

Protected Area Case Study: Masoala National Park, Madagascar

Jorge C. Llopis^{1,2}, Cortni Borgerson³, and Aristide Andrianarimisa⁴

1: Centre for Development and Environment, University of Bern, Switzerland

2: School of Natural Sciences, Bangor University, UK

3: Department of Anthropology, Montclair State University, USA

4: Wildlife Conservation Society, Madagascar Program

Context

Masoala National Park is one of the largest protected areas (PAs) in Madagascar, and a flagship for global biodiversity conservation. Established in 1997 as an International Union for Conservation of Nature (IUCN) Category II Site, the Masoala National Park protects a complex of 240,000 ha of biodiverse habitat, including the largest remaining lowland coastal moist evergreen forests in Madagascar, supported by some 3,000 mm of rainfall on an average year. It also includes three coastal marine parks, the Nosy Mangabe Special Reserve island, and 1,000 ha of buffer habitat allocated for sustainable use (Kremen *et al.* 1996, p. 64). It is home to at least 62 endemic flora species and 11 lemur species, three of which are endemic to the park (Goodman *et al.* 2018). In recognition of its importance to global conservation, the Masoala National Park was named a UNESCO World Heritage Site in 2007.

Over 145,000 people live within 10 km of the Masoala National Park, up from 44,500 estimated just before the park's creation (Borgerson *et al.* unpub. data; Kremen *et al.* 1996: 66). These communities depend on rice cultivation for subsistence, using both irrigated plots in the valley bottoms and upland rain-fed shifting cultivation systems (practices locally known as *horaka* and *jinja* respectively). Fishing and cultivation of cash crops, including vanilla and cloves, are also important sources of cash income for local communities. Communities depend on the region's rich natural resources for economic and personal health, as well as for food security (Borgerson *et al.* 2019), local cosmology (Golden 2014), and cultural identity (Keller 2008). Masoala's forests support people in myriad ways: wildlife are caught for meat; timber is harvested for the construction of houses, furniture, and transportation; non-timber forest products (NTFPs) are collected for roofing, weaving, and medicine (Kremen *et al.* 1998); waterways feed croplands; minerals are extracted; and the rivers and coasts are fished, harvested, and travelled. The remaining forests surrounding this protected area are also perceived by local people as space held in reserve for future agricultural lands. Because such expansion of agricultural land would conceivably improve food security within one of the world's least food secure nations (EIU, 2019), there are strong incentives to clear additional forests for food, and thus the expansion of agricultural clearing is the main threat to Masoala's biodiversity. Overall, socio-economic conditions of populations around the park are poor, more than 75% of households are food insecure, more than 95% are under the global poverty line, and child malnutrition is high (Borgerson *et al.* 2019). Communities have limited access to safe drinking water, electricity, health services, and K-12 education, a situation further exacerbated by the remoteness of most settlements, lack of roadways (both regionally and connecting to national economic centres), and the recurrent impact of tropical cyclones (Hatchell 1999).

New agricultural land for members of communities bordering the Masoala National Park is primarily acquired through forest clearing followed by cultivation, which grants customary ownership rights (Keller 2015). The land thus obtained can be passed down to subsequent generations, connecting ancestral owners to past and future generations in a continuous chain that constitutes a central foundation for both the cultural and socio-economic practices of local communities (Keller 2008). Both requests for formal permits to clear new forest land and land titling have been, and continue to be, rare in most communities that border the park (Kremen *et al.* 1999: 1061). Inequities in legal access to land because of wealth and status are common and are exemplified by differential access to irrigated rice cultivation plots. Such inequalities are to some extent related to the educational background of households, or the political connections individuals can draw on, also mediating who and how different groups enjoy benefits associated with the park (Keller 2015: 147-48).

