IUCN Conservation Outlook Assessment 2014 **(archived)**
Finalised on 14 August 2014

Please note: this is an archived Conservation Outlook Assessment for Rainforests of the Atsinanana. To access the most up-to-date Conservation Outlook Assessment for this site, please visit https://www.worldheritageoutlook.iucn.org.

Rainforests of the Atsinanana

SITE INFORMATION

Country:
Madagascar
Inscribed in: 2007
Criteria:
(ix) (x)

Site description:
The Rainforests of the Atsinanana comprise six national parks distributed along the eastern part of the island. These relict forests are critically important for maintaining ongoing ecological processes necessary for the survival of Madagascar’s unique biodiversity, which reflects the island’s geological history. Having completed its separation from all other land masses more than 60 million years ago, Madagascar’s plant and animal life evolved in isolation. The rainforests are inscribed for their importance to both ecological and biological processes as well as their biodiversity and the threatened species they support. Many species are rare and threatened especially primates and lemurs. © UNESCO

SUMMARY

2014 Conservation Outlook

Significant concern

Although a number of threats persist, many of them are localized. While agricultural encroachment is a problem at all sites, the rugged nature of the terrain limits its scope. The illegal logging crisis has abated but remains, alongside with associated hunting and artisanal mining, a significant problem that cannot be controlled at the site level, and may recur given a lack of political will. Appropriate management systems exist but are of unknown effectiveness, and management is under-resourced.

Current state and trend of VALUES

Low Concern
Trend: Deteriorating

No current or potential threats are likely to jeopardize any of the property's values entirely, but the values depend on the integrity of the property and extent of habitats. Several pressures, particularly logging, hunting and agricultural encroachment, are continuously diminishing the extent and quality of natural ecosystems within the property, thus progressively diminishing its values. All values are likely to be maintained in the long term, however.

Overall THREATS

High Threat

The property is largely composed of remote mountain areas and thus has high natural protection against unsustainable resource use. Nevertheless agricultural encroachment is a threat to all components, particularly Masoala. Illegal logging in Marojejy and Masoala reached crisis levels in 2009 but has since subsided in Marojejy where illegal logging on a significant scale has not occurred since 2011. However, the low efficiency of the management's response to the illegal logging crisis reduced the authority of the property's managers and triggered migration,

a bushmeat trade that threatens lemurs, artisanal mining and increasing agricultural encroachment. Potential social and livelihood change may result in increases in hunting, agricultural encroachment and other threats. Altitudinal range shifts driven by climate change may have severe impacts.

Overall PROTECTION and MANAGEMENT

Some Concern

Management at the scale of the property is ineffective at combating the drivers of illegal logging. At the site level, logging and the agricultural encroachment and artisanal mining it triggers have not been effectively managed due to the management authority’s lack of resources and authority. Appropriate management systems are in place but their effectiveness is unknown.

FULL ASSESSMENT

Description of values

Values

World Heritage values

- **Ongoing ecological processes necessary for the survival of Madagascar's unique biodiversity**
  Criterion:(ix)

  The Rainforests of the Atsinanana are relict forests, largely associated with steeper terrain along the eastern escarpment and mountains of Madagascar. The protected areas included in this serial property have become critically important for maintaining ongoing ecological processes necessary for the survival of Madagascar's unique biodiversity. This biodiversity reflects Madagascar's geological history and geographic placement. It is the world's fourth largest island and has been separated from all other land masses for at least 60-80 million years and thus most of its plant and animal life has evolved in isolation. These forests have also offered important refuge for species during past periods of climate change and will be essential for the adaptation and survival of species in the light of future climate change (SoOUV 2006).

- **Rich endemic flora**
  Criterion:(x)

  At least 11, 220 species of vascular plant occur in Madagascar, of which 84% are endemic (Callmander et al. 2011). The 2984 species recorded within the property (IUCN 2007) is likely to be an underestimation, but this includes members of at least 97 of the country’s 209 endemic plant genera and five of

the six endemic families (UNEP-WCMC 2007).

