

IUCN Conservation Outlook Assessment 2017 **(archived)**

Finalised on 08 November 2017

Please note: this is an archived Conservation Outlook Assessment for Tsingy de Bemaraha Strict Nature Reserve. To access the most up-to-date Conservation Outlook Assessment for this site, please visit <https://www.worldheritageoutlook.iucn.org>.

Tsingy de Bemaraha Strict Nature Reserve

SITE INFORMATION

Country:

Madagascar

Inscribed in: 1990

Criteria:

(vii) (x)

Site description:

Tsingy de Bemaraha Strict Nature Reserve comprises karstic landscapes and limestone uplands cut into impressive 'tsingy' peaks and a 'forest' of limestone needles, the spectacular canyon of the Manambolo river, rolling hills and high peaks. The undisturbed forests, lakes and mangrove swamps are the habitat for rare and endangered lemurs and birds. © UNESCO

SUMMARY

2017 Conservation Outlook

Good with some concerns

Overall, the strategic approach to conserving biodiversity and enhancing the value of natural resources in the Tsingy de Bemaraha complex (National Park and Integral Natural Reserve) is adequate and appropriate. The sources of pressures and threats are in decline and the peripheral areas of the protected area are better valued by the local communities with the technical and financial support of Madagascar National Parks. The property is composed of two appropriately managed, legally recognised protected areas and, by virtue of its impenetrable karst landscapes, is largely immune to anthropogenic pressures over much of its area. Threats include logging, subsistence hunting, agricultural encroachment and fire, but these are restricted to the forest edge, and no commercial extraction is known apart from the reptile trade. The property is appreciated by local communities, regional authorities, conservationists and tourists, and the recent description of numerous new mammal, bird, reptile and amphibian species serves to underscore its World Heritage status.

Current state and trend of VALUES

Low Concern

Trend: Stable

The values of the property are well maintained due to the low levels of threat. The unique geomorphological features are not threatened, while loss of forests and subsistence hunting have only minimal impacts on biodiversity values of the property, due to their localised nature.

Overall THREATS

High Threat

The Tsingy is afforded strong natural protection by its impenetrable nature and isolation, and the level of threat is low. Although local and migrant communities

encroach on the property and exert pressures including village and agricultural encroachment, selective logging, livestock grazing in forests, subsistence hunting, the collection of non-timber forest products and, in particular, the renewal of pasture fires, all these threats are highly localised and present little threat to the integrity of the property. With the exception of two reptile species, no natural resources from the property are known to be traded beyond the local scale. Recent data are lacking for all threats, which require careful monitoring. Natural gas extraction and climate change represent potential future threats. The drainage of lakes and marshes for rice cultivation in peripheral and contiguous areas of the Tsingy de Bemaraha Protected Area influences water flow, and the need for arable land may increase pressure for water.

Overall PROTECTION and MANAGEMENT

Mostly Effective

The majority of the property is naturally protected against threat by its impenetrable nature. It is legally protected and enjoys the support of local communities and regional authorities. An appropriate management system exists, although its effectiveness is unknown and the management plan is out of date.

FULL ASSESSMENT

Description of values

Values

World Heritage values

► Rich endemic flora

Criterion:(x)

The vegetation of the Bemaraha Plateau is dominated by western dry forest (Moat & Smith, 2007), one of the most threatened biomes in Madagascar (Ganzhorn et al., 2001). The flora of the dry forest is typically tropophilous, characterised by the genera *Dalbergia*, *Commiphora* and *Hildegardia*; xerophytic scrub made up of succulents grows on exposed rocks, and the more mesic conditions in canyons support a dense subhumid forest (ANGAP, 2003; Rasoloarison & Paquier, 2003). At least 583 plant species representing 102 families have been recorded (Rabarison, 2000; Schatz, 2001). Although endemism data are not available for the property, nationally 84% of vascular plants are endemic (Callmander et al., 2011). Threatened species include *Khaya madagascariensis* (EN), *Phylloxylon perrieri* (EN), *Dalbergia humbertii* (EN), *D. baronii* (VU) and *Delonix regia* (LC) (ANGAP, 2003).