Protected Area Establishment

The forests of the northeastern part of the Masoala peninsula have held the status of *Res erve Naturelle Int grale* (Integral Natural Reserve) since 1927, being reclassified as the *For t Class ee* (Classified Forest) du Cap Masoala in 1964 (Goodman *et al.* 2018: 766). The contemporary push for the conservation of most of the forests in the Masoala peninsula can be traced back to the late 1980s, when the area was declared a priority for international conservation (Mittermeier *et al.* 1987) and was included in Madagascar's National Environmental Action Plan (World Bank *et al.* 1988), one of the first such plans implemented in Africa. The park began as an Integrated Conservation and Development Project (ICDP) in the late 1980s, at a time when there was a global movement to incorporate ICDPs into the creation of protected areas. Like many other examples worldwide (Robinson and Redford 2004), Masoala shared the challenges associated with ICDP approaches, particularly in regard to the difficulty of delivering development to the extent needed to ensure the sustainable use of natural resources, and the fair distribution of the benefits and burdens related to the conservation intervention. The project depended on the support of the United States' Agency for International Development (USAID), and after an earlier failed start, was eventually implemented by CARE International, the Wildlife Conservation Society (WCS), and the Peregrine Fund, under the guidance of the National Association for the Management of Protected Areas (ANGAP, the parastatal organisation in charge of the managing the national parks of Madagascar) and the Malagasy ministry of forests (Kremen *et al.* 1999). The ICDP later became a National Park, co-managed originally by ANGAP and WCS, and is currently managed exclusively by Madagascar National Parks (MNP, formerly ANGAP), with WCS providing technical support (WCS 2020).

Masoala National Park was established to assure the continuity of its unique forest and marine biodiversity, while enabling the sustainable social and economic development of local communities around the park, goals that were mainly articulated by the organisations in charge of the creation of the park. In ecological terms, the design of the park was aimed at encompassing an area large enough to buffer against both human and natural disturbances, to cover all habitat and species found in the area and protect viable populations of rare or endangered species, and to assure connectivity of the park's different areas (Kremen *et al.* 1999: 1057). This aspect of the park's design was mainly informed by scientific knowledge, generated through biological inventories on avifauna, primates, small mammals,

butterflies and beetles and plants. The park design process looked for ways to protect these important biodiversity values with the least conflict with the people living in the park. A spatially-explicit analysis of the threats to this biodiversity based on likely expansion of shifting cultivation, suggested that the region most likely to experience agricultural expansion was not as valuable for biodiversity conservation, and the majority of this region was therefore left outside of the park borders. A separate analysis, based on timber inventories determined that much of this same region might be suitable for sustainable forest management, and the park project made significant efforts to develop forest management plans that would provide income to local people through sustainable selective forestry, in the hopes that income from forest management would provide incentive to resist agricultural expansion. Local knowledge was obtained through focus group interviews on socioeconomic and agricultural aspects conducted in 25 villages around the park (Kremen *et al.* 1999: 1058), and gathering of information on what local people considered their agricultural and forest land, which was used together with timber inventories to estimate potential for sustainable forest resources use rates. However, according to some scholars, critical cultural local values on forest land, such as the connection with both one's ancestors and descendants that accessing agricultural land by clearing forest represents for local communities, were left aside from the criteria informing the park's design, interrupting an inter-generational process of growth and rooting on the land (Keller 2008).

The conservation of the park's unique biodiversity depends on reducing anthropogenic pressures which are also central for local livelihoods, such as timber extraction and trade, unsustainable fishing, hunting of endangered species, and the conversion of forest land into *jinja* fields (Kremen *et al.* 1996: 63; Goodman *et al.* 2018: 776). For this reason, special emphasis was put in the design of the park on promoting education and on the provision of sustainable alternative livelihoods for residents which particularly aim to reduce the incentives for the practice of shifting cultivation. These included intensive rice cultivation, stabilization of shifting cultivation by crops rotation, artisanal production, or eco-certified forestry, that were being tested in three pilot watersheds before the park was established (Kremen *et al.* 1996: 65). However, insufficient financial and human resources have, so far, prevented the implementation of development activities of either sufficient scope or intensity, to include all households and communities. This is especially true for households which are remote, have high access to forest resources, and are of low socio-political and economic status, but are challenging to reach in terms of infrastructure and logistics.

