'Andriantantely. Depuis 2010, la fondation Aspinall (The Aspinall Foundation) a travaillé avec des VOI pour la conservation des lémuriens dont *Prolemur simus* et de leurs habitats. Son action a permis de retirer *P. simus* de la liste des 25 primates les plus menacés au monde en 2012. Pour ce faire, les axes et stratégies d'intervention ont été élaborés suite à une étude socio-économique menée en 2010. Cette étude a cherché à identifier les facteurs limitant la conservation de l'espèce et la préservation de son habitat. Les principaux facteurs identifiés étaient la pauvreté des Hommes vivant à la périphérie et dans la forêt, ainsi que la méconnaissance de la valeur de la biodiversité. La première étape de l'action de conservation a été la mise en place d'un système de patrouilles assuré par des gardes locaux. Parallèlement aux patrouilles, des campagnes de sensibilisation ont été menées auprès des communautés villageoises pour que leurs attitudes vis-à-vis des ressources naturelles et plus spécifiquement des lémuriens évoluent. Ces travaux de sensibilisation ont porté leurs fruits puisque ce sont les VOI elles-mêmes qui ont sollicité l'appui de la fondation pour l'obtention d'un contrat de transfert de gestion. Le premier contrat a été signé en janvier 2014, mais d'autres sont en cours de réalisation depuis début 2015. L'élaboration d'une stratégie de conservation à long terme pour l'ensemble de la forêt d'Andriantantely, impliquant la population locale de façon réelle et effective, reste à élaborer. Les campagnes d'éducation environnementale ont succédé à celles de la sensibilisation afin d'inculquer les pratiques d'une utilisation rationnelle des ressources naturelles pour

assurer un développement rural respectueux de l'environnement. Un long chemin reste néanmoins à parcourir pour que cette utilisation rationnelle soit pleinement adoptée par l'ensemble de la communauté, que les villages soient membres ou non des organisations communautaires ou VOI.

## INTRODUCTION

La fondation Aspinall (The Aspinall Foundation) est une organisation non-gouvernementale œuvrant à Madagascar depuis 2009 pour la sauvegarde des espèces menacées d'extinction, en particulier les lémuriens (King et Chamberlan 2010). Des missions de reconnaissance des sites pouvant abriter *Prolemur simus*, l'espèce phare sur laquelle la fondation a initialement travaillé, ont permis de découvrir l'espèce dans une partie du bloc forestier d'Andriantantely, district de Brickaville, à l'est de Madagascar (Ravaloharimanitra et al. 2011). Depuis cette découverte, diverses actions ont été menées, y compris dans les domaines social, économique et environnemental, afin de réduire considérablement les menaces et pressions pesant sur la population de ce lémurien dans ce site et son habitat (Lantovololona et al. 2012).

Les données fossiles et subfossiles ont montré que *Prolemur simus* avait eu une aire de répartition ancienne bien plus étendue que celle qui était connue récemment (Mahé 1976, Vuillaume-Randriamanantena et al. 1985, Godfrey et Vuillaume-Randriamanantena 1986, Godfrey et al. 2004). L'espèce a été présumée éteinte suite à l'absence d'observation d'individus au début du 20<sup>e</sup> siècle (Napier et Napier 1967) mais a été redécouverte dans la partie sud-est de l'île dans les années 1960 et 1970 (Petter et al. 1977, Meier et Rumpler 1987). Une étude collaborative menée en 2009 par la fondation Aspinall, l'Association Mitsinjo, le Groupe d'Étude et de Recherche sur les Primates de Madagascar (GERP) et Conservation International, a permis d'identifier la présence de l'espèce autour de la forêt d'Andriantantely (Ravaloharimanitra et al. 2011).

La fondation s'est alors impliquée dans la gestion de la forêt d'Andriantantely afin de préserver l'habitat des *Prolemur simus* et assurer leur conservation en même temps que celle des populations de trois autres espèces de lémuriens en Danger Critique d'Extinction (*Varecia variegata*, *Indri indri* et *Propithecus diadema*). Dans un premier temps, ses actions se sont limitées au suivi des groupes de *Prolemur simus* identifiés, pour dissuader les pratiques de chasse et d'installation de piège ainsi que pour connaître les habitudes des animaux. Ensuite, en réponse à une sollicitation des villageois de la région, elle a appuyé un processus destiné à obtenir un contrat de transfert de gestion aux VOI intéressés par la gestion de la forêt (King et al. 2013b). Finalement, la fondation s'est impliquée dans la mise en œuvre du plan d'aménagement et de gestion afin de veiller au respect du cahier des charges et l'application des mesures répressives connues localement sous le terme de *dina* pour concrétiser une convention collective portant sur le transfert de gestion. Le présent article décrit les étapes de la collaboration entre la fondation et les organisations villageoises (VOI), usufuitières des ressources naturelles d'Andriantantely.

La VOI (*Vondron'Olona Ifotony*) est un groupe d'intérêt de personnes appartenant à une organisation communautaire partageant les mêmes intérêts et les mêmes convictions. Dans le cas présent, l'organisation s'engage dans la gestion rationnelle des ressources naturelles, suivant un plan d'aménagement et de

gestion établi d'une manière participative et suivant un contrat établi avec l'administration forestière. L'étendue géographique d'un transfert ou d'une proposition de transfert de gestion peut concerner un bloc forestier s'étendant sur une partie ou la totalité d'un ou de plusieurs *fokontany* (la plus petite division administrative de Madagascar). Les VOI concernées ici, ont ensuite été regroupées en fédération de VOI, à l'initiative de Conservation International, généralement à l'échelle des districts. La fédération des VOI du district de Brickaville ou *Tsarafaniry* est composée des membres des comités de direction de chaque VOI fédérée.

## DESCRIPTION DU SITE

**SITUATION GÉOGRAPHIQUE DE LA FORÊT D'ANDRIANTANTELY.** La forêt classée d'Andriantantely (E048° 46', S18° 40') est un bloc de forêt humide de basse altitude, les altitudes étant comprises entre 300 et 700 m. Elle est considérée comme un satellite du corridor forestier d'Ankeniheny-Zahamena, au sud-est dudit corridor, à 35 km au nord-ouest de Brickaville. Le tableau de bord environnemental de la région Atsinanana, datant de 2005 et basé sur d'anciennes données de couverture forestière, mentionne une superficie de 5 835 ha. D'autres équipes ont estimé sa superficie à 4 170 ha (Andriamasimanana et al. 2001, Schmid et Alonso 2005). La diminution de la superficie pourrait être expliquée par la déforestation, conséquence de défrichements (*teviaala*) et de la pratique de la culture sur brûlis (*tavy*).

Du point de vue administratif, la plus grande partie du bloc forestier d'Andriantantely est localisée sur la Commune rurale de Lohariandava, la section nord-ouest sur celle d'Ambohimanana, la partie nord-est sur celle de Fetraomby et la partie sud-est sur celles de Fanasana gare et Razanaka. Les chefs-lieux des communes rurales de Fanasana gare et de Lohariandava sont desservies par le chemin de fer, anciennement appelé TCE ou Tananarive – Côte Est. Les sites proprement dits ne sont accessibles qu'à pied, le long de sentiers émanant de chaque commune.

### LA BIODIVERSITÉ DU BLOC FORESTIER D'ANDRIANTANTELY.

Lors de l'évaluation rapide de la biodiversité organisée par Conservation International en 1998 et 1999 sur cinq sites du Corridor Ankeniheny-Zahamena (CAZ), l'équipe de Schmid et Alonso (2005) a souligné le caractère intact et unique de la forêt d'Andriantantely pour la diversité des espèces de la faune et de la flore. L'équipe d'inventaire a recensé une plus grande diversité de lémuriens, de chauves-souris, de micromammifères et rongeurs endémiques que dans les autres sites étudiés. La forêt d'Andriantantely abrite ainsi 64 espèces d'oiseaux, est considérée comme le site le plus important pour la conservation de la diversité des insectes avec 27 familles et six ordres, indicateurs de l'état de la biodiversité. L'herpétofaune est représentée par 72 espèces recensées, dont une espèce d'amphibien et une espèce de reptile appartenant à des taxons non décrits (Schmid et Alonso 2005).

Ces données encourageantes pour mener des actions de conservation ont été renforcées par la découverte récente de *Prolemur simus*, qui porte à neuf le nombre de lémuriens observés dans cette forêt. Quatre de ces espèces de lémuriens sont classées en Danger Critique d'Extinction par l'UICN : *Prolemur simus*, *Varecia variegata*, *Indri indri* et *Propithecus*

*diadema* (UICN 2015), de sorte que la forêt d'Andriantantely est reconnue comme un des sites prioritaires pour la conservation des lémuriens à Madagascar (King et al. 2013a).

CONTEXTE SOCIO-ÉCONOMIQUE. La forêt s'étendant sur cinq communes et touchant au moins six *fokontany* et plusieurs villages et habitations éparses, dont certaines se trouvent au cœur même de la forêt (comme c'est le cas d'Ambodihara, commune rurale Lohariandava), le contexte socio-économique est complexe. Sur la base d'une estimation réalisée en 2010 par l'équipe chargée de l'élaboration du Plan de Gestion Environnementale et de Sauvegarde Sociale (PGESS) pour la Nouvelle Aire Protégée Corridor Ankeniheny-Zahamena (NAP CAZ), 18% de la population totale des trois communes rurales principales concernées par le bloc forestier d'Andriantantely (Ambohimana, Fetraomby et Lohariandava), pourraient être affectés par le projet de mise en place d'une aire protégée, car dépendants directement ou indirectement des ressources naturelles de la forêt.