► Rare and endemic birds

Criterion:(x)

The avifauna of the property is rich, with at least 94 recorded species (Rasoloarison & Paquier, 2003; Raherilalao & Wilmé, 2008). These include members of the endemic family Bernieridae, the near endemic families Vangidae and Leptosomatidae, and the endemic subfamilies Couinae and Philepittinae. Threatened species include Madagascar fish-eagle (*Haliaeetus vociferoides*, CR), Madagascar pond-heron (*Ardeola idae*, EN), Madagascar

heron (*Ardea humbloti*, EN), Madagascar teal (*Anas bernieri*, EN), Madagascar marsh-harrier (*Circus macroscelus*, EN) and Madagascar grebe (*Tachybaptus pelzelinii*, VU) (ANGAP, 2003; UNEP-WCMC, 2011); all but the latter, however, are wetland species and at best occasional visitors to the Manambolo River in the south of the property. Madagascar's newest bird species, the Tsingy wood-rail (*Mentocrex beankaensis*, NT), was described in 2011 and is restricted to the Bemaraha and Beanka massifs (Goodman et al., 2011).

► **Rare and endemic reptiles and amphibians**

Criterion:(x)

The Bemaraha Plateau displays extraordinary rates of local endemism amongst its reptiles and amphibians, and represents an important centre of endemism for these groups (Glaw et al., 2009). Of the minimum 63 reptile species recorded (ANGAP, 2003; Raselimanana, 2008; Bora et al., 2010), 58 are endemic to Madagascar and 17 (27%) appear to be endemic to the massif (e.g. Schimmenti & Jesu, 1996; Puente et al., 2005; Glaw et al., 2007; Köhler et al., 2007; Glaw et al., 2009). The 19 species of amphibian recorded represent the highest species richness of any site in the dry regions of Madagascar (Bora et al., 2010), and six of these species (some not yet described) appear to be endemic to the Bemaraha Plateau (Crottini et al., 2011). Several further candidate species of reptiles and amphibians await description (Bora et al., 2010; Gardner et al., 2011) and are probably also locally endemic. Threatened species include Madagascar big-headed turtle (*Erymnochelys madagascariensis*, CR), gecko sp. (*Paroedura tanjaka*, EN), leaf-tailed gecko spp. (*Uroplatus guentheri*, EN; *Uroplatus eburni*, VU), chameleon sp. (*Brookesia exarmata*, EN), Antsingy leaf chameleon (*B. perarmata*, EN), chameleon sp. (*Furcifer nicosiai*, EN), snake spp. (*Phisalixella variabilis*, EN; *Lycodryas citrinus*, VU), splendid skink (*Amphiglossus splendidus*, VU) and Madagascar coastal skink (*Madascincus intermedius*, LC).

► **Rare and endemic mammals**

Criterion:(x)

At least 42 species of mammal have been recorded within the property, of which 35 are endemic to Madagascar. Eleven species of lemur occur, representing five endemic families (Mittermeier et al., 2010; UNEP-WCMC, 2011); these include Van der Decken's sifaka (*Propithecus deckenii*, EN) and

the locally endemic Bemaraha woolly lemur (*Avahi cleesei*, EN). The eleven species of small mammal that occur (Soarimalala, 2008; Soarimalala & Goodman, 2011) include *Microgale grandidieri* (described in 2009, LC), Tsingy tuft-tailed rat (*Eliurus antsingy*, described in 2001, DD) and lowland red forest rat (*Nesomys lambertoni*, EN); all three are locally endemic to a small area of northwestern Madagascar, although not the property. Two species of carnivore in the endemic family Eupleridae have been recorded (Rasoloarison & Paquier, 2003), as well as 18 species of bat (Goodman et al., 2005; Kofoky et al., 2007; Goodman, 2011).

► **Unique and spectacular geomorphological features**

Criterion:(vii)

The 250 km long Bemaraha Plateau, composed of mid-Jurassic (approximately 200 mya) limestone of marine origin (Du Puy and Moat 1996), is heavily eroded into a karst landscape characterized by networks of deep crevasses, underground rivers and caves, separated by spectacular pinnacles of limestone, up to 100 m high, forming a “forest of sharp stones” (World Heritage Committee, 2012). It forms a unique, spectacular landscape of outstanding beauty (World Heritage Committee, 2012).

Assessment information

Threats

Current Threats

High Threat

The Tsingy is afforded strong natural protection by its impenetrable nature and isolation, and the level of threat is low. Although local and migrant communities encroach on the property and exert pressures including village and agricultural encroachment, selective logging, livestock grazing in forests, subsistence hunting, collection of non-timber forest products and, in particular, the renewal of pasture fires, all these threats are highly localised and present little threat to the integrity of the property. Recent data are, however, lacking.

With the exception of two reptile species, no natural resources from the property are known to be traded beyond the local scale. Forest clearing in low-lying areas for agriculture is, however, a significant ecological challenge affecting both the loss of the individuals of the different species concerned and the associated ecosystem services.

► **Invasive Non-Native/ Alien Species**

Data Deficient

Outside site

The introduced tree *Ziziphus* sp. (mokonazy locally) forms thick, monocultural stands in the Melaky region but does not appear to invade intact forest.