Despite the original intent and substantial effort devoted to promote forest conservation through engaging local communities in a variety of income-generating activities dependent on forest conservation (i.e. sustainable forest management, ecotourism), the loss of support the ICDPs experienced since the late 1990s meant a move towards larger landscape scale conservation approaches and a stronger focus on ecosystem and watershed protection (Hanson 2009). This means that forest conservation in Masoala has eventually been achieved through a strict protection regime, with a considerable focus of effort on monitoring and patrolling (Andrianjara *et al.* 2013), more recently through technology-based conservation

tools, such as web-based fire alerts¹, or the Spatial Monitoring and Reporting Tool (SMART²). Even if enforcing regulations were not within the park manager's (i.e. MNP) responsibilities, punishment of infractions has also been relatively common, in some cases with prison penalties for cultivating land within the park (Keller 2015: 136-38). Elected government officials from the department of water and forests of the national ministry of the environment work with park officials at each level of civic infrastructure, as only they have the authority to arrest legal transgressions within the park. The administrative and climatic realities of the park add further complexity to the conservation of this landscape. Masoala National Park is geographically split between two administrative districts which include at least nine communes and many small, very remote villages. The region is also both cut off from national infrastructure because of the impassibility of the National Road 5 (the closest road to the park), due to poor road conditions across all seasons and locally because of a lack of roads within the peninsula. Travel on the peninsula is frequently prevented by cyclones and poor weather during the austral winter, both at sea and along rivers and small trails within its interior.

The operating costs of the park were envisaged to be obtained through foreign aid during the parks' first phase, and then through a range of revenue sources, mostly from NGOs and other donors. Ecotourism was also envisaged as a steady source of revenue for running the park and contributing to the development of local communities (Kremen *et al.* 1999; Ormsby and Mannle 2006), although the limitations of its ability to entirely support the park were recognized early on. The recurrent political crises striking Madagascar—entailing sharp drops of tourist arrivals to the country—recent border closures to prevent the spread of pandemics, and the remoteness of the park, in particular a lack of access via national highways and dependable air transport, have meant that visitor numbers have never achieved 10,000 visitors/year as originally envisioned when the park was created (Kremen *et al.* 2000). Instead, the number of tourists visiting Masoala remains at approximately 3,000 per year (Goodman *et al.* 2018), many only visiting the uninhabited island Nosy Mangabe. Both in absolute and relative terms, this is far lower than the revenue inflow that tourism constitutes for other smaller and more accessible national parks in Madagascar, such as Ranomafana, which receives more than 20,000 visitors per year (Goodman *et al.* 2018). Without these sources of revenue, the park continues to be supported by a range of donors, including several NGOs and the Zurich Zoo, which opened a 1.1 ha replica of the Masoala ecosystem in the zoo's facilities in Switzerland in 2003 and provides some US\$125,000 annually for operating costs and development projects in the area (Zurich Zoo 2020).

Decision Making and Values

The park was designed by a team of Malagasy researchers from CARE International and WCS with support from foreign researchers, the former transitioning into positions as the park director, park management, and park rangers employed by MNP (Kremen pers. comm.).

¹ <https://forestwatcher.globalforestwatch.org/>

² <https://smartconservationtools.org/>

Although the process of establishing the park was at first received by local communities with approval (Kremen *et al.* 1999), lack of significant collaboration with local communities in the designing of the park may have contributed to both the lack of a sense of ownership over the conservation objectives of the park by residents and an absence of empowerment and access to sufficient alternatives to enact such objectives (Marcus 2001; Keller 2015). An illustrative point in this regard is that implementation of the park appears to have encouraged a phenomenon of pre-emptive forest clearance for the expansion of *jinja* fields, detected in the years leading up to the park's creation, along the western border of the park (Keller 2015; Llopis *et al.* 2019).