► Rare and threatened mammals

Criterion:(x)

Of the 123 species of non-volant mammals in Madagascar, 78 occur within the property (SoOUV 2006); of these, 100% are endemic (Goodman and Benstead 2005) and 72 are inscribed in the IUCN Red List of Threatened Species (IUCN 2012). All five endemic families of lemur are represented, as well as six genera of the endemic carnivore family Eupleridae and seven endemic genera of rodent (IUCN 2007). Six endemic genera of tenrecs (Afrosoricida) also occur (Soarimalala and Goodman 2011).

► Rare and endemic birds

Criterion:(x)

173 bird species occur within the property, representing 61% of all species recorded in Madagascar (UNEP-WCMC 2007). These include members of five endemic or near-endemic families (Brachypteraciidae, Mesitornithidae, Bernieridae, Vangidae and Leptosomatidae) and two endemic subfamilies (Couinae and Philepittinae) (Raherilalao and Goodman 2011). Eighteen species are inscribed in the IUCN Red List of Threatened Species (IUCN 2012), including the Madagascar serpent eagle Eutriorchis astur (EN) and Madagascar red owl Tyto soumagnei (EN) (UNEP and WCMC 2007).

► Diversity of habitats

Criterion:(x)

The altitudinal range (0-2658 m) of the property spans an exceptional diversity of Madagascar’s humid habitats, including the nationally very rare coastal rainforest and lowland rainforest in Masoala, mid-level and montane rainforest at all sites, lower sclerophyllous montane forest at Marojejy, Andringitra and Andohahela, replaced by ericoid montane thicket above 1800 m, and swamp vegetation at Ranomafana (UNEP-WCMC 2007).

Other important biodiversity values

► Endemic reptiles and amphibians

At least 160 species of amphibian have been recorded within the property (IUCN 2007), with a national endemism rate of 99% (Goodman and Benstead 2005). This richness is vastly underestimated, as only approximately half of Madagascar's known frog diversity has been described; within the property, for example, 31 undescribed species are known from Ranomafana (Vieites et al. 2009). Reptile species richness stands at 164 (MNP 2012), with a national endemism rate of 92% (Goodman and Benstead 2005).

Assessment information

Threats

Current Threats

High Threat

Given the cyclical and well-established nature of the trade (Randriamalala and Liu 2010, Global Witness and EIA 2009), logging may persist and spread to other components. All sites represent agricultural frontiers under increasing demographic pressure, although the steepest slopes are naturally protected, and demand for forest resources will remain high until met with alternatives. Climate change will likely have large impacts due to the altitudinal range within the property.

► Identity/ Social Cohesion/ Changes in local population and community

Data Deficient
Outside site

Migration linked to illegal logging and artisanal mining is likely to disrupt the social fabric of resident communities adjacent to the property, but no data are available. For example, data from elsewhere suggest that migrants may not respect local taboos (fady) that may protect species such as lemurs

(Jenkins et al. 2011).

▶ Tourism/ visitors/ recreation

Very Low Threat
Inside site
Outside site

High numbers of visitors may disturb ecosystems and fauna, but no data are available for Madagascar. Any impacts will be highly localized, and apart from Ranomafana, other sites have low visitation rates.

▶ Fire/ Fire Suppression

Low Threat
Inside site
Outside site

Intact rainforests do not burn, but fires set for pasture renewal outside forests may progressively push back the forest edge. Fires are identified as a low to medium threat for five of the sites (PNM-ANGAP NDa, NDb, NDc, NDd, NDe) but, in conjunction with grazing, may play a positive role in the maintenance of ericoid montane thicket in Andringitra (Rabetaliana and Schachenmann 1999).

▶ Invasive Non-Native/ Alien Species

Data Deficient
Inside site
Outside site

Although not identified as a threat in any site management plans, the invasive guava Psidium cattleanum and other species are a problem at Ranomafana, where their invasion is facilitated by logging. Once logged, sites never recover their native species diversity because of the dominance and persistence of invasives (Brown and Gurevitch 2004). Is likely a threat, to varying degrees, at all sites, but no data are available.