Les informations récoltées en 2010 auprès des intervenants dans le domaine de la conservation du district de Brickaville montrent que huit VOI distribuées sur six *fokontany* appartenant à trois communes rurales, seraient intéressées par la gestion de la forêt d'Andriantantely (Tableau 1). La fondation travaille étroitement avec deux de ces VOI depuis la découverte de *Prolemur simus* dans le bloc forestier, depuis 2010 et participe notamment à la délimitation des surfaces de transfert de gestion. Le transfert de gestion représente un long travail de collaboration entre l'administration forestière délégataire et le groupe d'intérêt VOI à laquelle la gestion sera transférée.

L'étude socio-économique réalisée dans les villages périphériques de la forêt d'Andriantantely a conclu que l'indice de développement de la population était faible. Lantovololona et ses collaborateurs concluent, en 2012, que ces villages dépendent ainsi étroitement des ressources naturelles. Ces mêmes auteurs ont aussi relevé la présence d'habitations humaines temporaires en lisière de forêt, l'abattage de grandes quantités de bois pour l'usage local, principalement destiné à la construction d'habitations et au bois de chauffe, la collecte de produits forestiers non ligneux, l'installation de pièges, l'utilisation de sarbacanes pour la chasse et enfin le passage en forêt des villageois accompagnés de chiens. La situation politique instable que Madagascar a connue entre 2009 et 2013 n'a pas favorisé la

conservation de la biodiversité. La population s'est appauvrie en dépendant de plus en plus des ressources naturelles.

## OBJECTIFS

Lorsque la fondation Aspinall s'est installée à Madagascar, elle cherchait avant tout à sauver *Prolemur simus* de la menace d'extinction qui pesait sur l'espèce (King et Chamberlan 2010, Rakotonirina et al. 2011), conformément à sa philosophie, en collaborant avec les partenaires de la place et acteurs engagés à différents niveaux dans la protection des lémuriens et de leurs habitats. Les membres des VOI peuvent être considérés comme les principaux acteurs locaux, car ils vivent à proximité de la forêt et qu'ils sont les principaux concernés par la conservation des ressources naturelles et de leur utilisation pérenne. Le présent article décrit ainsi la mise en place d'un système de gestion communautaire des ressources naturelles du bloc forestier d'Andriantantely, pour la conservation des lémuriens et de leurs habitats.

## MÉTHODES

CONSERVATION DES LÉMURIENS. Pour appréhender localement la situation de *Prolemur simus* et remporter l'adhésion des riverains au projet de conservation proposé, la fondation Aspinall a commencé par identifier les sites abritant, ou susceptibles d'abriter, l'espèce. Des campagnes d'inventaire ont été menées dans plusieurs communes et auprès de plusieurs VOI à la périphérie et dans le Corridor forestier d'Ankeniheny-Zahamena (Ravaloharimanitra et al. 2011). Les membres des VOI y ont contribué, en partageant oralement leurs connaissances des lémuriens présents dans leur forêt, en proposant une localisation sur une carte topographique des lieux abritant des bambous, et enfin, en proposant des personnes issues de la VOI et pouvant servir de guide à l'équipe de chercheurs. Des vérifications sur site ont été organisées sur la base de ces consultations.

Dans un second temps, un système de patrouille, assuré par des gardes locaux, a été mis en place pour relever des données régulières sur *Prolemur simus* et son habitat (Ravaloharimanitra et al. 2011). Les VOI ont été chargées d'identifier et de désigner les personnes compétentes et motivées pour assurer les patrouilles. Ces candidats ont été formés en collaboration avec l'Association Mitsinjo, puis par les primatologues de la fondation (Lantovololona et al. 2012). Des rapports de patrouille ont été établis mensuellement et annuellement sur la base des données collectées par les gardes depuis 2010. Depuis 2010, trois patrouilles effectuent un suivi hebdomadaire régulier des groupes de lémuriens identifiés dans trois zones différentes de la forêt.

Des campagnes de sensibilisation destinées à toutes les personnes de tout âge dans la zone à proximité des sites abritant *Prolemur simus* ont été effectuées (Ravaloharimanitra et al. 2013a). Une attention particulière a été accordée aux écoliers, afin de les inciter à participer activement à la conservation de l'espèce et de son habitat. Des cahiers scolaires ont été distribués pour servir de véhicule d'informations et d'éducation (Chamberlan 2012).

ORGANISATION ET MISE EN ŒUVRE DES ACTIONS DE CONSERVATION. Dans un premier temps, la fondation a procédé à l'identification des facteurs responsables de la dégradation des ressources naturelles. Les études socio-économiques menées par Lantovololona et ses collaborateurs en

TABLEAU 1. Récapitulatif des VOI demanderesses ou bénéficiaires de Transferts de Gestion

| VOI                    | Commune, Fokontany, Siège de la VOI          | Localisation des ressources                 | Surface transférée ou à transférer (ha) | Nombre de membres | Etape du transfert de gestion      |
|------------------------|--|---|---|-------------------|------------------------------------|
| Dimbiazanjafy          | Fanasana, Lanonana, Lanonana                 | Andriantantely / Marodimatika               | 310                                     | 70                | 22 I 2014                          |
| Soafaniry              | Fetraomby, Ambinaninifanasana, Ambodimanga   | Andriantantely                              | *                                       | 75                | En cours 2015                      |
| Mevasoa                | Fetraomby, Ambohimazava, Ambohimazava        | Andriantantely / Belambo                    | **                                      | **                | **                                 |
| Zarasoa                | Fetraomby, Ambinaninifanasana, Ampasimiady   | Andriantantely                              | 100                                     | *                 | Projet de fusion avec d'autres VOI |
| Andriantantely         | Fetraomby, Ambodikily, Andranomihotra        | Andriantantely                              | 2 231                                   | 24                | **                                 |
| Sahatonny              | Fetraomby, Ambinaninifanasana, Sahavily      | Andriantantely Sahatonny                    | 100                                     | **                | Projet de fusion avec d'autres VOI |
| Soafaniry Sahamanantsy | Lohariandava, Ambodiantafana, Ambodiantafana | Andriantantely / Sahasarotra / Sahamanantsy | 1 158                                   | 34                | 30 XI 2014                         |
| Tambatra               | Lohariandava, Andonabe, Andonabe             | Forêt Sahasarotra                           | 694                                     | 62                | 30 XI 2014                         |

2012 ont montré que les gens de la région dépendaient étroitement des ressources naturelles, au point de les menacer. Ces études ont aussi identifié la présence de VOI dans la zone, mais des VOI peu organisées ou inactives. Raik (2007) a noté que le transfert de gestion des ressources naturelles aux communautés locales pouvait avoir un impact positif sur la conservation à conditions que ces communautés comprennent les intérêts qu'elles peuvent tirer de cette gestion. La réalité sur le terrain est généralement réduite à des VOI qui ont un niveau de connaissances limitées et de faibles capacités de gestion pour élaborer une stratégie. Pour éviter un transfert de gestion peu profitable aux VOI concernées par la forêt d'Andriantantely, plusieurs réunions d'information ont été organisées avant toute chose pour informer les membres des VOI et renforcer leurs compétences afin qu'ils puissent s'organiser pour mieux défendre leurs intérêts tout en respectant l'environnement.

Afin de réduire les adhésions motivées par le seul espoir d'obtenir une aide financière personnelle des bailleurs ou des organismes d'appui, nous avons procédé à une période test de 2012 à 2014. Des réunions d'information, d'éducation et de formation des membres ont été organisées au cours de cette période. Les thèmes abordés incluaient la gestion de la vie associative, les droits, devoirs, obligations et responsabilités des membres vis-à-vis de l'association et de l'association vis-à-vis des parties contractantes du transfert de gestion, la gestion des ressources naturelles. Divers supports didactiques et audiovisuels comme des documentaires, des jeux de rôle, des simulations, ont été utilisés.

Face à des conditions particulières comme lors de cataclysmes naturels, des actions sociales ont été entreprises afin d'aider la population et plus particulièrement pour éviter que la vulnérabilité causée par le cataclysme ne se traduise par une pression démesurée sur les ressources naturelles. Par exemple, après le passage du cyclone Giovanna en 2012, des matériaux pour la réhabilitation des écoles ont été octroyés (Chamberlan et al. 2013). L'objectif poursuivi était de montrer aux gens que les travaux de conservation, malgré leurs exigences et leurs obligations, comportaient aussi leur part d'avantages mais que ceux-ci devaient profiter à la collectivité. La fondation a aussi doté les VOI de matériels pour mettre en œuvre les formations dispensées et instaurer une méthode de gestion documentée et archivée.

**IMPLICATION DES AUTORITÉS LOCALES ET COORDINATION DES ACTIVITÉS AVEC LES INTERVENANTS.** L'organisation de la société malgache dans les zones reculées de Madagascar repose encore sur la hiérarchie d'âge. Les communautés vivant à la périphérie de la forêt d'Andriantantely ne font pas exception et l'autorité traditionnelle prime sur toute autre forme d'autorité, y compris celles liées aux lois et règlements. Il était donc primordial de convaincre les aînés pour transmettre efficacement les messages de sensibilisation à la conservation de la biodiversité. Des relations privilégiées ont donc été tissées avec cette autorité morale en l'associant à chacune des étapes du projet de conservation et en lui demandant de valider chacune des décisions prises.

Le contrat de transfert de gestion est un contrat passé entre l'administration forestière et la VOI. La mairie fait partie de la commission d'enquête préalable à la signature du contrat et joue le rôle d'interface entre l'administration forestière et la VOI. Elle

joue également le rôle de conseil et de recours administratif en cas de conflit durant la phase de gestion. Au niveau local et dans le cadre du transfert de gestion des ressources naturelles, la mairie est représentée par le *fokontany*. Faute de moyens techniques et administratifs, l'administration forestière n'est pas capable d'assumer toute seule les travaux préliminaires à un transfert de gestion. De son côté, la VOI n'est pas en mesure de supporter les frais engendrés par la mobilisation des agents de l'administration pour la régularisation et l'officialisation du contrat de transfert. La fondation a alors établi une collaboration avec l'administration forestière pour mettre en œuvre et accélérer le processus de transfert.