Involvement of local communities in the management of the Masoala National Park has been mostly achieved by the transfer of management rights in the buffer areas around the park to communities in the park's periphery. However, while this transfer involves devolving rights to local communities, local residents might perceive the procedure as being unfair for at least two reasons. First, local communities might have perceived the park as divesting them of rights to land they perceive as rightfully theirs. And second, once communities sign contracts to receive the transfer of management rights for lands included within the protected area's buffer zone, they became responsible for enforcing substantially more restrictive regulations. Yet local communities may not have sufficient means or incentives to enforce park rules or deter park access (Llopis *et al.* 2019). Starting in 2013, further efforts to strengthen co-management with local communities were undertaken, including the setting up of advisory committees bringing together community representatives, elected authorities, and technical and financial partners. Further integration of the *dina* (local regulations agreed between communities and accepted by local authorities) into protected area management and law enforcement strategies is currently being pursued.

However, collaboration between local communities and park management has proved protractedly challenging, in part because in some communities, land already under cultivation fell within the park's core area (Keller 2015). Although provisions were made in the design of the plan for compensating households whose agricultural fields fell inside the park when it was established, payments either insufficiently covered the long-term costs of land-loss, or in the worst cases, never materialised (Keller 2015: 134-36). Further, even if the park's design strived not to include human settlements within the core zone, some scattered households within this zone, and considered as temporary, were relocated to a new settlement founded *ad hoc* outside the parks' core boundary in what is known as a *Zone d'Occupation Contrôlée* (controlled occupation zone), an area where residents were allowed to continue living, but further agricultural land expansion was not permitted (Kremen *et al.* 1999). Besides the relocation, this episode also involved alienating agricultural land already in use, which could have further contributed to a feeling of resentment against the park and its objectives (Keller 2015: 141-43).

Once the Masoala National Park was created, while residents were aware of the park's existence, the involvement of different NGOs and subsequent changes in priorities led to confusion about the park's objectives among local inhabitants (Ormsby and Kaplin 2005). Such shift in priorities would have been reflected in the move from the focus of the ICDP on promoting integrated welfare, with a management strategy addressing economic incentives of local populations based on natural resource use indicators, to an approach more strongly relying on forest clearing indicators and surveillance and enforcement as the

main management strategies, aimed at deter behaviour but not necessarily addressing incentives. This shift in the project's management would have confused local residents, whom, once the ICDP ceased its activities, nonetheless came to perceive it was a duty of the park's staff to continue delivering development projects associated with the ICDP to the area. Illustrating this point, shortly after park's creation, residents who showed a positive perception of the park did so in relation to the development projects related to the ICDP (Marcus 2001; Ormsby and Kaplin 2005), with residents in some communities further stressing that development should accompany, if not precede, conservation initiatives (Llopis *et al.* 2020). While many communities continue to recognize the important role of the park in protecting the resources on which they depend, they continue to lack any sufficient alternatives to unsustainable resource use.

Many local people see their relationship with the park as one more concerned with external powers than forest conservation (Keller 2009: 77). This is reinforced by the history of natural resource management and exploitation by powers external to the local context. As in many parts of Madagascar, and in Masoala in particular, these actors included the pre-colonial Merina monarchy based in the central Malagasy highlands, the French colonial rulers, and the post-colonial state and its alliance with international actors for the management of protected areas in the country (Keller 2009). According to some scholars, power struggles between the Malagasy state and international conservation actors, and not conservation goals themselves, resulted in the criminalization of expanding the *jinja* fields into the forest, reducing independence and food security, and contributing to a local feeling that lands were taken away by powerful external forces for their own benefit (Keller 2015). In addition, the strategy followed by park authorities, of placing park agents in local villages, contributes to the perception of some residents of being permanently under surveillance (Keller 2009: 78).