► **Other**

Data Deficient

Inside site

The gecko *Uroplatus henkeli* and, in particular, the highly sought-after dwarf chameleon *Brookesia perarmata* were both formerly collected illegally from within the property (Ramilison & Rabibisoa, 1998), but trade in the latter declined following its listing in Appendix I of CITES in 2002 (Carpenter & Robson, 2005). Collection apparently continues but at unknown rates (Rasoloarison & Paquier, 2003).

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

Low Threat

Inside site

Outside site

Rasoloarison and Paquier (2003) suggest that local communities are “real allies” in the conservation of the Tsingy because of the area’s important cultural heritage value, but that the arrival of migrants who don’t share these values has started to “modify this balance”.

► **Other Biological Resource Use**

Low Threat

There is “considerable collection pressure” for honey and tubers from adjacent communities (Fanarena, 1999), but this pressure is probably

localised and restricted by the impenetrable nature of much of the property.

► **Poaching**

Low Threat

Inside site

Outside site

Lemurs such as *Eulemur rufus*, *Cheirogaleus medius* and *Lepilemur randrianasoloi* are hunted and trapped in the property by adjacent communities (Ausilio, 1993), but impact is limited to areas near villages (IUCN, 1990). Lemur trapping necessitates the clearing of small areas of forest, totalling 1.2 ha in 2001 (ANGAP, 2003). The turtle *Erymnochelys madagascariensis* (CR) is collected for food from the Manambolo River (ANGAP, 2003). Recently the level of threat has been low.

► **Livestock Farming / Grazing**

High Threat

Inside site, localised(<5%)

Outside site

Fires are set annually to renew pastures for cattle, but only on the fringes of the World Heritage area (IUCN, 1990; IUCN Consultation, 2012). Cattle also graze in much of the accessible forest and may reduce regeneration locally (IUCN, 1990). Forest clearing located in areas of low wetland for agriculture is a significant ecological challenge affecting both the loss of the individuals of the different species concerned and the related ecosystem services.

► **Tourism/ visitors/ recreation**

Very Low Threat

Inside site

Outside site

There are few bats in caves visited by tourists, though it is not clear whether this relationship is causal (Kofoky et al., 2007). Some infrastructure (e.g. bridges) can detract from the wilderness aesthetic of the site (pers. obs.). However, tourism is spatially concentrated due to the impenetrable nature of the Tsingy, and any impacts are therefore highly localised (IUCN Consultation, 2012). Further, the number of visitors is limited by the distance and poor accessibility of the property from the nearest city/commercial

airport.

► **Roads/ Railroads**

Low Threat

Inside site

American oil prospectors blasted a seismographic trail through the Tsingy in 1984, facilitating access into previously inaccessible areas (IUCN, 1990, Rasoloarison & Paquier, 2003), and thus contributing to other threats.

► **Fire/ Fire Suppression**

High Threat

Inside site, extent of threat not known

Outside site

Fires are set within the property in June-October, before the rainy season, to stimulate the growth of new grass, and to clear trails for people. The Tsingy is naturally resistant to fires, however (Rasoloarison & Paquier, 2003).

Pasture fires may be impossible to eradicate given the cultural importance of cattle, but do little damage to Outstanding Universal Value areas and occur only on the periphery of the property (IUCN Consultation, 2012).

► **Housing/ Urban Areas**

Data Deficient

Inside site

Outside site

Several villages have been established in the eastern portion of the Integral Nature Reserve with extensive areas of rice paddies (IUCN, 1990; Rasoloarison & Paquier, 2003). Threat is highly localised and no recent data exist.

► **Crops**

High Threat

Inside site, extent of threat not known

Outside site

Although rice paddies are mentioned by Rasoloarison and Paquier (2003), agricultural encroachment is not listed as a threat in the site management plan (ANGAP, 2003). The drainage of lakes and marshes for rice cultivation in

peripheral and contiguous areas of the Tsingy de Bemaraha Protected Area influences water flow, and the need for arable land may increase pressure for water.

Potential Threats

Data Deficient

Although natural gas exists under the property, the combined National Park and World Heritage statuses will probably prevent its extraction. The impacts of climate change remain unknown.

► Habitat Shifting/ Alteration

Data Deficient

The impacts of climate change on the distribution of habitats and species require study, but the Bemaraha Plateau has served as a climatic refugium in the past (Goodman et al., 2008).

► Droughts

Data Deficient

The impacts of climate change on the distribution and intensity of precipitation require study.

► Temperature extremes

Data Deficient

The impacts of climate change on temperature require study.