À l'obtention d'un contrat de transfert de gestion des ressources naturelles, les VOI doivent soumettre leur *dina* pour homologation auprès du tribunal. Le *dina* est un règlement qui formule les sanctions portant sur chaque type d'infractions au cahier des charges, et constituant ainsi un document clé du contrat de transfert. À l'obtention de cette homologation, les sanctions définies peuvent immédiatement être appliquées par la VOI, sans recours à des Officiers de la Police Judiciaire. Le rôle de la fondation consistait à appuyer l'application du *dina*. Les procédures administratives auprès du tribunal étant extrêmement longues, il est quasiment impossible d'obtenir l'homologation d'un *dina* lors d'un premier contrat de transfert. Pour pallier à ce problème, la fondation a établi une collaboration avec la gendarmerie.

Compte tenu de la diversité des intervenants dans le district de Brickaville, des réunions mensuelles ont été organisées à partir de 2011 pour assurer la coordination des interventions de conservation. Il s'agissait d'harmoniser les interventions de chaque entité et d'échanger des informations pour éviter toute confusion au sein des VOI. Ces réunions ont ensuite été reprises à un rythme trimestriel par la direction régionale en charge de la conservation de l'Environnement et des Forêts de la région Atsinanana. Au niveau local, ce rôle d'interface a été assuré par la fédération des VOI, connue sous le nom de Tsarafaniry pour le district de Brickaville.

## RÉSULTATS

Les patrouilles régulières qui collectaient des données dans chaque site ont permis l'amélioration des connaissances sur *P. simus*, sans oublier que les passages réguliers en forêt ont aussi fait baisser le piégeage et autres pressions anthropiques sur l'habitat de ce lémurien. Randriahaingo et ses collaborateurs (2014) ont noté que le nombre d'individus de *P. simus* observés dans les huit groupes, suivis régulièrement autour d'Andriantantely, était passé de 48 en 2011 à 103 en 2014. Ces patrouilles ont également permis la création d'emplois pour quelques personnes vivant à la périphérie des sites en améliorant ainsi leur situation économique.

Les activités de sensibilisation déployées depuis 2010 ont permis aux VOI de comprendre l'intérêt d'obtenir des contrats de transfert de gestion, ce qu'elles ont formulé en 2012. La procédure a été entamée à partir de cette période. Les différentes étapes à suivre lors du processus du transfert de gestion, décrites par King et ses collaborateurs (2013b), sont primordiales car elles sont les conditions de son effectivité. Il s'agissait de mettre en œuvre les appuis nécessaires pour augmenter les compétences afin que la VOI puisse acquérir son autonomie pour prendre des décisions rationnelles et efficaces, même si les termes du

contrat et du plan d'aménagement et de gestion reflètent souvent les aspirations de l'organisme d'appui.

Les VOI font souvent remarquer qu'un contrat signé avec des exploitants forestiers est plus avantageux qu'un contrat conclu avec des organismes de conservation de la nature. En effet, pour pouvoir évacuer ses produits, un exploitant forestier aménage ou réhabilite des accès au village. Ces accès permettent aussi à la population locale d'évacuer ses propres produits agricoles. En outre, les travaux d'abattage, transformation et évacuation des produits forestiers, constituent une source temporaire de revenus pour la population locale. Pour assurer la conservation de la nature, il est ainsi primordial de convaincre la population locale de se projeter sur le long terme et leur montrer l'importance du capital naturel par rapport à un avantage immédiat mais éphémère. Au cours des actions menées, certains décideurs administratifs ont opté pour le profit immédiat. De plus, malgré la collaboration avec l'administration forestière, mais à cause de l'étendue de ses responsabilités, seules trois VOI prétendant à la gestion du bloc forestier, avaient obtenu un contrat de transfert de gestion en 2014 et avaient été sensibilisée aux textes et législations relatifs au transfert de gestion, à la gestion des ressources naturelles et à la biodiversité.

La période de 2012 à 2014 a constitué la période test pour la VOI Dimbiazan-jafy, celle dont l'obtention du contrat a été appuyée par la fondation. Cette VOI admettait que jouir de l'usage de la forêt et des produits forestiers constituaient un profit d'une très grande valeur, et qu'en contrepartie de cette jouissance, elle avait le devoir de gérer la forêt de manière pérenne pour satisfaire les besoins du présent et du futur. Cependant le nombre de membres de cette VOI est allé en diminuant, de 70 personnes en 2012 à 30 personnes 2014. Ne sont restées que les personnes réellement motivées par la gestion durable des ressources naturelles de leur localité.

Les réunions trimestrielles de coordination des interventions, dans le domaine de la conservation de l'environnement et des forêts, ont permis d'identifier les huit VOI prétendant à la gestion du bloc forestier d'Andriantantely (Tableau 1). Elles ont également permis aux intervenants d'une même zone de se connaître et de communiquer, mais elles ont été momentanément suspendues à partir de 2012, suite aux problèmes politiques au niveau national. La fédération Tsarafaniry, mise en place par Conservation International, est supposée prendre le relais et jouer le rôle d'interface entre les VOI et les bailleurs. Cette fédération s'est trouvée fragilisée car la plupart des VOI qui la constitue, en particulier celles en dehors du bloc forestier d'Andriantantely, sont encore très fragiles et peu organisées. De plus, le texte régissant ces fédérations est encore flou, fragilisant encore plus la structure.

## CONCLUSION

La forêt d'Andriantantely est non seulement remarquable en termes de diversité biologique, mais également en termes d'endémicité (Schmid et Alonso 2005). Les personnes vivant à la périphérie de cette forêt ignorent cependant son importance biologique et pratiquent des activités illicites ayant des impacts négatifs sur les ressources naturelles de cette forêt qui s'en trouve ainsi menacée.

Des groupes d'intérêt que sont les VOI avec les usagers de la forêt ont été constitués afin de réguler l'accès aux ressources naturelles mais, faute de moyens, la plupart de ces groupes

n'avaient toujours pas officialisés en 2014 et ne profitaient pas d'un contrat de transfert de gestion. Le processus ne devrait cependant être accéléré inutilement. Il faut en effet que les VOI deviennent les acteurs réels de la conservation des ressources naturelles en intégrant le développement local. Les communautés villageoises doivent comprendre leur intérêt dans un système générateur de développement et de profits. Elles doivent pouvoir distinguer le transfert de gestion du transfert de biens et assimiler que la possibilité d'un profit personnel ne doit pas être la principale motivation pour adhérer à la VOI.

La mise en place d'une patrouille de surveillance a permis d'améliorer les connaissances et le niveau de conservation des groupes de *Prolemur simus* sur divers sites de la forêt d'Andriantantely et sur sa périphérie. Dans un avenir immédiat, l'extension de ces patrouilles de suivi à d'autres espèces et d'autres territoires du bloc forestier est recommandée (King et al. 2013a), sans oublier de considérer sérieusement une gestion à long terme, impliquant la population locale de manière réelle et effective.

Le paiement des services environnementaux est une option proposée pour assurer la conservation de la biodiversité. Les personnes des communautés locales doivent préalablement prendre conscience de la valeur de la biodiversité qui les entoure et des services qu'elle leur fournit, consentent à la respecter et à la préserver pour leur plus grand bien. Les campagnes de sensibilisation doivent participer à cet aspect. L'éducation environnementale s'appuyant sur les connaissances acquises localement est un levier efficace pour travailler sur cet aspect. Enfin, ces personnes doivent valoriser au mieux les aides reçues et les avantages des mesures adoptées afin d'en profiter pleinement et d'en comprendre l'impact sur leur vie quotidienne.

## REMERCIEMENTS

Nous adressons nos vifs remerciements à toutes les personnes et institutions publiques ou privées ayant contribué, de près ou de loin, à la réalisation de ce projet, en particulier le Ministère en charge de l'Environnement et des Forêts qui nous a délivré le permis de recherche et a consenti aux transferts de gestion du site aux diverses VOI par le biais de la Direction Régionale en charge de l'Environnement et des Forêts de la Région Atsinanana. Nous tenons également à remercier vivement les représentants des hiérarchies administratives et traditionnelles locales, en particulier Monsieur le Chef de District de Brickaville et Monsieur le Maire de la Commune Rurale de Fanasana Gare, ainsi que les Présidents des *fokontany*. Enfin, notre reconnaissance sincère va à tous les patrouilleurs locaux pour leur collaboration et compréhension. Les activités ont été financées en principal par The Aspinall Foundation et nous remercions d'ores et déjà The Mohamed bin Zayed Species Conservation Fund (projet 14258776) et la fondation Beauval Nature pour le début de leur soutien de nos projets de conservation dans la forêt d'Andriantantely. Et enfin, et non la moindre, nous remercions les rapporteurs anonymes qui ont consacré une grande partie de leur temps et de leur savoir pour évaluer cette contribution, et dont les critiques ont permis l'amélioration de la version antérieure du présent article