Changes over time

The protection status of Masoala National Park has remained stable since establishment in 1997. However, the re-identification and marking of park boundaries, using paint to identify its physical delimitations, has resulted in highly problematic and controversial events during the last two decades. Paint locations shifted at each marking event, in most occasions enclosing additional village land. According to the park management, the incursion of marking toward community boundaries was due to inaccuracies during the initial marking of borders, when park staff feared community backlash and avoided marking land under cultivation. Nonetheless, the unannounced and non-negotiated later change in the location of border markings was perceived as park expansion and an encroachment on villages' land (Keller 2015: 124-27; 145).

Management of Masoala National Park is primarily driven by threats to its biodiversity (Andrianjara *et al.* 2013). While park managers concentrate much of their effort on monitoring and patrolling, as well as conservation education and awareness raising, local communities will be compelled to continue to unsustainably use resources until there are sufficient alternatives to such practices.

Outcomes

After being included in the UNESCO's World Heritage List in 2007 as part of the Rainforests of the Atsinanana site³, Masoala has had annual evaluations according to the criteria of World Heritage, including assessments of deforestation, biodiversity value, threat level, and other indicators. Such evaluation is aligned with the IUCN's Integrated Management Effectiveness Tool (IMET), which concerns the planning, monitoring and evaluation of protected areas and directly support managers in the field and at national agencies. Besides such evaluations, several studies provide insights into some of the impacts of Masoala National Park on deforestation and biodiversity conservation, ecosystem services, food security, human-wildlife conflicts, and natural resources governance outcomes on the peninsula.

Masoala National Park has been doing relatively well in terms of reducing deforestation and biodiversity loss (Goodman *et al.* 2018: 776; Eklund *et al.* 2019). This allows it to continue to constitute a unique habitat for the wildlife within the park, and to provide essential ecosystem services to the communities that surround it, in the face of expanding habitat loss, food insecurity, and water challenges elsewhere nationally. However, its periphery continues losing forest at a significant rate (Goodman *et al.* 2018: 776), in some areas up to 1% a year on average in the last decade (Llopis *et al.* 2019:16), which broadly aligns with rates across Madagascar in the last decade (Vieilledent *et al.* 2018). Further, conservation prospects under expected climate change scenarios are worrisome, both reducing forests and increasing anthropogenic pressures. Without current conservation measures, the effects of climate change on forest cover, ecosystem integrity, biodiversity, and the ecosystems role in supporting local communities would be dire, threatening both the long-term viability of Madagascar's most endangered lemur species due to reduced habitat suitability, and the long-term health and food security of local communities (Morelli *et al.* 2019). In terms of biological diversity, habitat loss is happening at a slower rate within the park than in other national parks, allowing the park to serve as what may be the final refuge for many keystone endemic species (Morelli *et al.* 2019).

The park's effects on the local human population have been more complex, however. On the one hand, residents perceive that they depend on the park for its protection of forests that provide them with firewood, roofing materials, honey, timber for construction, medicinal plants, lands that are a key part of their ecological place and world views, and water essential for drinking and the irrigation of rice; services which residents believe would have decreased in availability had the park not been created and deforestation continued (Llopis *et al.* 2020: 13; Ormsby and Kaplin 2005: 160). However, the long-term assurance of these services does not replace the need for alternatives to clearing new land for agriculture. The inability for communities which border the park to acquire new *jinja* fields increased food insecurity, particularly in households which lack access to irrigated rice fields or cash crop production, and thus income with which to obtain food (Llopis *et al.* 2020: 9; Keller 2015).