► Oil/ Gas exploration/development

Data Deficient

There are natural gas deposits under the property, but the concession holder Madagascar Oil is staying away from the site, respecting the 2.5 km protective zone (IUCN Consultation, 2012). Large tar sand finds elsewhere in the Melaky region may transform the regional economy and demographics with unknown impacts on the property.

► Other Activities

Low Threat

Inside site, localised(<5%)

Outside site

The increasing need for timber for construction by local communities has fuelled logging pressure.

Protection and management

Assessing Protection and Management

► Relationships with local people

Mostly Effective

The local population is generally supportive of the site owing to the revenues generated through tourism and shared with communities as well as other related economic opportunities. Tourism was also a major reason why the main road into the region was upgraded, allowing local people to take advantage of it. Local people are involved in management of the site, including surveillance, and there is a general sense of pride in it being a World Heritage site (IUCN Consultation, 2012).

► Legal framework

Mostly Effective

The property is composed of two protected areas, a Strict Nature Reserve (IUCN category Ia) in the north, and a National Park (IUCN category II) in the south (UNEP-WCMC, 2011); both are governed by national protected areas legislation (Code des Aires Protégées, Government of Madagascar, 2001) which forbids extractive resource use within both categories, but Madagascar National Parks does not have authoritative power to apply the law and relies on state security services.

► Enforcement

Mostly Effective

Enforcement is effective but the involvement of local communities and benefit sharing from the protected area management can be further improved (e.g. in ecotourism).

► **Integration into regional and national planning systems**

Mostly Effective

The Melaky region is committed to the protected area (IUCN Consultation, 2012), but it is not clear whether the property is integrated into the regional development plan. The property is managed as part of a network under a national plan (PlanGRAP) but this has not been updated since 2001. Protected area management and expansion (although not the property specifically) was integrated into the Madagascar Action Plan (MAP, Government of Madagascar, 2007), but the MAP has not been retained as a guiding development framework since the political crisis in 2009.

► **Management system**

Mostly Effective

An appropriate and adequate management plan exists, incorporating analyses of conservation targets and threats, as well as conservation strategies and a monitoring plan (ANGAP, 2003). The management plan was updated in 2012 (Madagascar National Parks, 2013).

► **Management effectiveness**

Some Concern

Management is not sufficiently effective at preventing entry and illicit resource use by adjacent communities (Rasoloarison & Paquier, 2003), but impacts are small and localised. Collaborative management of the property between the park manager and local communities in a participatory manner would enhance the success of protection, particularly through involvement in ecotourism and ecological monitoring.

► **Implementation of Committee decisions and recommendations**

Data Deficient

The property has not been examined by the Committee since 1992.

► **Boundaries**

Some Concern

Although the World Heritage Committee (2011) notes clarifications of the property boundaries, there appears to remain much confusion about the area and status of the property. The property is known as Tsingy de Bemaraha Strict Nature Reserve (SNR) and is said to have an area of 152,000 ha (IUCN, 1990; UNEP-WCMC, 2011). The southern half of the property, however, has the status of National Park (NP), while the northern half remained an SNR. The area of the two components is given as 72,340 ha for the NP and 85,370 ha for the SNR (ANGAP, 2003; UNEP-WCMC, 2011; MNP, 2012) for a contradictory total of 157,710 ha). While the website of Madagascar National Parks (accessed on 17 July 2014) continues to refer to the northern half of the property as a Strict Nature Reserve, the status of the northern half was changed to that of National Park by Decree no. 498-2011 of 6 September 2011 (IUCN Consultation, 2017) – the name of the property should reflect this change. The boundaries of the NP are clear and marked, although those of the SNR were not clear in 2003 (ANGAP, 2003).

There is a need to improve the peripheral management strategy for conservation areas and natural resource development, taking into account the concerns, capacity and skills of local communities.

► **Sustainable finance**

Some Concern

As for other protected areas in Madagascar, sustainable funding is a potential problem, but the property makes money through tourism and is considered an exceptional conservation priority, so is likely to be maintained even in periods of constraint for Madagascar National Parks (IUCN Consultation, 2012). The Fondation pour les Aires Protégées et la Biodiversité de Madagascar has been created to ensure sustainable financing of the protected area system, but is not yet fully capitalised.

► **Staff training and development**

Mostly Effective

Management capacity was rated as high in 2003 (ANGAP, 2003); the staff are committed and some have a good science background (IUCN Consultation, 2012). A staff training programme has been developed every year by the human resources department of Madagascar National Parks (pers. comm.). Recently a new team of protected area staff has been created to enhance biodiversity conservation and sustainable management of natural resources.