## RÉFÉRENCES

- Andriamasimanana, R. H., Rabenandrasana, M. N., The Seing Sam, V. R., Virginie, M. C., Ratelolahy, J. F. et Rakotonirainy, E. O. 2001. Effets de la fragmentation de la forêt humide sur les populations d'oiseaux et de lémurien dans le Corridor Mantadia-Zahamena. *Lemur News* 6: 18–22.
- Chamberlan, C. 2012. Sauver *Prolemur simus* – 3000 cahiers scolaires "Godroka" distribués autour du CAZ. *Lemur News* 16: 26.
- Chamberlan, C., Ranaivosoa, L., Ravaloharimanitra, M., Randrianarimanana, H. L., Randriahaingo, H. N. T., Roulet, D. & King, T. 2013. Distribution of school reconstruction materials following Cyclone Giovanna to local communities working to conserve greater bamboo lemurs in and around the Ankeniheny-Zahamena Corridor, eastern Madagascar. *Lemur News* 17: 2–4.
- Hockley, N. J. & Andriamarivololona, M. M. 2007. The economics of community forest management in Madagascar: is there a free lunch? USAID, Antananarivo, Madagascar. <<http://ow.ly/MS6cm>> accessed 10/04/2014.
- King, T. & Chamberlan, C. 2010. Conserving the Critically Endangered greater bamboo lemur. *Oryx* 44, 2: 167. (doi:10.1017/S0030605310000207)
- King, T., Rasolofoharivelo, T., Randrianasolo, H., Dolch, R., Randrianarimanana, L. & Ratolojanahary, T. 2013a. Andriantantely. In: *Lemurs of Madagascar: A Strategy for their Conservation 2013–2016*, pp 69–70. IUCN/SSC Primate Specialist Group, Bristol Conservation and Science Foundation, and Conservation International, Bristol, UK.
- King, T., Ravaloharimanitra, M., Randrianarimanana, H. L. L., Rasolofoharivelo, M. T. & Chamberlan, C. 2013b. Community-based conservation of critically endangered lemurs at the Sakalava and Ranomainty sites within the Ankeniheny-Zahamena rainforest corridor, eastern Madagascar. *Lemur News* 17: 63–70.
- Lantovololona, F., Bonaventure, A., Ratolojanahary, T., Rafalimandimby, J., Ravaloharimanitra, M., Ranaivosoa, P., Ratsimbazafy, J., Dolch, R. et King, T. 2012. Conservation de *Prolemur simus* autour de la forêt de basse altitude d'Andriantantely, District de Brickaville. *Lemur News* 16: 7–11.
- Raik, D. 2007. Forest management in Madagascar: an historical overview. *Madagascar Conservation & Development* 2, 1: 5–10. (doi:10.4314/mcd.v2i1.44123)
- Rakotonirina, L., Rajaonson, A., Ratolojanahary, T., Rafalimandimby, J., Fanomezantsoa, P. et al. 2011. New distributional records and conservation implications for the critically endangered greater bamboo lemur *Prolemur simus*. *Folia Primatologica* 82, 2: 118–129. (doi:10.1159/000330910)
- Randriahaingo, H. N. T., Ravaloharimanitra, M., Randrianarimanana, H. L., Chamberlan, C., Ratsimbazafy, J. et King, T. 2014. Étude et conservation de *Prolemur simus* aux alentours de la forêt de basse altitude d'Andriantantely, Madagascar. *Lemur News* 18: 67–72.
- Ravaloharimanitra, M. & King, T. 2012. First community-managed reserve for greater bamboo lemurs inaugurated. *Lemur News* 16: 26.
- Ravaloharimanitra, M., Ratolojanahary, T., Rafalimandimby, J., Rajaonson, A., Rakotonirina, L. et al. 2011. Gathering local knowledge in Madagascar results in a major increase in the known range and number of sites for critically endangered greater bamboo lemurs (*Prolemur simus*). *International Journal of Primatology* 32: 776–792. (doi:10.1007/s10764-011-9500-4)
- Ravaloharimanitra, M., Ranaivosoa, L., Chamberlan, C. et King, T. 2013a. Sensibilisation à la conservation de *Prolemur simus* dans le District de Brickaville. *Lemur News* 17: 6–8.
- Ravaloharimanitra, M., Ranaivosoa, L., Mihaminekena, T.H., Chamberlan, C. et King, T. 2013b. Conservation communautaire de *Prolemur simus* à Ambalafary, District de Brickaville, Madagascar. *Lemur News* 17: 54–57.
- Schmid, J. et Alonso, L. E. (eds.) 2005. Une évaluation biologique rapide du corridor Mantadia-Zahamena à Madagascar. Bulletin RAP d'Évaluation Rapide 32. Conservation International. Washington, DC.

## SUPPLEMENTARY MATERIAL.

AVAILABLE ONLINE ONLY.

Figure S1. Localisation de la forêt d'Andriantantely

Figure S2. Localisation des *fokontany* et villages proches de la forêt d'Andriantantely

## ARTICLE

<http://dx.doi.org/10.4314/mcd.v10i1.S6>

# Community-managed conservation efforts at Tsingy Mahaloka/KOFAMA, northern Madagascar: Right place at the wrong time?

Ian C. Colquhoun

Correspondence:

Ian C. Colquhoun

Department of Anthropology, The Centre for Environment &amp; Sustainability, The University of Western Ontario.

London N6A 5C2 - Canada

E-mail: colquhou@uwo.ca

## ABSTRACT

This paper provides a retrospective account of efforts, from 2007 to 2013, to establish a community-managed protected area just south of Ankarana National Park that would encompass the limestone massif known locally as Tsingy Mahaloka and adjacent remnant forest patches. Community members of the rural commune of Antsiravibe came together in 2007 and, with support from the Peace Corps, formed KOFAMA (*Koperativa Fikambanana Ankarabe Mitsinjo Arivo*) to oversee management of the Tsingy Mahaloka site. When KOFAMA was initially established, Tsingy Mahaloka was envisioned as an ecotourist destination. Ecotourism is a pillar of the new IUCN “Lemurs of Madagascar” conservation action plan (2013–2016), and can allow rural communities to (i) secure revenue for habitat protection; (ii) create economic incentives and benefits for residents; and, (iii) facilitate locally-supported conservation efforts. Ecotourism to Tsingy Mahaloka was seen as a means for future sustainable development in the area. KOFAMA, as the local organization to be responsible for management of the protected area, was intended to operate by a “bottom-up” approach, where local stakeholders take active participation and leadership in decision-making affecting the protected area. But, obviously, an ecotourist site needs tourists; this has proven to be a problem for KOFAMA and the Tsingy Mahaloka site. The Tsingy Mahaloka site, on the face of it, would appear to offer much that would attract and educate ecotourists, including: striking topography (the massif’s sheer limestone cliffs rising 80–100 metres above a flat coastal plain), a diverse endemic avifauna, a resident crowned lemur population, and extensive caves containing human burials made over generations. However, the site’s relatively remote location and Madagascar’s recent political crisis have worked against Tsingy Mahaloka becoming established as a site that ecotourists regularly visit. Regardless, a core group of local residents remain committed to the project’s original goals. At this point in KOFAMA’s history, however, an initial assessment of the organization draws attention to the limits of a “build it and they will come” approach to ecotourism, sustainable development, and locally-managed conservation efforts. The struggles encountered by KOFAMA in its efforts to oversee the Tsingy Mahaloka site highlight the importance of detailed ethnographic and socioeconomic work prior to embarking on such locally-managed conservation efforts.

## RÉSUMÉ

Le présent compte rendu porte sur une rétrospective des efforts déployés de 2007 à 2013 pour établir une aire protégée au sud du Parc National de l’Ankarana et qui concerne le massif calcaire du Tsingy Mahaloka ainsi que ce qu’il reste de forêt sur sa périphérie. En 2007, les membres de la communauté de la commune rurale d’Antsiravibe se sont organisés avec le soutien des volontaires du Corps de la Paix pour former le KOFAMA (*Koperativa Fikambanana Ankarabe Mitsinjo Arivo*) afin de superviser le site du Tsingy Mahaloka reconnu comme une aire à protéger par la communauté. Lorsque KOFAMA a été initialement établi, le Tsingy Mahaloka avait été retenu comme une destination écotouristique. L’écotourisme est d’ailleurs un pilier du nouveau plan d’action de conservation des lémuriers de Madagascar de l’UICN pour la période 2013–2016. L’écotourisme est ainsi proposé aux communautés rurales de la périphérie des aires protégées comme un moyen de sécuriser des revenus en échange de la protection de l’habitat, mais aussi un moyen de proposer des incitations économiques et des avantages pour les résidents, et enfin une structure destinée à faciliter les efforts de conservation qui sont supportés localement. L’écotourisme lié au Tsingy Mahaloka a été considéré comme une activité de développement durable qui s’inscrit dans l’avenir de la région. KOFAMA, en tant qu’organisation locale responsable de la gestion de l’aire protégée est destiné à fonctionner selon une approche de bas en haut dans laquelle les acteurs locaux s’engagent réellement et dirigent les prises de décisions affectant l’aire protégée. Mais, de toute évidence, le processus a besoin de touristes, ce qui a constitué un problème pour KOFAMA et le Tsingy Mahaloka. À première vue, le Tsingy Mahaloka semble offrir de nombreuses caractéristiques propres à attirer et éduquer des écotouristes, dont une topographie remarquable avec des falaises calcaires abruptes de 80–100 mètres de haut dominant une plaine côtière, une avifaune endémique variée, une population résidente de Lémurs couronnés et des grottes abritant des sépultures humaines déposées par plusieurs générations. Mais, non seulement le Tsingy Mahaloka est-il relativement isolé, mais la crise politique de 2009 à 2014 Madagascar a également joué contre le développement de l’écotourisme. Malgré cela, un groupe de gens motivés poursuit les premiers objectifs du projet. À ce stade de l’histoire de KOFAMA, une évaluation initiale de l’organisation montre les limites d’une approche du type

« proposons quelque chose, ils viendront voir » aussi bien pour l'écotourisme, le développement durable que les efforts déployés localement pour la protection de la nature. Les problèmes rencontrés par KOFAMA dans ses efforts pour protéger le Tsingy Mahaloka soulignent l'importance de mener un travail ethnographique et socio-économique détaillé avant d'embarquer dans des efforts de protection de la nature gérés localement.