Complicating the picture, populations living in the periphery of the park have experienced in recent years the effect of a price boom for vanilla, the most important cash crop in the area. In addition to the social

³ <https://whc.unesco.org/en/list/1257/>

turmoil driven by the price boom (Zhu 2018), and while the relationship between the cultivation of this high-value crop and the protection of the forests still remains far from fully understood, there are indications that expansion of vanilla cultivation might be increasing pressure on the forests around the national park (Llopis *et al.* 2019).

Human-wildlife conflicts over poultry surrounding the park are a significant threat to extant endemic carnivores, including the *fosa* (*Cryptoprocta ferox*), a euplerid carnivoran (Borgerson 2015: 411). The park is one of the few national parks large enough to support a sufficient population of *fosa* (Murphy *et al.* 2018), yet an average of one *fosa* is eaten per year by every 17 households on the peninsula (Borgerson *et al.* 2019).

Illustrating the delicate governance context surrounding Masoala, is the illegal exploitation of rosewood (*Dalbergia* spp.), a protected precious wood genus, within the park's boundaries, whose extraction and exportation sharply increased during the last political crisis which struck the country from 2009-2014 (Randriamalala and Liu 2010). Some scholars have argued that high ranking politicians and elected officials have benefited from the exploitation and illicit trade of this precious wood, which primarily is shipped to China, with political implications that are long-lasting (Wilmé *et al.* 2020; Anonymous 2018). In addition to the direct impacts of illegal rosewood logging on Masoala's biodiversity, which prompted the park to be included in UNESCO's List of World Heritage Sites in Danger⁴, this situation will likely negatively affect long-run conservation efforts with local communities.

Conclusions

Masoala National Park has successfully slowed forest loss, ensuring one of Madagascar's key biodiversity hotspots can continue to constitute a supportive habitat for endemic wildlife and provide essential ecosystem services to human populations. However, without other interventions, such ecosystem services are insufficient, and sustainable use of natural resources around the park might be unable to ensure the food security of the local communities reliant on this land for providing both agricultural (Llopis *et al.* 2021) and wild foods (Borgerson *et al.* 2019). Further, while the park ensures the continuation of forests which are central to local cosmology (Golden 2014), it also prevents the continuation of land clearing for *jinja*, which threatens the cultural identity of rice farmers bequeathed by their ancestors to assign additional value to land, passing it on to the next generation (Llopis *et al.* 2021; Keller 2015: 133-34). To address these long-lasting dilemmas, further efforts are needed to provide realistic and reliable alternatives to local communities to ensure that unsustainable use of natural resources does not undermine local well-being, and that benefits and burdens are distributed fairly among the many actors involved in the conservation of Masoala's unique biodiversity.