► **Sustainable use**

Mostly Effective

National legislation governing the protected area (Code des Aires Protégées, Government of Madagascar, 2001) forbids all extractive use of natural resources, but a local-use exemption could be granted under existing legislation. All current resource use is illicit, and any potential for sustainable use by local communities is currently unrealised.

► **Education and interpretation programs**

Highly Effective

The 2003 management plan (ANGAP, 2003) includes strategies for the education of adjacent communities, and park 'rangers' have an education role. Following awareness-raising programmes and environmental education for several years, local residents are aware of the importance of the property at a national and international level in terms of its diverse fauna, flora and karst landscape including its ecosystem services.

► **Tourism and visitation management**

Highly Effective

Tourism is well managed and its impacts are highly localised (IUCN Consultation, 2012). Infrastructure (trails, viewpoints, bridges, etc.) is good along well-established circuits, and professional guides are available. Visitor numbers are constrained by the isolation of the property.

► **Monitoring**

Some Concern

The management plan for the property (ANGAP, 2003) contains an ecological

monitoring plan, but it is not clear whether the plan was implemented and whether monitoring outputs have been used for adaptive management. Monitoring efforts for the property provide good indicators of faunal and floral species in terms of its biological health and ecological quality.

► **Research**

Mostly Effective

The property has been the site of much recent research which has led to the description of several new species (e.g. Glaw et al., 2007, 2009; Köhler et al., 2007; Bora et al., 2010; Goodman et al., 2011). In recent years research activities have focused on speleology, an inventory of karstic systems, flora and fauna, socio-economic contexts, geographical information systems, anthropology, the ways of life of local communities, and the zoning system. These various research activities have been carried out in the national park and in the Tsingy de Bemaraha Strict Nature Reserve, and have been valued and used in the conservation of biodiversity and the sustainable management of natural resources. The budget or funding for research activities is very limited, and no research infrastructure exists on site.

Overall assessment of protection and management

Mostly Effective

The majority of the property is naturally protected against threat by its impenetrable nature. It is legally protected and enjoys the support of local communities and regional authorities. An appropriate management system exists, although its effectiveness is unknown and the management plan is out of date.

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

Mostly Effective

Management by Madagascar National Parks is focused within the property, with little or no consideration for the wider landscape or region (ANGAP, 2003). There are, however, no regional or local markets in natural resources from the property, and, excepting the issues of human migration, pasture fires and the reptile trade, management beyond the scale of the property is

largely unnecessary.

State and trend of values

Assessing the current state and trend of values

World Heritage values

► Rich endemic flora

Low Concern

Trend:Deteriorating

Although fires burn forest edges each year, most of the vegetation cover is naturally protected by the Tsingy and impacts are minimal (Rasoloarison & Paquier, 2003; IUCN Consultation, 2012).

► Rare and endemic birds

Low Concern

Trend:Stable

No rare or endemic birds appear particularly threatened within the property, although localised subsistence hunting may affect some species.

► Rare and endemic reptiles and amphibians

Low Concern

Trend:Stable

The impact of commercial collection of *Brookesia perarmata* and *Uroplatus henkeli* remains unknown, but is likely highly localised (Rasoloarison & Paquier, 2003). Numerous new and locally-endemic species have been recently described (Bora et al., 2010).

► Rare and endemic mammals

Low Concern

Trend:Stable

Although subsistence harvesting may impact some species, particularly lemurs, its impacts are highly localised (Ausilio, 1993; ANGAP, 2003; IUCN

Consultation, 2012).

► **Unique and spectacular geomorphological features**

Good

Trend:Stable

There are no pressures known to negatively impact the Tsingy karst itself, apart from the impacts of tourism which are highly localised and well-managed (IUCN Consultation, 2012).

Summary of the Values

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

Low Concern

Trend: Stable

The values of the property are well maintained due to the low levels of threat. The unique geomorphological features are not threatened, while loss of forests and subsistence hunting have only minimal impacts on biodiversity values of the property, due to their localised nature.

Additional information

Benefits

Understanding Benefits

► **Collection of medicinal resources for local use, Outdoor recreation and tourism, Natural beauty and scenery**

The property is an important tourist destination. Visitor numbers increased by 33% annually between 1992 and 1999 (Rasoloarison & Pacquier, 2003), but no up-to-date data are available.

►

Importance for research, Contribution to education, Collection of genetic material

The advanced knowledge of Tsingy de Bemaraha has made it possible to value the various biological, ecological, biogeographical, paleontological, anthropological and socio-cultural options for the development of the protected area complex of Tsingy de Bemaraha.

