



The Andringitra National Park in Madagascar

Hanta Rabetaliana is Project Coordinator of the World Wide Fund for Nature (WWF) Madagascar Programme.

Michel Randriambololona is with the Ecological Monitoring Unit of the WWF Andringitra project.

Peter Schachenmann is Principal Technical Adviser of the WWF Andringitra project.

The use of traditional knowledge and modern methods for the management of mountain natural resources.

[**A hamlet just inside the border of Andringitra National Park**](#)

The Andringitra mountains in southern Madagascar are a granite outcrop of the ancient Precambrian rock. Altitudes range from 500 to 2 600 us above sea level. The range is aligned north-south, lies approximately 100 km from the Indian Ocean and 120 km north of the Tropic of Capricorn, and marks the southern limit of Madagascar's eastern escarpment. Its highest elevation is Pie Boby, at 2 658 us, the second highest summit in Madagascar. Pie Boby is an isolated mountain (an inselberg) that stands out as prominently as an island above the barren plain.

The Andringitra mountain range acts as a topographic barrier and this dictates the main characteristics of the area. Within a few kilometres there are very pronounced climatic and biogeographic differences between the windward, humid, oceanic flank to the east and the leeward, dry, continental flank to the west. These differences are combined with marked altitudinal zonation ranging from tropical lowland to subalpine highland.

The changing landscape is reflected in cultural and socio-economic diversity. Each of the three main cultural groups has its own identity, value system, beliefs and distinctive survival strategy, and each is adapted to the local habitat.

The Bara Haronga in the tropical forests to the east of Andringitra have perfected traditional, sustainable swidden agriculture for rainfed rice cultivation. The beginnings of simple agroforestry systems that integrate perennial crops (coffee, sugar cane and fruit-trees) with cattle grazing are found around hamlets in the forest. The Betsileo agriculturists in the northern foothills of Andringitra have sculptured elaborate terraces on the mountain flanks for a sophisticated irrigation system for rice cultivation; this has created a beautiful landscape. The Bara tribes in the west and south use the natural resources of open savannah in an agropastoral farming system.

Over the last 200 years, the features of the mountain landscape, such as peaks, forests, prairies, lakes and waterfalls, together with processes that include thunderstorms, hailstorms and occasional snowfall, have shaped the cultural identity of each social group. In turn, the

human population, evolving within the natural environment, has left its mark on the landscape.

Explorers in the early twentieth century, such as Perrier de la Bathie and Humbert, recognized the massif as an important centre of landscape and habitat diversity and, in 1927, the central part of the mountain range (about 31 160 ha) was declared a Strict Nature Reserve. However, the area was little known to outsiders until the early 1990s when the Malagasy Environmental Action Plan was introduced and the Andringitra National Park was established.

THE MALAGASY ENVIRONMENTAL ACTION PLAN

The Malagasy Environmental Action Plan designated this diverse mountain region as the Andringitra National Park in July 1993. The main stakeholders are the local communities who depend directly and indirectly on the natural resources of the Andringitra mountains. However, the action plan introduced national and international scientists who work as partners to study the park's biological components and ecological processes. At the national level, the caretaker institutions are the Association National pour la Gestion des Aires Protegees (ANGAP) and the Directorate for Water and Forests. The World Wide Fund for Nature (WWF) is the technical catalyst and facilitator for an Integrated Conservation and Development Project (ICDP) and the German Bank, through Kreditanstalt für Wiederaufbau, is the external donor.

The primary aim of the action plan was to complete a geographical survey of the entire area. The key questions asked were: What resources and what unique physical, biological and cultural features does the Andringitra region possess? Where are they located and what are the actual and potential threats to their conservation and socio-economic development? What are the traditional survival strategies of the local people? Where, when and how should the members of the Environmental Action Plan intervene?

At this early stage, interdisciplinary teams from national and international resource organizations joined together with indigenous people to investigate the ecological processes and resource use patterns of the area. They used a scientific approach in conjunction with traditional knowledge. It was necessary to create trust and mutual respect among the many stakeholders, who included local people, scientists, political and institutional decision-makers, national and international conservation organizations and donors, managers and the general public.

[The highest area of Andringitra National Park, with sclerophyll forest formations visible in depressions](#)

Four years after it was established, the Environmental Action Plan was able to report the results of studies in the following three important areas:

- a list of main features with emphasis on the vegetation and animal species, especially those that are unique to Andringitra, and a proposal that the park be eligible for designation as a National Monument and is a potential World Heritage Site;
- multidisciplinary training of the local inhabitants by outside scientists to increase the capability in resource use;
- introduction of a legal base for community resource use rights and responsibilities within the park and extending outside its perimeters.