## INTRODUCTION

Ecotourism aims to achieve three main objectives (Healy 1994, Goodwin 1996, Goodwin and Swingland 1996, Scheyvens 1999, Horwich and Lyon 2007, Kothari et al. 2013, Ardoin et al. 2015): (i) to produce financial support for the establishment, management, and protection of natural areas; (ii) gain economic benefits for residents living near those protected natural areas; and, (iii) out of those economic benefits, produce conservation action that is actively supported by local residents. Additionally, numerous studies are in agreement that in advance of ecotourism projects, best practices should include a detailed socio-economic assessment of the community, or communities, involved in the plan (e.g., Stem et al. 2003, Naughton-Treves et al. 2005, Wilder and Walpole 2008, Kothari et al. 2013, Pullin et al. 2013).

Under Madagascar's National Environmental Action Plan, or NEAP, which ran between 1991 and 2008, major focus was placed on the protection and management of the country's 'national heritage' of biodiversity (Mercier 2006). An internationally significant development in Madagascar's NEAP came in 2003 at the V<sup>th</sup> World Parks Congress in Durban, South Africa, when then-President Marc Ravalomanana made the bold announcement that Madagascar would, by 2008, triple its protected areas system from 1.7 million hectares to 6.0 million hectares (Scally 2006, Dhital et al. 2015). The target of 6.0 million hectares, subsequently referred to as the Durban Vision, would place 10% of the country's surface area under Madagascar's protected areas system (Scally 2006, Virah-Sawmy et al. 2014). The 'Durban Vision' involved the creation of new national parks and other protected areas. But, a key component of the Durban Vision plan was to also incorporate an extensive program of community-level management into the nation's protected areas system – that is, the creation of numerous Community-Managed Protected Areas, or CMPAs, island-wide (Ferguson 2009). This involved the devolution of control management responsibility for protected areas from the government of Madagascar to local communities, under the jurisdiction of community forest management committees, *Vondron' Olona Ifotony* or VOI (WRM 2008, Virah-Sawmy et al. 2014, Dhital et al. 2015). One manifestation of this larger national program to utilize community-managed protected areas as a means to increase Madagascar's protected area coverage was a collaborative plan developed in early 2007 between village associations in the rural commune of Antsiravibe and the Peace Corps. The plan was to create a community-managed conservation area at a local site known as Tsingy Mahaloka.

The Tsingy Mahaloka site (E48° 59', S13° 03'), is relatively remote, located approximately 15km west of the small village of Isezy along Route Nationale (RN) 6, just south of Ankarana National Park. Located adjacent the rural commune of Ampotsehy, Tsingy Mahaloka is an impressive limestone karst massif, or mogote, rising sharply from the coastal plain immediately southwest of Ankarana National Park. Tsingy Mahaloka seemed ideally suited to be a community-managed protected area given

its striking topography, diverse endemic avifauna, resident crowned lemur *Eulemur coronatus* population, and extensive caves containing human burials made over generations. At first blush, the site would appear to offer much for the attraction and education of ecotourists.

In late November of 2007, an 'umbrella association'— dubbed KOFAMA (*Koperative Fikambanana Ankarabe Mitsinjo Arivo*) was formed, bringing together existing village associations that shared outlooks and activities concerning the preservation of local Malagasy culture and sustainable management of the surrounding environment. The planned goal of the village associations in KOFAMA, through their collaboration with the local Peace Corps volunteer, was to make Tsingy Mahaloka a site for sustainable ecotourism (Turner 2007, Colquhoun et al. 2011). Administrative positions in KOFAMA are held by villagers from the rural commune of Ampotsehy.

In mid-2007 a team of researchers from the University of Western Ontario and the Université d'Antsirana established links with people in the rural commune of Ampotsehy and the Peace Corps. In collaboration with the President and Vice-President of KOFAMA and the regional Peace Corps volunteer, the research team made plans to begin fieldwork at Tsingy Mahaloka to study the development of this ecotourist project (Colquhoun et al. 2011). At that time, efforts to attract ecotourists were just beginning. KOFAMA was operating primarily through the voluntary participation of some 20 local residents. Apart from some organizational input from the regional Peace Corps volunteer, KOFAMA had no external assistance or funding. Although the Tsingy Mahaloka site is relatively close to Ankarana National Park, a popular ecotourist destination, the number of ecotourists visiting the Tsingy Mahaloka area in 2007–2008 was only nominal and the site had not been widely advertised to tour guides in the region. However, field school visits to the Tsingy Mahaloka site in 2008, 2010, and 2012 by researchers and students from the University of Western Ontario and Université d'Antsirana did contribute some income to the members of KOFAMA. In addition, longer term stays by anthropology graduate students conducting both sociocultural and primatological Master's thesis research (2008, 2010, and 2011) also generated revenue to KOFAMA. Beyond outlining the historical background surrounding the formation and development of KOFAMA, the focus of this paper is to highlight the results of a consultative assessment of KOFAMA's state of organization undertaken, with KOFAMA's permission and support, in May and June of 2010 by an international team of anthropologists and primatologists. The main outcome of this collaborative research project was an extensive set of recommendations that were brought forward to the KOFAMA membership, and are presented in this paper. The recommendations include suggested paths to address structural and administrative issues that KOFAMA has experienced, and ways the association can move towards its stated goals of preserving local Malagasy culture and developing sustainable management of the Tsingy Mahaloka site. These details of the 2010 fieldwork with the members of KOFAMA and the residents of the rural commune of Antsiravibe are presented in the broader context of the continuing review of the development of KOFAMA from 2007 to 2013.

## APPROACH

The research team conducting the 2010 field project on KOFAMA's state of organization brought together collaborators from the Université d'Antsiranana, University of Western Ontario (Canada), University of West Georgia and Eastern Kentucky University (United States), and the Musée du Quai Branly (France). All the non-Malagasy researchers, five in total, were anthropologists (three sociocultural anthropologists, and two primatologists who have both conducted ethnoprimate research), and all had worked in northern Madagascar since the early 1990s. In collaboration with the KOFAMA executive members (President and Vice-President), we sought to gather perceptions of KOFAMA's efforts at locally-managed conservation from people living adjacent to the Tsingy Mahaloka site. The group also sought to gauge the levels of local involvement and commitment that KOFAMA had been able to muster.

The group was assisted in this collaborative project by a team of ten senior undergraduate students (five anthropology students from University of Western Ontario and five Anglo-American Studies students from the Université d'Antsiranana), as well as two Master's students from Western University and two graduate students from Université d'Antsiranana. The research effort was also facilitated by the regional Peace Corps volunteer. Between 1–14 June 2010, a total of 71 detailed, semi-structured interviews were conducted with adults who had first agreed to be interviewed. All interviews took place at the homes of the interviewees, at multiple sites in the vicinity of the Tsingy Mahaloka site, including the communities of Amposehy, Antsiravibe, and Analsatrana. All interviews were conducted in Malagasy and recorded for later translation. Data collected included basic demographic data (i.e., age and sex of the interviewee), as well as: the individual's place of birth; self-identification of their Malagasy ethnicity; where their family tombs/burials were located; marital status; level of education, religious affiliation; what traditional *fady* (i.e., cultural prohibitions, or taboos) they practiced; how they made their livelihood (and if a farmer, what crops they grew and what animals they kept); whether they had ever worked with tourists; whether they knew about, and were a member of, KOFAMA; what they saw as possible benefits of, or problems with, KOFAMA; and, whether they were concerned with tourists (*vazaha*) possibly transgressing Malagasy customs or *fady*.

Following the collection of the interview data, translation of the interviews from Malagasy into English was undertaken by the students working in pairs – i.e., one Université d'Antsiranana student from the Anglo-American Studies Program paired with a University of Western Ontario student. By the end of the field course in late June 2010, sufficient translation and preliminary analysis of the interview data had been completed for the five undergraduate student pairs to give a bilingual (Malagasy-English) set of public presentations at the Université d'Antsiranana. Final completion of the interview translations was completed at the University of Western Ontario during the fall-winter semesters of 2010–2011 when the two Université d'Antsiranana graduate students who had participated in the fieldwork at KOFAMA came to Canada on exchange.

## OUTCOME OF ASSESSMENT

In June of 2011, an interim report on, and recommendations from, our 2010 field project was delivered to the KOFAMA association

members. The Peace Corps volunteer working in the region was also made aware of the report and its recommendations. Our recommendations to the members of KOFAMA included: (i) Make efforts to communicate the existence of Tsingy Mahaloka and the attractions offered there to tour operators in Antsiranana and Nosy Be; (ii) communicate the existence of Tsingy Mahaloka and the goals of KOFAMA to inhabitants of the region through various media including public meetings, radio broadcasts, and visits to schools; (iii) that the goals of KOFAMA be discussed, clarified and/or determined, and that these goals be clearly indicated in written and oral form for the sake of the membership. Regular meetings of the association should occur to ensure that the membership is kept informed of progress towards meeting these goals; (iv) that the members of KOFAMA discuss and develop a clear plan for the management of money generated by the project, with clear guidelines for how this money is to be reinvested, redistributed and saved; (v) that regular communication be maintained with local elders responsible for cultural care of the human remains buried in Mandresibe Cave (at the base of Tsingy Mahaloka) in order to develop and regularly evaluate policies regarding use of this site as an attraction; (vi) that KOFAMA members should discuss, develop, and make known clear policies related to the collection, distribution, and management of money generated by tours of the cave tombs; (vii) that through consultation with local elders and others responsible for this site, KOFAMA members develop a clear, safe and respectful circuit that tourists and guides can consistently follow through the cave – such a circuit should be designed to ensure the well-being of visitors, entombed ancestors and local descendants, and to maintain the integrity of the human remains and cultural material found on site; (viii) that with the assistance of visiting researchers and students, KOFAMA members continue to document, monitor, and publicize the diversity of flora and fauna in and around the community-managed forest; (ix) that KOFAMA members promote conservation of local biodiversity in the managed area and in surrounding communities; and that, (x) KOFAMA members promote the conservation and growth of the community-managed forest by limiting the felling of trees, encouraging fuel wood collection from elsewhere, and planting native species on forest edges.