▶ Subsistence hunting

Low Threat
Inside site
Outside site

Identified as a low to very high threat in all six component sites in the

property (PNM-ANGAP 2003, NDa, NDb, NDc, NDd, NDe), but data on impacts are lacking. Targeted species include lemurs, birds and small mammals. At all sites hunting is likely to be highly associated with illegal logging, artisanal mining and other activities that attract people into the property (Debonnet and Mauvais 2011).

► Habitat Shifting/ Alteration

Data Deficient
Inside site
Outside site

All sites are associated with mountain systems and can expect upslope displacement of habitats and species with climate change; this is a particular concern for montane habitats. Such displacements have already been observed at Tsaratanana, a site not included in the property but adjacent to Marojejy (Raxworthy et al 2008).

► Tourism/ Recreation Areas

Very Low Threat
Outside site

Hotel construction on the west coast of the Masoala Peninsula, largely outside the National Park, has not been preceded by impact assessments and risks disfiguring the landscape and triggering illegal resource use (construction materials, hunting by construction workers) (Confidential consultation 2012). Threat is highly localized.

► Crops

High Threat
Inside site
Outside site

Slash-and-burn cultivation is considered the primary threat to Madagascar’s forests (Fritz-Vietta et al. 2011). It occurs at the forest frontier, i.e. around the edges of forest blocks designated as protected areas, and is identified as a major threat to all six component sites in the property (PNM-ANGAP 2003, NDa, NDb, NDc, NDd, NDe). Analysis of satellite imagery suggest no abnormal encroachment in Marojejy, but worrying agricultural encroachment along river valleys in Masoala; deforestation rates of 0.71%/year during 2005-2010 are above the national average and an increase from the rate of

0.01%/year during 1990-2005 (Debonnet and Mauvais 2011). No data are available for the remaining four sites in the property. Restoration of affected areas since 2009 is in the order of 0.01% per year of the total surface area of the property, i.e. equivalent to 48 ha per year. However, this rate of restoration fluctuates, and in 2013 was 0.031 %, or approximately 150 hectares (Rakotoarivelo, pers.comm.).

► Livestock Farming / Grazing

Data Deficient
Inside site
Outside site

Livestock grazing is identified as a low to medium threat at three sites; Zahamena, Andringitra and Andohahela (PNM-ANGAP NDb, NDd, NDe), and probably occurs at all sites in the property. Nothing is known about the impacts of grazing in Madagascar’s rainforests, although grazing may have a positive role in the maintenance of ericoid montane thicket in Andringitra (Rabetaliana and Schachenmann 1999).

► Mining/ Quarrying

High Threat
Inside site
Outside site

Artisanal mining is noted as a recent threat at Ranomafana (gold; PNM-ANGAP NDc), Zahamena (quartz; PNM-ANGAP NDb), Marojejy and Masoala (quartz and other minerals; Debonnet and Mauvais 2011). No data exist to quantify the amplitude or impacts of the phenomenon, which appears to be increasing in Masoala. Increases are thought to be due to the same governance issues that affect illegal logging (Debonnet and Mauvais 2011), and may represent a displacement activity for people who migrated to the property for illegal logging (WHC 2010). Impacts are highly localized but may be high in the long-term if they lead to settlement within the property, with associated impacts such as subsistence hunting, unsustainable resource use etc.

► Roads/ Railroads

Very Low Threat

Inside site
Outside site

Most sites are associated with rugged mountain areas with low demand for roads. A national road traverses Ranomafana but adjacent areas appear well-managed (IUCN 2007). Paths used by people and cattle traverse Ranomafana [and probably all sites], and are associated with fires and hunting (IUCN 2007). Human intrusion is considered a low threat at Marojejy (PNM-ANGAP 2003).