⁴ <https://whc.unesco.org/en/news/639>

References

- Andrianjara, A. H., A. Andrianarimisa and F. Ratelolahy (2013). *Masoala*. Lemurs of Madagascar. A Strategy for Their Conservation 2013–2016. C. Schwitzer, R. A. Mittermeier, N. Davies et al. Bristol, UK, IUCN SSC Primate Specialist Group, Bristol Conservation and Science Foundation, and Conservation International: 56-58.
- Anonymous (2018). Rosewood democracy in the political forests of Madagascar. *Political Geography* **62**: 170-183.
- Borgerson, C. (2015). Optimizing conservation policy: the importance of seasonal variation in hunting and meat consumption on the Masoala Peninsula of Madagascar. *Oryx* **50**(3): 405-418.
- Borgerson, C., B. Razafindrapaoly, D. Rajaona, B. J. R. Rasolofoniaina and C. D. Golden (2019). Food Insecurity and the Unsustainable Hunting of Wildlife in a UNESCO World Heritage Site. *Frontiers in Sustainable Food Systems* **3**(99).
- EIU (2019). *Global Food Security Index 2019. Strengthening food systems and the environment through innovation and investment*. London, The Economist Intelligence Unit Limited.
- Eklund, J., L. Coad, J. Geldmann and M. Cabeza (2019). What constitutes a useful measure of protected area effectiveness? A case study of management inputs and protected area impacts in Madagascar. *Conservation Science and Practice* **0**(0): e107.
- Golden C. 2014. Spiritual roots of the land: heirarchy and relationships oft he religious cosmologies of humans and their environment in the Maroantsetra region of Madagascar. *Worldviews* (18)255-263.
- Goodman, S. M., M. J. Raheirilalao and S. Wohlhauser, Eds. (2018). *Les Aires Protégées Terrestres de Madagascar : Leur Histoire, Description et Biote / The Terrestrial Protected Areas of Madagascar: Their History, Description and Biota*. Antananarivo, Madagascar, Association Vahatra. 1716 pp.
- Hanson, P. W. (2009). Engaging green governmentality through ritual. The case of Madagascar's Ranomafana National Park. *Études océan Indien* 42-43: 85-113.
- Hatchwell, M. (1999). *Plan de gestion du Parc National de Masoala. (Masoala National Park Management Plan)*, Antananarivo, Madagascar: Wildlife Conservation Society.
- Keller, E. (2008). The banana plant and the moon: Conservation and the Malagasy ethos of life in Masoala, Madagascar. *American Ethnologist* **35**(4): 650-664.
- Keller, E. (2009). Who are "they"? Local understandings of NGO and state power in Masoala, Madagascar. *Tsantsa* **14**: 76-85.

- Keller, E. (2015). *Beyond the Lens of Conservation. Malagasy and Swiss Imaginations of One Another*. New York and Oxford, Berghahn Books. 244 pp.
- Kremen, C., J. O. Niles, M. G. Dalton, G. C. Daily, P. R. Ehrlich, J. P. Fay, D. Grewal and R. P. Guillery (2000). Economic Incentives for Rain Forest Conservation Across Scales. *Science* **288**(5472): 1828-1832.
- Kremen, C., I. Raymond, K. Lance and A. Weiss (1996). Monitoring Natural Resource Use on the Masoala Peninsula, Madagascar: A Tool for Managing Integrated Conservation and Development Projects. *Measuring Conservation Impact. An Interdisciplinary Approach to Project Monitoring and Evaluation*, Providence, Rhode Island, US, Ecological Society of America and the Society for Conservation Biology.
- Kremen, C., Raymond, I. & Lance, K. (1998) An Interdisciplinary Tool for Monitoring Conservation Impacts in Madagascar. *Conservation Biology*, **12**, 549–563.
- Kremen, C., V. Razafimahatratra, R. P. Guillery, J. Rakotomalala, A. Weiss and J.-S. Ratsisompatrarivo (1999). Designing the Masoala National Park in Madagascar Based on Biological and Socioeconomic Data. *Conservation Biology* **13**(5): 1055-1068.
- Llopis, J. C., J. F. Chastonay, F. C. Birrer, R. Bär, R. N. N. Andriatsitohaina, P. Messerli, A. Heinimann and J. G. Zaehring (2021). North-eastern Madagascar under telecoupling: Assessing year-to-year changes in the supply of ecosystem services relevant to actors at multiple scales. *Ecosystem Services* **48**: 101249.
- Llopis, J. C., C. L. Diebold, F. Schneider, P. C. Harimalala, L. Patrick, P. Messerli and J. G. Zaehring (2020). Capabilities Under Telecoupling: Human Well-Being Between Cash Crops and Protected Areas in North-Eastern Madagascar. *Frontiers in Sustainable Food Systems* **3**(126).
- Llopis, J. C., P. C. Harimalala, R. Bär, A. Heinimann, Z. H. Rabemananjara and J. G. Zaehring (2019). Effects of protected area establishment and cash crop price dynamics on land use transitions 1990–2017 in north-eastern Madagascar. *Journal of Land Use Science* **14**(1): 52-80.
- Marcus, R. R. (2001). Seeing the Forest for the Trees: Integrated Conservation and Development Projects and Local Perceptions of Conservation in Madagascar. *Human Ecology* **29**(4): 381-397.
- Mittermeier, R. A., L. Rakotovoao, V. Randrianasolo and E. J. Sterling (1987). *Priorités en matière de conservation des espèces à Madagascar*, International Union for Conservation of Nature, Séminaire scientifique international relatif à l'état des recherches sur les écosystèmes forestiers de Madagascar, Antananarivo, MG, 28-31 octobre 1985. 167 pp
- Morelli, T. L., A. B. Smith, A. N. Mancini, E. A. Balko, C. Borgerson, R. Dolch, Z. Farris, S. Federman, C. D. Golden, S. M. Holmes, M. Irwin, R. L. Jacobs, S. Johnson, T. King, S. M. Lehman, E. E. Louis, A. Murphy, H. N. T. Randriahaingo, H. L. L. Randrianarimanana, J. Ratsimbazafy, O. H.