## WHAT WORKED AND WHAT DID NOT WORK, AND WHY

First and foremost, the collaborative approach taken in the fieldwork conducted at Tsingy Mahaloka since 2007 has been at least of some benefit to all those involved – the researchers, the students, the members of the KOFAMA association, and the Peace Corps Volunteers alike (Colquhoun et al. 2011). This was particularly true in the 2010 field season, where we were able to actively include the field course students in our research project focused on KOFAMA – rather than doing some sort of small-scale project within the field course, the students were able to gain real field research experience and contribute to the KOFAMA research project. The other side of this is that the Student Exchange Agreement between the University of Western Ontario and the Université d'Antsiranana has been a mechanism by which we have been able to provide opportunities for Malagasy students to gain international experience and advance their own research projects. While visiting the Tsingy Mahaloka site, we paid camping fees to the KOFAMA association as well as a daily rate per individual for meals; these funds were shared among the

members of KOFAMA. Even though it was a drawn-out process, the certification system to gain the KOFAMA association the necessary governmental clearance to assume community management of Tsingy Mahaloka ultimately proved workable. Madagascar's move to use the community management of protected areas as a means to increase the country's total protected areas system has been criticized (e.g., Gardner (2011) argued that far from being protected areas, Madagascar's new community-managed conservation areas were actually areas that needed protection from people). But, this criticism was largely centered on Madagascar's new system of community-managed protected areas as not aligning with the currently established IUCN categories for protected area status. Presently, the IUCN protected area definition, management categories and governance types encompasses six management categories (Dudley 2008, Rasoavahiny et al. 2008, Dudley et al. 2009). However, Gardner's (2011) criticism of Madagascar's community-managed conservation area initiative fails to recognize or acknowledge that these areas can actually encompass multiple IUCN protected area categories. For example, the KOFAMA site as a protected area captures IUCN Category 2 (as an ecotourism site), Category 3 (Tsingy Mahaloka is a sacred site for the local Antankarana people – there are generations old burials in caves deep in the massif; see also Sponsel 2008, Dudley et al. 2009), Category 4 (the massif is the locale of the most southwesternly located population of crowned lemurs in Madagascar; Colquhoun 2011), and Categories 5 and 6 (which address the sustainable use of the Tsingy Mahaloka as a protected area). Indeed, there is now a diverse body of comparative literature on collaboratively managed protected areas (CMPAs) that has established broad agreement on their value (e.g., Kothari 2008, Kothari et al. 2013) and supports the view that a community-managed approach to conservation is certainly something that should be considered as part of a broad-based conservation strategy (see also Reynolds and Bettinger 2008). In terms of monitoring the crowned lemur population resident on Tsingy Mahaloka (Solomon 2009), an especially useful and flexible conceptual framework for considering the potential interactions between the lemurs and people living adjacent to the Tsingy Mahaloka massif is Sponsel's (1997) ethnoprimate paradigm (see also Estrada 1997). Ethnoprimate is the field of study that considers the interfaces between human and nonhuman primate ecology; Sponsel (1997) defines ethnoprimate as encompassing: comparative ecology, predation ecology, synecology, cultural ecology, ethnoecology, and conservation ecology. In the larger context of lemur conservation efforts across Madagascar, the ethnoprimate paradigm will be a productive tool going forward. Sites such as Tsingy Mahaloka and associations like KOFAMA figure prominently in the new IUCN Lemurs of Madagascar Conservation Action Plan for 2013–2016 (Schwitzer et al. 2013, 2014), which promotes a three-pronged conservation strategy focused on: (i) working closely with local communities and including community-managed protected areas as valid conservation efforts; (ii) promoting lemur ecotourism; and, (iii) maintaining the long-term presence of field researchers at key sites and establishing new research projects on other species and at new sites (Laurance 2013).

While the Tsingy Mahaloka site seemed, initially, to possess qualities that made it a promising candidate for development as an ecotourist site and community-managed conservation area, a

combination of factors have so far prevented this potential from being reached. Although Tsingy Mahaloka appeared to be the right place for a community-managed conservation area, events that transpired subsequent to initiating the project in 2007 turned this into a case of it being the wrong time for such a plan. Perhaps the largest impediment to KOFAMA's development was Madagascar's recent political crisis that began to unfold in 2009. Western governments (e.g., France, Great Britain, Canada, the United States) issued travel warnings, advising their citizens against all non-essential travel to Madagascar. Tourist travel to Madagascar plummeted as a result; while 2008 had seen a promising trickle of 'back-pack' ecotourists to Tsingy Mahaloka, in 2009 the site did not record a single ecotourist visitor. The lack of ecotourist traffic continued in 2010 – as mentioned above, when we arrived in late May 2010 to conduct research on the KOFAMA association, we were the first visitors they had received that year. Return visits by members of the University of Western Ontario-Université d'Antsiranana research team to Tsingy Mahaloka in 2012 and 2013 revealed much the same situation – the ecotourist camping area at the site was becoming overgrown with vegetation and the few buildings at the site were in a state of disrepair.

While the turmoil of Madagascar's political crisis could not have been predicted in 2007, more thorough planning for a community-managed protected area and ecotourist destination at Tsingy Mahaloka may have better-prepared the members of KOFAMA for the difficulties the organization encountered. In hindsight, obtaining detailed socio-economic data (similar to the data we compiled in 2010) about the members of KOFAMA and their communities could have contributed to framing the association's long-term strategy (e.g., Stem et al. 2003, Naughton-Treves et al. 2005, Wilder and Walpole 2008, Kothari et al. 2013, Pullin et al. 2013).

The relatively remote location of Tsingy Mahaloka has also proven to be an obstacle to KOFAMA's successful development. The site is only accessible by the dirt track that runs west from RN6 and the village of Isesy. In comparison to the community of Mahamasina, a popular ecotourist destination located along RN6 adjacent to the main entry point to Ankarana National Park, the Tsingy Mahaloka site is difficult to reach. It is also not well-known to tour guides, again in contrast to Mahamasina. While Mahamasina is only about a two-hour drive south of Antsiranana, it takes about an additional hour and a half to get to Tsingy Mahaloka. The tourists that do venture to Tsingy Mahaloka need to be interested in seeking places "off the beaten track". Although a brochure to advertise the Tsingy Mahaloka site was drafted in 2011 (which was one of the recommendations in our preliminary report to KOFAMA), its distribution has been a problem and the Tsingy Mahaloka site still has not been incorporated into the tour packages offered by tour guides in Antsiranana.

Not only have there been numerous reports cautioning that ecotourism may well have only limited or localized economic benefits and impact (e.g., Durbin and Ratrimoarisoa 1996, Stem et al. 2003, Naughton-Treves et al. 2005, Pullin et al. 2013, Gezon 2014, Scales 2014), there have also been several reports that advocate for sound socioeconomic assessments of the involved communities prior to launching a community-managed conservation endeavor, because it is a long-term process (Naughton-Treves et al. 2005, Wilder and Walpole 2008, Kothari et al. 2013, Gezon 2014, Cullman 2015). Preliminary results from our interview data with people living in the vicinity of the Tsingy

Mahaloka site indicated that the KOFAMA association suffered from a major problem in local recognition. Only 34 of the 71 individuals (47.9%) interviewed indicated that they had heard of KOFAMA. As for membership in KOFAMA, just eight of the 71 individuals interviewed (11.3%) were actively involved in the association. Unexpectedly, the interviews also revealed a diversity of ethnic backgrounds among people living in the area, rather than a uniform Antankarana ethnicity (which we had more or less assumed). Individuals in our survey/interview sample self-identified as belonging to a total of no fewer than 10 different ethnic groups. Migration into the region in the recent past has been due to people seeking employment in the sugar cane industry. We found that a majority of KOFAMA's members had immigrated to the area from other parts of Madagascar. Consequently, there were not the same deep kin connections within the KOFAMA association that typify many other rural Malagasy associations. What people in the KOFAMA association largely have in common is that they all now live in the same area. While this may serve as a basis for forming the association in the first place, it is not a particularly strong basis for maintaining the association. Our interview data also revealed that people were integrated into social networks that involved many organizations of different sorts. Thus, below the surface, KOFAMA faces competition for peoples' time and commitment from other associations and organizations in the area. KOFAMA could find itself squeezed for membership because people in the area may feel that they are already extended in their commitments to other associations.

## LESSONS LEARNED

The development of KOFAMA has relied heavily on the key roles played by a series of Peace Corps volunteers right from the initial formation of the association (Colquhoun et al. 2011). Madagascar's recent political crisis played havoc with the length of interaction, and the continuity, that Peace Corps volunteers had with the KOFAMA association (e.g., evacuations of volunteers in 2009 during the political crisis due to the U.S. government's opposition to the High Authority of Transition). This, together with inter-personal issues among KOFAMA members (e.g., matters of trust in the handling and management of KOFAMA funds), has hindered the efficacy of KOFAMA's operation.