► Commercial hunting

High Threat
Inside site
Outside site

A novel trade in lemur bushmeat (Barrett and Ratsimbazafy 2011) is linked to the illegal logging crisis in Marojejy and Masoala, where hunting is carried out by loggers. Patrols in Masoala recovered two traps in 2007 and 109 traps in 2010 (Debonnet and Mauvais 2011), and 129 in 2011 (Rakotoarivelo, pers. comm.). In 2012 and 2013, this number appears to stabilize at 69 (Rakotoarivelo, pers. comm). Impacts at Masoala include 30 - 75% reductions in density of Varecia rubra (EN) and Eulemur albifrons (VU) and reductions in female fertility (WCS Report). Given the role of lemurs as seed dispersers (e.g. Dew and Wright 1998), potential extirpations may have long-term impacts on forest ecology. Recently, poaching has been reduced by 46% (SOC Report, 2014).

► Logging/ Wood Harvesting

High Threat
Inside site
Outside site

Illegal logging is identified as a threat to all six components of the property (PNM-ANGAP NDa, NDb, NDc, NDd, NDe), though for four components trade is not export oriented, but satisfies local and regional demand. Logging of valuable rosewood and palisandre (Dalbergia spp.) and ebony (Diospyros spp.) was a recognized problem in Marojejy prior to 2009 (Patel 2007), but reached crisis proportions in Marojejy and Masoala following the political crisis of that year (Randriamalala and Liu 2010, Global Witness and EIA 2009). In 2009 more than 60, 000 trees were harvested from these sites,

impacting at least 4000 ha; about 500, 000 additional trees were cut to facilitate transport (Randriamalala and Liu 2010). By 2011 logging was thought to have stopped in Marojejy and continued at reduced intensity in Masoala (Debonnet and Mauvais 2011); however, the trade appears to exhibit boom and bust cycles (Randriamalala and Liu 2010). Direct impacts may include an increase in fire and invasive species, habitat degradation and a loss of genetic diversity (Patel 2007), but data are lacking (Debonnet and Mauvais 2011). Secondary effects are more worrying, and include increases in commercial and subsistence hunting, artisanal mining and unsustainable resource use by loggers. Logging also facilitates agricultural expansion by diminishing the authority of, and respect for, protected area rules (Debonnet and Mauvais 2011). The President of the Republic of Madagascar has expressed a will to implement strong measures to address and halt the illegal trade in rosewood (SOC report, 2014).

► Fishing / Harvesting Aquatic Resources

Very Low Threat
Inside site
Outside site

Crayfish harvesting is widespread at Ranomafana but may be sustainable (Jones et al. 2005). Fishing and harvesting of other freshwater resources probably occurs at accessible watercourses throughout the property, but no data are available.

► Other Biological Resource Use

Low Threat
Inside site
Outside site

Non-timber forest products such as medicinal plants, fruit, honey, wild silk, fibres for construction etc. are widely collected throughout the country. Collection has been identified as a threat for five of the sites (PNM-ANGAP NDa, NDb, NDc, NDd, NDe), but little is known about its impacts.

Potential Threats

High Threat

Climate change will have unknown impacts but will alter the distribution of

habitats and species across the property. Potential social and livelihood change may result in increases in hunting, agricultural encroachment and other threats.

► Droughts

Data Deficient
Inside site
Outside site

The impacts of changes in rainfall patterns on the property's values will require specific research.

► Temperature changes

Data Deficient
Inside site
Outside site

The impacts of temperature changes on the property's values will require specific research.

► Changes in traditional ways of life and knowledge systems

Data Deficient
Outside site

Livelihood change may be triggered by demographic growth (high population growth rate and migration). No data are available for communities adjacent to the property, but experiences elsewhere in Madagascar indicate that reductions in the viability of traditional livelihoods (e.g. farming) can lead to increasing dependence on forest-based revenue generating activities, such as hunting and logging.