► Collection of timber, e.g. fuelwood

In principle, the status of the Tsingy de Bemaraha protected area does not allow extraction or exploitation of biological or mineral resources. However, illegal exploitation of fauna and flora (CITES and IUCN) have been observed in the different ecological zones of Tsingy de Bemaraha. The property provides a range of resources including wood, honey, edible and medicinal plants, bushmeat and so on. These could be sustainably harvested to provide benefit to adjacent communities, if the legal framework were to be relaxed and an appropriate management mechanism developed.

► Cultural identity and sense of belonging, History and tradition, Sacred or symbolic plants or animals, Sacred natural sites or landscapes, Wilderness and iconic features

The Tsingy of Bemaraha are believed to be the tomb sites of the aborigines' ancestors, the 'vazimba' and the final resting place of the souls of the ancestors.

► Importance for research, Contribution to education

Much biological research has been carried out on the property which contributes to the sum of global knowledge.

► Carbon sequestration, Soil stabilisation, Pollination

The estimated 85,000 ha of forests contain unquantified stocks of carbon that would be released if the forests were burned or converted.

► Water provision (importance for water quantity and quality)

The Bemaraha Plateau receives considerable precipitation in the rainy

season and regulates the hydrology of the region to its west; this includes the Manambolomaty and Bemamba lake complexes, both of high biodiversity importance, as well as an unquantified extent of rice paddies and feed lakes stocked with fish (Rasoloarison & Pacquier, 2003).

► **Collection of wild plants and mushrooms, Livestock grazing areas**

Presence of honey and wild yams.

► **Access to drinking water**

Various rivers are fed by runoff from the Tsingy de Bemaraha limestone plateau. These rivers provide water for agriculture and rice cultivation on the plains downstream, west and east of Tsingy de Bemaraha.

Water use by local communities has very limited impact on the property.

► **Tourism-related income, Provision of jobs**

The existence of faunal and floral resources in the Tsingy of Bemaraha benefits the local communities and their well-being.

Summary of benefits

The property provides hydrological regulation services to the region to its west, including economically and biologically important wetland areas, and contains 85,000 ha of carbon-storing forest. Its ecosystems are of global importance for biodiversity conservation as well as providing the opportunity for knowledge generation and recreation, but its potential for the sustainable provision of forest products has not been realised.

Projects

Compilation of active conservation projects

Nº	Organization/ individuals	Project duration	Brief description of Active Projects
1	Madagascar National Parks	From: 2009	National NGOs working in protected area networks.

Nº	Organization/ individuals	Project duration	Brief description of Active Projects
2	Madagasikara Voakajy		Research organization that received a Darwin award to carry out research into small vertebrates in Bemahara from 2005 to 2008.
3	The Peregrine Fund		Manage the Manambolomaty new protected area, a wetland site to the west of Tsingy de Bemaraha.
4	WWF		Manages a mangrove conservation project to the west of Tsingy de Bemaraha.
5	Durrell Wildlife Conservation Trust		Manages bird conservation projects to the west of Tsingy de Bemaraha.
6	Biodiversity Conservation Madagascar		Manages the Beanka new protected area to the north of Tsingy de Bemaraha.

REFERENCES

Nº References

- 1
ANGAP. (2003). Plan de gestion de la conservation du complexe d'aires protégées Tsingy de Bemaraha. [online] Antananarivo: ANGAP. Available at: http://madadoc.irenala.edu.mg/documents/v02314_TSI.pdf (Accessed on 11 July 2019).

 - 2
Ausilio, E. (1993). Participation au diagnostic écologique par l'inventaire des populations des lémurien des forêts de Tsimembo, de l'Antsingy et de la région de Tsiandro. Unpublished report for Projet Bemaraha.

 - 3
Bora, P., Randrianantoandro, J.C., Randrianelona, R., Hantalalaina, E.F., Andriantsimanarilafy, R.R., Rakotondravony, D., Ramilijaona, O.R., Vences, M., Jenkins, R.K.B., Glaw, F. and Köhler, J. (2010). Amphibians and reptiles of the Tsingy de Bemaraha plateau, western Madagascar: checklist, biogeography and conservation. *Herpetological Conservation and Biology*, 5, pp.111-125.

 - 4
Callmander, M.W., Phillipson, P.B., Schatz, G.E., Andriambololonera, S., Rabarimanarivo, M., Rakotonirina, N., Raharimampionona, R., Chatelain, C., Gautier, L. and Lowry II, P.P. (2011). The endemic and non-endemic vascular flora of Madagascar updated. *Plant Ecology and Evolution*, 144(2), pp.121-125.

 - 5
Carpenter, A.I. and Robson, O. (2005). A review of the endemic chameleon genus *Brookesia* from Madagascar, and the rationale for its listing on CITES Appendix II. *Oryx*, 39, pp.375-380.