Plans to develop Tsingy Mahaloka into an ecotourist destination and the organization of the KOFAMA association departed from the best-practices model of conducting detailed socioeconomic analyses of the communities involved before launching an ecotourist project (Stem et al. 2003, Naughton-Treves 2005, Kothari 2008, Wilder and Walpole 2008, Kothari et al. 2013, Pullin et al. 2013, Gezon 2014, Cullman 2015). Rather, local support for establishment of a protected area was generated, and local expectations raised, ahead of any real tourist traffic to the site. That background context, together with Tsingy Mahaloka's remote location and Madagascar's recent political crisis, has handicapped efforts to establish Tsingy Mahaloka as an ecotourism destination. Despite this, a small core of the KOFAMA association remains committed to achieving some version of the original plan for Tsingy Mahaloka. Based on the track record since KOFAMA's founding, ecotourism does not look like it is a sustainable undertaking at the Tsingy Mahaloka site. Future field research and student excursions could certainly bring more people to this remote area, and revenue to KOFAMA, but this will require a

continued high level of institutional support from the participating universities. In 2010–2011 the University of Western Ontario tried to raise funds from alumni to establish a field station at Tsingy Mahaloka, which would have facilitated a continuing research presence there (Laurance 2013, Stroud et al. 2014). Unfortunately, this fund-raising initiative was not successful, and plans for a field station have been shelved for the time being.

It is important to put KOFAMA's history and the stalled ecotourist project at Tsingy Mahaloka into a broader context. Kothari (2008: 31) notes that, "... lack of adequate implementation of the fundamental principles of equitable conservation cannot be seen as a failure of the principles themselves (Brechin et al. 2002, Wilshusen et al. 2002, Spiteri and Nepalz 2006). Moreover, evidence from around the world suggests that new paradigm approaches to conservation (especially co-managed protected areas and community conserved areas) do indeed often work, where implemented with sufficient policy back-up, on-ground capacity, and other key ingredients (see examples in Kothari 2006a, b)." So, while ecotourism and community-based protected area management has not successfully been established at Tsingy Mahaloka, it is worth remembering that across Madagascar there are numerous successful community-managed protected areas, and this will continue to be an important part of the 'tool-kit' for lemur conservation (Schwitzer et al. 2013, 2014). While the final story of KOFAMA and the Tsingy Mahaloka site has yet to be written, the story thus far is certainly a cautionary one. To paraphrase the well-known line from the 1989 film 'Field of Dreams' – even if you build it, they might not come.

## ACKNOWLEDGEMENTS

This project was funded by a Social Sciences and Humanities Research Council of Canada International Opportunities Fund grant awarded to Andrew Walsh (Principal Investigator) and Ian Colquhoun (Co-Principal Investigator), SSHRC-IOF grant number 861-2009-1012. This research project had the approval of the University of Western Ontario's Non-Medical Research Ethics Board. Thanks to Andrew Walsh, Lisa Gezon, Laurent Berger, and Ben Freed for their contributions to the fieldwork at Tsingy Mahaloka, and to all the students for their hard work and enthusiasm. Louis-Philippe d'Arvisenet handled the logistical requirements of our research team masterfully. To the Peace Corps volunteers who have worked with KOFAMA at different times, a word of appreciation is due – Christi Turner, Julia Nelson, Cori Hinton, Ted Koenig are saluted for their work with the people of the rural communes of Antsiravibe and Ampotsehy. It is worth noting that another hopeful sign going forward is that former Peace Corps volunteers Julia Nelson and Christi Turner have joined forces to establish an NGO named *Atsika*, which means 'we', or 'us', in the Antankarana dialect; *Atsika* will endeavor to assist KOFAMA and the people living in the vicinity of Tsingy Mahaloka and aims to develop "... educational opportunities for Malagasy people in the Ankarana community through youth scholarships, adult education, and vocational training focused on the ecotourism sector. Adhering to the principles of sustainable, responsible, community-managed ecotourism, *Atsika* helps the people of the Ankarana region to improve their lives and the lives of their families, whilst promoting environmental conservation and sustainable income generation." (<http://www.atsika.org/index.html>).

## REFERENCES

- Ardoin, N. M., Wheaton, M., Bowers, A. W., Hunt, C. A. and Durham, W. H. 2015. Nature-based tourism's impact on environmental knowledge, attitudes, and behavior: a review and analysis of the literature and potential future research. *Journal of Sustainable Tourism* 23, 6: 838–858. (doi:10.1080/09669582.2015.1024258)
- Brechin, S. R., Wilshusen, P. R., Fortwangler, C. L. and West, P. C. 2002. Beyond the square wheel: Toward a more comprehensive understanding of biodiversity conservation as social and political process. *Society and Natural Resources* 15, 1: 41–64. (doi:10.1080/089419202317174011)
- Colquhoun, I. C. 2011. Establishing the southwestern limits in the geographic distributions of *Eulemur coronatus* and *E. sanfordi*. Paper presented at the 38th Annual Meeting of the Canadian Association for Physical Anthropology (CAPA-ACAP), Saskatoon, Saskatchewan, 27–30 October 2011.
- Colquhoun, I. C., Totomarovario, A. and Walsh, A. F. 2011. Good neighbors. *Anthropology News* 52, 9: 7.
- Cullman, G. 2015. Community forest management as virtualism in northeastern Madagascar. *Human Ecology* 43, 1: 29–41. (doi:10.1007/s10745-015-9725-5)
- Dhital, N., Rasoloarisoa Vololomboahangy, R. and Khasa, D. P. 2015. Issues and challenges of forest governance in Madagascar. *Canadian Journal of Development Studies / Revue canadienne d'études du développement* 36, 1: 38–56. (doi:10.1080/02255189.2015.989197)
- Dudley, N. (ed.) 2008. Guidelines for Applying Protected Area Management Categories. IUCN, Gland, Switzerland. Available at <https://goo.gl/e064W6>
- Dudley, N., Higgins-Zogib, L. and Mansourian, S. 2009. The links between protected areas, faiths, and sacred natural sites. *Conservation Biology* 23, 3: 568–577. (doi:10.1111/j.1523-1739.2009.01201.x)
- Durbin, J. and Ratrimoarisoa, S.-N. 1996. Can tourism make a major contribution to the conservation of protected areas in Madagascar? *Biodiversity and Conservation* 5, 3: 345–353. (doi:10.1007/BF00051778)
- Estrada, A. 1997. Book Review: New World Primates. *International Journal of Primatology* 18, 6: 1047–1049. (doi:10.1023/A:1026308516556)
- Ferguson, B. 2009. REDD comes into fashion in Madagascar. *Madagascar Conservation & Development* 4, 2: 132–137. (doi:10.4314/mcd.v4i2.48654)
- Gardner, C. 2011. IUCN management categories fail to represent new multiple-use protected areas in Madagascar. *Oryx* 45, 3: 336–346. (doi:10.1017/S0030605310001808)
- Gezon, L. L. 2014. Who wins and who loses? Unpacking the “Local People” concept in ecotourism: A longitudinal study of community equity in Ankarana, Madagascar. *Journal of Sustainable Tourism* 22, 5: 821–838. (doi:10.1080/09669582.2013.847942)
- Goodwin, H. 1996. In pursuit of ecotourism. *Biodiversity & Conservation* 5, 3: 277–291. (doi:10.1007/BF00051774)
- Goodwin, H. J. and Swingland, I. R. 1996. Ecotourism, biodiversity and local development. *Biodiversity and Conservation* 5, 3: 275–276. (doi:10.1007/BF00051773)
- Healy, R. G. 1994. Tourist merchandise as a means of generating local benefits from ecotourism. *Journal of Sustainable Tourism* 2, 3: 137–151. (doi:10.1080/09669589409510691)
- Horwich, R. H. and Lyon, J. 2007. Community conservation: practitioner's answer to critics. *Oryx* 41, 3: 376–385. (doi:10.1017/S0030605307001010)
- Kothari, A. 2006a. Collaboratively managed protected areas. In: *Managing Protected Areas: A Global Guide*, I. Lockwood, G. Worboys, G. and A. Kothari (eds.), pp. 528–548. IUCN, Gland, Switzerland and Earthscan, London.
- Kothari, A. 2006b. Community conserved areas. In: *Managing Protected Areas: A Global Guide*, I. Lockwood, G. Worboys, G. and A. Kothari (eds.), pp. 549–573. IUCN, Gland, Switzerland and Earthscan, London.
- Kothari, A. 2008. Protected areas and people: the future of the past. *Parks* 17, 2: 23–34. Available at <http://goo.gl/J5amJD>
- Kothari, A., Camill, P. and Brown, J. 2013. Conservation as if people also mattered: Policy and practice of community-based conservation. *Conservation & Society* 11, 1: 1–15. (doi:10.4103/0972-4923.110937)
- Laurance, W. F. 2013. Does research help to safeguard protected areas? *Trends in Ecology & Evolution* 28, 5: 261–266. (doi:10.1016/j.tree.2013.01.017)
- Mercier, J.-R. 2006. Madagascar moving towards sustainable development: was the preparation of the National Environmental Action Plan (NEAP) a false start? *Madagascar Conservation & Development* 1, 1: 50–54. (doi:10.4314/mcd.v1i1.44122)
- Naughton-Treves, L., Holland, M. B. and Brandon, K. 2005. The role of protected areas in conserving biodiversity and sustaining local livelihoods. *Environment and Resources* 30: 219–252. (doi:10.1146/annurev.energy.30.050504.164507)
- Pullin, A. S., Bangpan, M., Dalrymple, S., Dickson, K., Haddaway, N. R., et al. 2013. Human well-being impacts of terrestrial protected areas. *Environmental Evidence* 2013 2: 19. (doi:10.1186/2047-2382-2-19)
- Rasoavahiny, L., Andrianarisata, M., Razafimpahanana, A., Ratsifandrihamanana, A. N. 2008. Conducting an ecological gap analysis for the new Madagascar protected area system. *Parks* 17, 1: 12–21.
- Reynolds, V. and Bettinger, T. 2008. Guidelines for Conservation Through Community Involvement. Position Statement of the International Primatological Society. Available at <http://goo.gl/mTZxV>
- Scales, I. R. 2014. The future of conservation and development in Madagascar: time for a new paradigm? *Madagascar Conservation & Development* 9, 1: 5–12. (doi:10.4314/mcd.v9i1.2)
- Scally, R. 2006. Biodiversity: Expanding Madagascar's national parks and protected areas. In: *GIS for Environmental Management*. R. Scally (ed.), pp. 1–15. ESRI Press, Redlands, California.
- Scheyvens, R. 1999. Ecotourism and the empowerment of local communities. *Tourism Management* 20, 2: 245–249. (doi:10.1016/S0261-5177(98)00069-7)
- Schwitzer, C., Mittermeier, R. A., Davies, N., Johnson, S. E., Ratsimbazafy, J., et al. (eds.), 2013. *Lemurs of Madagascar: A Strategy for Their Conservation 2013–2016*. IUCN/SSC Primate Specialist Group, Bristol Conservation and Science Foundation, and Conservation International, Bristol, UK.
- Schwitzer, C., Mittermeier, R. A., Johnson, S. E., Donati, G., Irwin, M., et al. 2014. Averting lemur extinctions amid Madagascar's political crisis. *Science* 343, 6173: 842–843. (doi:10.1126/science.1245783)
- Solomon, S. 2009. Living on the edge: A preliminary dry season study of crowned lemur (*Eulemur coronatus*, Gray 1842) and Sanford's lemur (*E. sanfordi*, Archbold 1932) responses to anthropogenic habitat changes in northern Madagascar. Unpubl. Master thesis, Western University, London, Canada.
- Spiteri, A. and Nepalz, S. K. 2006. Incentive-based conservation programs in developing countries: A review of some key issues and suggestions for improvements. *Environmental Management* 37, 1: 1–14. (doi:10.1007/s00267-004-0311-7)
- Sponsel, L. E. 1997. The human niche in Amazonia: Explorations in ethnoprimateology. In: *New World Primates: Ecology, Evolution, and Behavior*, W. G. Kinzey (ed.), pp. 143–165. Aldine de Gruyter, New York.
- Sponsel, L. E. 2008. *Sacred Places and Biodiversity Conservation*. <http://goo.gl/WFPpTe> accessed 10 March 2015.
- Stem, C. J., Lassoie, J. P., Lee, D. R., Desher, D. D. and Schelhas, J. W. 2003. Community participation in ecotourism benefits: The link to conservation practices and perspectives. *Society & Natural Resources* 16, 5: 387–413. (doi:10.1080/08941920309177)
- Stroud, J. T., Rehm, E., Ladd, M., Olivas, P. and Feeley, K. J. 2014. Is conservation research money being spent wisely? Changing trends in conservation research priorities. *Journal for Nature Conservation* 22, 5: 471–473. (doi:10.1016/j.jnc.2014.05.003)
- Turner, C. 2007. Community Ecotourism in the Ankarana Region, Madagascar: Creating a new route in collaboration with the local population. Unpubl. planning document prepared for the Rural Commune of Antsiravibe and the Peace Corps.
- Virah-Sawmy, M., Gardner, C. J. and Ratsifandrihamanana, A. N. 2014. The Durban Vision in practice: Experiences in the participatory governance of Madagascar's new protected areas. In: *Conservation and Environmental Management in Madagascar*. I. R. Scales (ed.), pp. 216–251. Routledge, London.
- Wilder, L. and Walpole, M. 2008. Measuring social impacts in conservation: experience of using the most significant change method. *Oryx* 42, 4: 529–538. (doi:10.1017/S0030605307000671)