► Other

Very Low Threat
Outside site

Although not mentioned in any site management plans (PNM-ANGAP NDa, NDb, NDc, NDd, NDe), illegal collection of reptiles and amphibians (e.g. chameleons, geckoes, frogs) for the international pet trade is widespread in Madagascar (e.g. Andreone et al. 2006) and may take place in the property.

Protection and management

Assessing Protection and Management

► Legal framework and enforcement

Some Concern

The six components of the property are legally protected as National Parks (IUCN Cat II) and thus governed by national legislation (Code de Aires Protégées, GoM 2001), but MNP does not have authoritative power to apply the law. Loopholes in legislation regarding wood exports, and corruption, facilitate and permit the rosewood crisis (Randriamalala and Liu 2010, Global Witness and EIA 2009). Magistrates are not applying sanctions against those breaking the law in Masoala (Confidential consultation 2012). A lack of resources handicaps surveillance, which is inadequate (Confidential consultation 2010, 2012).

► Management system

Mostly Effective

Detailed, appropriate management plans exist but have not been updated since 2003, and the degree to which they have been implemented is unclear. An integrated management plan for the six components was apparently prepared in 2010, but was not available during the assessment. The management system appears appropriate and sufficient (Debonnet and Mauvais 2011).

► Management effectiveness

Data Deficient

Evaluations of management effectiveness are not available. Management is under-resourced, with surveillance in Marojejy and Masoala insufficient in the face of illegal logging (Anonymous consultation 2010, 2012). With regards to logging, the crisis stems from issues beyond the scale of the protected areas and site-based management is necessarily ineffective (Debonnet and Mauvais 2011).

► Implementation of Committee decisions and recommendations

Some Concern

Requests to the State Party for reports and support for missions have been satisfied, and a range of actions have been taken to stem the rosewood crisis (WHC 2012). There remains, however, a lack of political will to fully engage with the issue and bring the trade to a halt (Debonnet and Mauvais 2011).

► Boundaries

Some Concern

Boundaries of the component sites are unclear. After a recent (Schweter, 2008) investigation into Marojejy’s boundary, it became clear that all published size estimates for the park were incorrect. Marojejy is actually only 55,050 hectares but still widely reported as 60,000 hectares. For many component sites, park area measurements have not been recently assessed. Boundaries are c ineffective in preventing agricultural encroachment or other incursions (Debonnet and Mauvais 2011).

► Sustainable finance

Some Concern

Madagascar National Parks is extremely dependent on external financing, but budgets for Marojejy and Masoala appear stable and adequate (Debonnet and Mauvais 2011). The Fondation des Aires Protégées et Biodiversité de Madagascar has been created to ensure sustainable financing, but is not yet fully capitalized. Key donors suspended support for Madagascar following the political crisis of 2009 (WHC 2010).

► Sustainable use

Some Concern

As National Parks (IUCN cat II) bound by the Code des Aires Protégées, all extractive use of natural resources within the property is forbidden (GoM 2001), although local use exemptions can be made (Debonnet and Mauvais 2011). Extractive use does take place but is largely illegal, regardless of sustainability.

► Tourism and interpretation

Mostly Effective

Ranomafana remains the only easily accessible and popular site, and tourism remains underdeveloped at all sites. Nationally visitation is vulnerable to periodic political crises. Marojejy was closed to visitors during the peak of the rosewood crisis in 2009. Tourism infrastructure within the property is rated as poor to adequate (PRQ 2011). A large scale construction project at Marojejy (building a drivable road from the national highway to the park entrance) was only half completed in 2012/2013. Completing this project and improving financial oversight will benefit tourism significantly as Marojejy is still more inaccessible than many other parks in Madagascar.

► Monitoring

Data Deficient

Management plans for all sites contain a monitoring plan, but it is not clear whether these were/are implemented. They are not directed towards management needs (PRQ 2011). Management plans have not been updated since 2003, and have not therefore been adapted on the basis of monitoring outcomes.