- Razafindratsima and A. L. Baden (2019). The fate of Madagascar's rainforest habitat. *Nature Climate Change* **10**: 89–96.
- Murphy, A., B. D. Gerber, Z. J. Farris, S. Karpanty, F. Ratelolahy and M. J. Kelly (2018). Making the most of sparse data to estimate density of a rare and threatened species: a case study with the fosa, a little-studied Malagasy carnivore. *Animal Conservation* **21**(6): 496-504.
- Ormsby, A. (2008). Development of Environmental Education Programs for Protected Areas in Madagascar. *Applied Environmental Education & Communication* **6**(3-4): 223-232.
- Ormsby, A. and B. A. Kaplin (2005). A framework for understanding community resident perceptions of Masoala National Park, Madagascar. *Environmental Conservation* **32**(02): 156-164.
- Ormsby, A. and K. Mannle (2006). Ecotourism Benefits and the Role of Local Guides at Masoala National Park, Madagascar. *Journal of Sustainable Tourism* **14**(3): 271-287.
- Randriamalala, H. and Z. Liu (2010). Rosewood of Madagascar: Between democracy and conservation. *Madagascar Conservation & Development* **5**(1): 11-22.
- Robinson, J.G. and Redford, K.H. (2004) *Jack of all trades, master of none: inherent contradictions among ICD approaches*. In Getting Biodiversity Projects to Work (eds T.O. McShane & M.P. Wells), pp. 10–34. Columbia University Press, New York, USA
- Vieilledent, G., C. Grinand, F. A. Rakotomalala, R. Ranaivosoa, J.-R. Rakotoarijaona, T. F. Allnutt and F. Achard (2018). Combining global tree cover loss data with historical national forest cover maps to look at six decades of deforestation and forest fragmentation in Madagascar. *Biological Conservation* **222**: 189-197.
- WCS (2020). *WCS's activities in MaMaBay*. Retrieved 15.08.2020, from <https://madagascar.wcs.org/WCS-activities-in-MaMaBay.aspx>.
- Wilmé, L., J. L. Innes, D. Schuurman, B. Ramamonjisoa, M. Langrand, C. V. Barber, R. A. Butler, G. Wittemyer and P. O. Waeber (2020). The elephant in the room: Madagascar's rosewood stocks and stockpiles. *Conservation Letters*: e12714.
- World Bank, U.S. Agency for International Development, Cooperation Suisse, United Nations Educational Scientific and Cultural Organization, United Nations Development Program and Worldwide Fund for Nature (1988). *Madagascar - Environmental action plan*. Washington, D.C., World Bank. 84 pp.
- Zhu, A. (2018). Hot money, cold beer: Navigating the vanilla and rosewood export economies in northeastern Madagascar. *American Ethnologist* **45**(2): 253-267.

Zurich Zoo (2020). *Masoala*. Retrieved 16.03.2020, from <https://www.zoo.ch/en/conservation-animals/conservation-projects/masoala>.