 - 6
Crottini, A., Glaw, F., Casiraghi, M., Jenkins, R.K.B., Mercurio, V., Randrianantoandro, J.C., Randrianirina, J.E. and Andreone, F. (2011). A new Gephyromantis (Phalacomantis) frog species from the pinnacle karst of Bemaraha, western Madagascar. *ZooKeys*, 81, pp.51-71.

 - 7
Du Puy, D. and Moat, J. (1996). A refined classification of the primary vegetation of Madagascar based on the underlying geology: using GIS to map its distribution and to assess its conservation status. In: *Biogéographie de Madagascar*, W, Lourenço (ed.), pp. 205-218. Paris: Editions ORSTOM.

 - 8
Fanarena. (1999). Utilisation des ressources naturelles dans le Parc Nationale des Tsingy de Bemaraha. Unpublished report for Parc Nationale des Tsingy de Bemaraha (cited in Rasoloarison & Paquier, 2003).

 - 9
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, pp.346-348.
-

Nº References

10

Gardner, C., Jasper, L. and Razafinarivo, N. (2011). A new, isolated population of *Oplurus* (Iguanidae) from Tsingy de Bemaraha National Park, western Madagascar. *Herpetology Notes*, 4, pp.253-254.

11

Glaw, F. Köhler, J., Bora, P., Rabibisoa, N.H.C., Ramilijaona, O. and Vences, M. (2007). Discovery of the genus *Plethodontohyla* (Anura: Microhylidae) in dry western Madagascar: description of a new species and biogeographic implications. *Zootaxa*, 1577, pp.61-68.

12

Glaw, F., Nagy, Z.T., Köhler, J., Franzen, M. and Vences, M. (2009). Phylogenetic relationships of a new species of pseudoxyrhophiine snake (Reeptilia: Lamprophiidae: *Thamnosophis*) suggest a biogeographical link between western and northern Madagascar. *Organisms, Diversity and Evolution*, 9, pp.13-22.

13

Goodman, S.M. (2011). *Les chauves-souris de Madagascar*. Antananarivo: Association Vahatra.

14

Goodman, S.M., Andriafidison, D., Andrianaivoarivelo, R., Cardiff, S.G., Ifticene, E., Jenkins, R.K.B., Kofoky, A., Mbohoahy, T., Rakotondravony, D., Ranivo, J., Ratrimomanarivo, F., Razafimanahaka, J. and Racey, P.A. (2005). The distribution and conservation of bats in the dry regions of Madagascar. *Animal Conservation*, 8, pp.153-165.

15

Goodman, S.M., Raherilalao, M.J. and Block, N.L. (2011). Patterns of morphological and genetic variation in the *Mentocrex kiolooides* complex (Aves: Gruiformes: Rallidae) from Madagascar, with the description of a new species. *Zootaxa*, 2776, pp.49-60.

16

Goodman, S.M., Raherilalao, M.J., Raselimanana, A.P., Ralison, J., Soarimalala, V. and Wilmé, L. (2008). Introduction. In: S.M. Goodman and L. Wilmé (eds.) *Malagasy Nature: Les forêts sèches de Madagascar*, pp. 2-32.

17

Government of Madagascar. (2001). *Loi 2001/05 portant code de gestion des aires protégées*.

18

Government of Madagascar. (2007). *Madagascar Action Plan – un plan audacieux pour le développement rapide*. Government document, Antananarivo, Madagascar.

19

IUCN Consultation. (2012). *IUCN World Heritage Confidential Consultation. Tsingy de Bemaraha, Madagascar*.

20

IUCN Consultation. (2017). *IUCN World Heritage Confidential Consultation. Tsingy de Bemaraha, Madagascar*.

21

IUCN. (1990). *World Heritage Nomination – IUCN Technical Evaluation, Tsingy de Bemaraha Strict Nature Reserve (Madagascar)*. [online] Gland, Switzerland: IUCN. Available at: <<https://whc.unesco.org/en/list/494/documents/>>; [Accessed 13 March 2019].

Nº **References**

22

Jasper, L. and Gardner, C. (2015). Life amongst the thorns: Biodiversity & Conservation of Madagascar's spiny forest. WWF Madagascar, John Beaufoy Publishing. 318p.

23

Kofoky, A., Andriafidison, D., Ratriomomanarivo, F., Razafimanahaka, H.J., Rakotondravony, D., Racey, P.A. and Jenkins, R.K.B. (2007). Habitat use, roost selection and conservation of bats in Tsingy de Bemaraha National Park, Madagascar. *Biodiversity and Conservation*, 16, pp.1039-1053.