► Research

Some Concern

Management plans for each site do not contain a research plan. Current knowledge of the sites in insufficient for effective management (PRQ 2011)

► Education and interpretation programs

Serious Concern

Knowledge and understanding of the property and its values are rated as poor to non-existent among local communities and landowners, and the values are not adequately presented and interpreted (PRQ 2011). However, since 2014, an interpretation centre has been constructed in Maroantsetra, where the park administration of Masoala National Park is based. This centre serves to provide education to the local population, and also promotes

tourism (Rakotoarivelo, pers. comm.).

► Integration into regional and national planning systems

Data Deficient

The six components are managed as a network under a national plan (PlanGRAP, PNM-ANGAP 2001) which has been updated in 2014 (Rakotoarivelo, pers. comm.). All components theoretically figure in regional and communal development plans, but it is not clear whether this is actually the case. Protected area management and expansion (although not the property specifically) was integrated into the Madagascar Action Plan (MAP, GoM 2007), but the MAP has not been retained as a guiding development framework since the political crisis in 2009.

► Staff training and development

Some Concern

Opportunities for staff training are few (PRQ 2011), probably limited by the inaccessibility of the sites and a lack of resources. However, Madagascar National Parks develops a staff training programme every year (Rakotoarivelo, pers. comm.).

► Relationships with local people

Some Concern

50% of entrance fees at National Parks are shared with local communities, but only Ranomafana attracts tourists in large numbers. The relationship is rated as fair (PRQ 2011), with local communities contributing directly to some management decisions through the Protected Area Orientation and Support Committee (COSAP) (Rakotoarivelo, pers. comm.). Several management programmes are geared towards improving the well-being of local communities while conserving natural resources, such as the programme for the Transfer of Management of Natural Resources (Rakotoarivelo, pers. comm.). Credibility and respect for MNP’s authority have diminished due to its inability to tackle illegal logging (Debonnet and Mauvais 2011).

Overall assessment of protection and management

Some Concern

Management at the scale of the property is ineffective at combating the drivers of illegal logging. At the site level, logging and the agricultural encroachment and artisanal mining it triggers have not been effectively managed due to the management authority's lack of resources and authority. Appropriate management systems are in place but their effectiveness is unknown.

▶ Assessment of the effectiveness of protection and management in addressing threats outside the site

Some Concern

The illegal logging crisis is facilitated by loopholes in the law and a lack of political will, and is beyond the control of the property's management authority. Its secondary impacts include an increase in agricultural encroachment and artisanal mining, which the management authority has been unable to control. Outside threats continue to impact on the property's values

State and trend of values

Assessing the current state and trend of values

World Heritage values

▶ Ongoing ecological processes necessary for the survival of Madagascar's unique biodiversity

Low Concern
Trend:Deteriorating

The large altitudinal range of the property maximizes its robustness and adaptive potential to climate change, though there may be major change within the property. Montane habitats risk being lost

► Rich endemic flora

Low Concern
Trend:Deteriorating

Valuable species such as Dalbergia spp. have become locally rare, but are not likely to be extirpated entirely by exploitation due to diminishing returns (WHC 2010). Species with narrow ecological niches may be lost to agricultural encroachment or climate change induced habitat shifts, particularly in montane habitats and coastal rainforest.

► Rare and threatened mammals

High Concern
Trend:Deteriorating

Commercial and subsistence hunting of lemurs has caused population decreases within the property (Debonnet and MAuvais 2011), and local extinctions elsewhere in the country. Local extinctions of large-bodied, diurnal species may occur within the property if hunting increases further.

► Rare and endemic birds

Low Concern
Trend:Deteriorating

Except for a few hunted species, viability is tightly linked to the maintenance of habitat. Coastal rainforest and montane habitats harbour few species entirely restricted to these habitats.

► Diversity of habitats

Low Concern
Trend:Deteriorating

Coastal rainforests and montane habitats, occupying the extremes of altitude, are the most threatened by climate change, while lowland rainforests are particularly vulnerable to agricultural encroachment. The full spectrum of habitats is likely to be maintained in the long term.