- Wilshusen, P. R., Brechin, S. R., Fortwangler, C. L. and West, P. C. 2002. Reinventing a square wheel: Critique of a resurgent "protection paradigm" in international biodiversity conservation. *Society & Natural Resources* 15, 1: 17–40. (doi:10.1080/089419202317174002)
- WRM (World Rainforest Movement). 2008. The Impact of Forest Conservation Policies on Forest Dependent Communities in SE Madagascar: Lessons for Sustainability of Madagascar's New Protected Areas. *WRM Bulletin* 133. <<http://goo.gl/u94vlt>> accessed 10 March 2015.

## IMPRESSUM

Madagascar Conservation and Development is the journal of Indian Ocean e-Ink. It is owned by this institution and its production is its own responsibility.

### EDITOR-IN-CHIEF

Lucienne Wilmé [Missouri Botanical Garden, Madagascar]

### GUEST EDITORS

Ian C. Colquhoun [Western University, Canada], Josia Razafindramanana [GERP, Madagascar], Lena M. Reibelt [University of Hildesheim, Germany], Julia Nowack [University of New England, Australia]

### EXECUTIVE EDITORS

Patrick O. Waeber [Madagascar Wildlife Conservation, Switzerland], Charlie J. Gardner [University of Kent, UK], Marion Langrand [Sciences Po., France], Onja H. Razafindratsima [Rice University, United States], Erik R. Patel [Duke Primate Center, United States]

### EDITORS

Jonah Ratsimbazafy [Durrell Wildlife Conservation Trust, Madagascar], Carel van Schaik [University of Zurich, Switzerland], Ute Radespiel [TiHo Hannover, Germany], Harison Rabarison [University of Antananarivo, Madagascar], Daniela B. Raik [Conservation International, Madagascar], Jean-Solo Ratsisompatrivo [DAI, Madagascar], Chris Birkinshaw [Missouri Botanical Garden, Madagascar], Herilala Randriamahazo [Wildlife Conservation Society, Madagascar], Lily-Arison Rene de Roland [The Peregrine Fund, Madagascar], Joleen Timko [University of British Columbia, Canada], Porter P. Lowry II [Missouri Botanical Garden, USA/France], Marie Jeanne Raherilalao [Vahatra, Madagascar], Joerg U. Ganzhorn [University of Hamburg, Germany], Nadia Rabesahala Horning [Middlebury College, USA], Genese M. Sodikoff [Rutgers University, USA], Miguel Pedrono [Centre de coopération internationale en recherche agronomique pour le développement, France], Sandra J. T. M. Evers [University of Amsterdam, The Netherlands], Julian Glos [University of Hamburg, Germany], Rémi A. Ratsimbazafy [WWF Madagascar], David A. Burney [National Tropical Botanical Garden, Hawaii, USA], Alison F. Richard [University of Cambridge, UK and Yale University, USA], Frank Glaw [Zoologische Staatssammlung München, Germany], Neal J. Hockley [Bangor University, UK], Maarten J. de Wit [University of Cape Town, South Africa], John S. Sparks [American Museum of Natural History, USA], Tsilavo Raharimahefa [Laurentian University, Canada], François Moutou [French mammal society SFEPM and French agency for sanitary security ANSES, France], Paul Smith [Botanic Gardens Conservation International, UK], Michel Sartori [Musée cantonal de zoologie, Switzerland], Pascal Danthu [Centre de coopération internationale en recherche agronomique pour le développement, France], Natalie Vasey [Portland State University, USA], Paulina D. Jenkins [The Natural History Museum, UK], Wilson R. Lourenço [Muséum national d'Histoire naturelle, France], Lolona Ramamonjisoa [Silo National des Graines Forestières, Madagascar], Justin Moat [Royal Botanic Gardens Kew, UK], Melanie L. J. Stiassny [American Museum of Natural History, USA], Roger Edmond [University of Antananarivo, Madagascar], Kazuhiro Eguchi [Kyushu University, Japan], Laurie R. Godfrey [University of Massachusetts, USA], Jean-Pierre Sorg [ETH

Zurich, Switzerland], Jeffrey C. Kaufmann [University of Southern Mississippi, USA], Christian A. Kull [Monash University, Australia], Matthieu Le Corre [Université de La Réunion, La Réunion], Jean-Laurent Pfund [Center for International Forestry Research CIFOR, Madagascar], Sheila O'Connor [WWF, USA], Barry Ferguson [University of East Anglia, UK].

### COPY EDITORS

Julian Cooke [Anglo-Malagasy Society, UK], Trevor G. Jones [Blue Ventures, Madagascar], Christian Camara [Missouri Botanical Garden, Madagascar], Finella Pescott [FAO, Thailand], Suzi Malan [University of British Columbia, Canada], Derek Schuurman [UK], Arnaud De Grave [Bricolages Ondulatoires & Particulaires, France], Eric Mathieu [Projet Marojejy, Madagascar]

### TRANSLATIONS

Ralisa Andriamahavita [Madagascar], Raphaël D. Chavardès [University of British Columbia, Canada]

### COVER PICTURE

The National Park of Tsimanampetsotsa is home to some of the oldest baobabs in the world. A recent study by Patrut et al. (2015) in PLOS One 10(3) carbon-dated the tree to be more than 1,000 years old. By Joerg Ganzhorn.

### LAYOUT EDITORS

Christine Buerki [Madagascar Wildlife Conservation, Canada], Arnaud De Grave [Bricolages Ondulatoires & Particulaires, France]

### PRODUCTION SOFTWARE

MCD has been layouted and produced using the open-source Scribus DTP (desktop publishing application) – <http://scribus.net>

### FOUNDER EDITORS

Patrick O. Waeber [Madagascar Wildlife Conservation, Switzerland], Daniel C. Hänni [Jane Goodall Institute Switzerland]

### JOURNAL INFORMATION

All journal related information for authors, reviewers, readers and sponsors is available online at <http://www.journalmcd.com>.

ISSN 1662-2510

Madag. conserv. dev.