24

Köhler, J., Glaw, F. and Vences, M. (2007). A new green treefrog, genus *Boophis* Tschudi, 1838 (Anura, Mantellidae) from arid western Madagascar: phylogenetic relationships and biogeographic implications. *Tropical Zoology*, 20, pp.215-227.

25

Madagascar National Parks (MNP). (2012). [Online] Available at: <http://www.parcsmadagascar.com/fiche-aire-protegee.php?Ap=...> (Accessed 3 December 2012).

26

Madagascar National Parks (MNP). (2013). Plan de Gestion et d'Aménagement du Parc National Tsingy de Bemaraha. 48 pages.

27

Mittermeier, R.A., Louis Jr, E.E., Richardson, M., Schwitzer, C., Langrand, O., Rylands, A.B., Hawkins, F., Rajaobelina, S., Ratsimbazafy, J., Rasoloarison, R., Roos, C., Kappeler, P.M. and Mackinnon, J. (2010). Lemurs of Madagascar, 3rd Edition. Conservation International.

28

Moat, J. and Smith, P. (2007). Atlas of the vegetation of Madagascar. Royal Botanic Gardens, Kew.

29

Petignat, A. and Jasper, L. (2012). Baobabs de Madagascar: les Arbres à l'Envers. Antananarivo: Carambole.

30

Puente, M., Raselimanana, A.P. and Vences, M. (2005). Rediscovery and redescription of the Malagasy dwarf gecko *Lygodactylus klemmeri*. *Zootaxa*, 1073, pp.31-35.

31

Rabarison, H. (2000). Typologie des formations végétales des Tsingy de Bemaraha (Analyses phytologiques, classiques et multidimensionnelles) et modes d'utilisations des ressources forestières par les communautés riveraines. Thèse de Doctorat de 3^è Cycle en Sciences Biologiques Appliquées. Département de Biologie et Écologie Végétale. Établissement d'Enseignement Supérieur des Sciences. 120 pages.

32

Raherilalao, M.J. and Wilmé, L. (2008). L'avifaune des forêts sèches malgaches. In: S.M. Goodman and L. Wilmé (eds.) *Malagasy Nature: Les forêts sèches de Madagascar*, pp. 76-105.

Nº **References**

33

Ramilison, O. and Rabibisoa, N. (1998). Inventaire de l'Herpétofaune et étude d'impact sur les collectes de deux espèces reptiliennes, *Brookesia perarmata* (Chamaeleonidae) et *Uroplatus henkeli* (Gekkonidae) dans le parc national No. 7 'Tsingy de Bemaraha'. Unpublished report (cited in Carpenter & Robson, 2005).

34

Raselimanana, A.P. (2008). Herpétofaune des forêts sèches malgaches. In: S.M. Goodman and L. Wilmé (eds.) *Malagasy Nature: Les forêts sèches de Madagascar*, pp. 46-75.

35

Rasoloarison, V. and Paquier, F. (2003). Tsingy de Bemaraha. In: S.M. Goodman and J.P. Benstead (eds.) *The Natural History of Madagascar*, pp. 1507-1512. Chicago: University of Chicago Press.

36

Schatz, G. 2001. *Generic Tree Flora of Madagascar*. St Louis, United States of America & London, United Kingdom: Missouri Botanical Gardens & Royal Botanic Gardens, Kew.

37

Schimmenti, G. and Jesu, R. (1996). *Brookesia exarmata* sp. nov. (Reptilia, Chamaeleonidae): a new dwarf chameleon from the limestone outcrops of western Madagascar. *Italian Journal of Zoology*, 63, pp.193-197.

38

Soarimalala, V. (2008). Les petits mammifères non-volants des forêts sèches malgaches. In: S.M. Goodman and L. Wilmé (eds.) *Malagasy Nature: Les forêts sèches de Madagascar*, pp. 106-134.

39

Soarimalala, V. and Goodman, S.M. (2011). *Les petits mammifères de Madagascar*. Antananarivo: Association Vahatra.

40

UNEP-WCMC. (2011). *Tsingy de Bemaraha Strict Nature Reserve, Madagascar*. UNEP-WCMC World Heritage Information Sheets. Cambridge, UK: UNEP-WCMC.

41

World Heritage Committee. (2011). Decision 35 COM 8D Tsingy de Bemaraha Strict Nature Reserve, Clarifications of property boundaries and areas by States Parties in response to the Retrospective Inventory. [Online] Available at: < <https://whc.unesco.org/en/decisions/4407>>; (Accessed: 11 July 2019).

42

World Heritage Committee. (2012). Decision 36 COM 8E Tsingy de Bemaraha, Adoption of retrospective Statements of Outstanding Universal Value. [Online] Available at: (Accessed: 11 July 2019).