Other important biodiversity values

► Endemic reptiles and amphibians

At least 160 species of amphibian have been recorded within the property (IUCN 2007), with a national endemism rate of 99% (Goodman and Benstead 2005). This richness is vastly underestimated, as only approximately half of Madagascar's known frog diversity has been described; within the property, for example, 31 undescribed species are known from Ranomafana (Vieites et al. 2009). Reptile species richness stands at 164 (MNP 2012), with a national endemism rate of 92% (Goodman and Benstead 2005).

Summary of the Values

► Assessment of the current state and trend of World Heritage values

Low Concern

Trend: Deteriorating

No current or potential threats are likely to jeopardize any of the property's values entirely, but the values depend on the integrity of the property and extent of habitats. Several pressures, particularly logging, hunting and agricultural encroachment, are continuously diminishing the extent and quality of natural ecosystems within the property, thus progressively diminishing its values. All values are likely to be maintained in the long term, however.

► Assessment of the current state and trend of other important biodiversity values

Low Concern

Trend: Deteriorating

VX: Some species may be particularly vulnerable to climate change, but otherwise will be maintained as long as habitat is conserved

Additional information

Key conservation issues

▶ Logging of precious woods

National

Recommendations have been made (Debonnet and Mauvais 2011) but not fully implemented. Requires international efforts given lack of political will.

▶ Meeting needs of adjacent populations

Local

The drivers of agricultural encroachment must be identified and mitigated at the appropriate scale to stabilize the boundaries of the property. Alternatives to slash-and-burn agriculture will need to be developed and popularized. Madagascar National Parks may not be the appropriate institution to carry out this work.

▶ Management effectiveness (surveillance and enforcement)

Local

Currently insufficient to prevent logging, artisanal mining and agricultural encroachment. Madagascar National Parks does not have enforcement powers and relies on the police and armed forces. The judiciary fails to enforce the law.

▶ Finance and resources

Regional

Currently insufficient to control threats

Benefits

Understanding Benefits

▶ Water provision (importance for water quantity and quality)

All six components contain headwaters of economically important watersheds, including over 75, 000 ha of irrigated riziculture. The value of irrigation and potable water provision to urban areas was calculated as US$ 3/ha/year in 2003 (Carret and Loyer 2003).

▶ Carbon sequestration

Carbon stored above and below-ground within rainforest and other habitats.

▶ Outdoor recreation and tourism

Around 49, 000 tourists visit protected areas in Madagascar, generating expenditures of 26-29 million US$/year (Wollenberg et al 2011).

▶ Importance for research

The property provides the opportunity for much biodiversity-related research. Ranamafana hosts a world-class research centre established by Stony Brook University (Centre ValBio).

▶ Is the protected area valued for its nature conservation?

The property ensures the conservation of thousands of species that exist nowhere else on earth. Many of the species represent endemic genera and families and thus unique lineages, increasing their contribution to global genetic diversity. The altitudinal range of the property maximizes the potential of habitats and species to adapt to climate change.

Summary of benefits

The property contains large, functional ecosystems that provide a range of ecosystem services benefiting a variety of actors at local, national and global scales. Hydrological regulation services benefit downstream rice cultivators and urban water users, while the carbon stored within the property is globally important in mitigating climate change, if maintained. The property is vital for biodiversity conservation in the face of climate change, and provides valuable

recreational and research services. Ecosystem goods that could be sustainably used by local communities are undercapitalized due to the strict protection afforded the property.

Projects

Compilation of active conservation projects

№	Organization/ individuals	Project duration	Brief description of Active Projects
1	Madagascar National Parks		Designated managers of all components of property.
2	Wildlife Conservation Society (WCS)		Works with MNP and local communities at Masoala National Park.
3	Duke Lemur Center SAVA Conservation		Research of silky sifaka (Propithecus candidus) and illegal logging at Marojejy National Park.
4	Centre ValBio		Primate and ecology research centre at Ranomafana National Park, managed by Stony Brook University

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