PHYSICAL CHARACTERISTICS AND DYNAMIC EVOLUTION

Samples taken from a vertical section of the Precambrian rock on Pie Bobby have been dated at 340 to 400 million years old at the highest elevation (2 658 m) and 200 million years at the

lowest sampling site, 1 715 us below. The differential resistance to weathering of the granites, their lithology and physical and chemical weathering have resulted in a great variety of geomorphological features and the natural rock has been sculpted into beautiful forms. The only glacial moraine in Madagascar lies at the base of the eastern escarpment at about 1 900 us, indicating a period of earlier glaciation, the age of which has not yet been determined. This is a spectacular landscape with outstanding macro- and microforms of natural rock that resemble modern art exhibits at an outdoor museum; the area has great potential for tourism.

The Andringitra National Park is a rare example of a mountain ecosystem where biodiversity, habitat and cultural identities have an interrelationship that is mutually beneficial to all. Although only about 30 percent of the national park is covered by forests, the forest structure is highly diverse, ranging from high humid tropical forest at low altitudes, through sclerophyll and bamboo forest, to heathland and bush in the upper areas. Edaphic and climatic conditions, combined with anthropogenic disturbance at higher altitudes, have resulted in a mosaic pattern of diverse vegetation types, especially in the zones of transition.

The interface of latitude and altitude produces a stress climate which, in the Andringitra mountains, has led to species convergence at higher altitudes. *Philippia* spp. (Ericaceae), *Helichrysum* spp. and *Stoebe* spp. (Asteraceae) and *Panicum cupressifolium* (Poaceae) are interspersed to form almost indistinguishable ericoid/cupressoid growth forms.

The inselberg (island) factor combined with altitudinal zonation have led to high local endemism. Among the monocotyledons, of the 40 percent that are native to Madagascar, 7.7 percent are endemic to the Andringitra mountains. Among the dicotyledons, the corresponding proportions are 24 and 3.4 percent; among the reptiles, 80 and 12 percent; and among the amphibians, 52 and 11.4 percent. There are also 15 recorded species of insectivore.

There are 15 recorded species of lemur, all endemic to Madagascar. Most significant of these is the ring-tailed lemur (*Lemur catta*) which has adapted from its typical habitat in the lowland forests of southern Madagascar to a high mountain environment with abrupt climate changes and dominant succulent rock vegetation. These lemurs have colonized rocky outcrops and vertical cliffs as their preferred habitat on the western flank of Andringitra up to the highest peaks and now occupy a unique ecological niche.

The altimontane prairies of the Andohariana plateau, at 2 000 us above sea level, are the only such prairies on the African continent and can be compared with the paramos and puna of the Andes in South America - a result of latitude, altitude, a marked seasonality between dry and wet conditions and high daily temperature fluctuations. Unlike similar sites elsewhere (where the dominant genera are *Festuca*, *Calamagrostis*, *Agrostis*, *Poa* and *Koeleria*) the Andohariana plateau is dominated by several species of the *Panicum* genus. This altimontane prairie is also a centre of orchid diversity: *Aloe andringitrensis* and *Disa andringitrana* are common and recognized as the flagship species.

Historically, the Andringitra region was discovered by livestock owners in search of favourable climates and good pastures for their cattle. Subsequently, settlers during the early twentieth century settled the valley bottoms between 1 000 and 1 400 us and began to convert natural vegetation into a cultural landscape. In much of the rest of Madagascar, this traditional process of migration, colonization and land-use change, aggravated by the effects of demographic, socio-economic and political constraints, has led to deforestation, exploitation of natural resources and loss of biodiversity.

In contrast, Andringitra, owing to its more remote location and steep topography, has been less affected by degradation and here there is still the opportunity to balance human needs with conservation goals. The mountains have high economic potential with abundant water resources and fertile alluvial soils, and there is a rich cultural history which is narrated in

today's local folklore. The northern peripheral zones of the park (home of the Betsileo tribe) present a beautiful cultural landscape, with many mystic and sacred sites, such as the well-known waterfalls of Riambavy and Riandahy, the mystic lakes and marshes of Amboromena and the sacred forests of Velontsoa, Tsaranoro and Ambohimana. At these sites, natural resources and biodiversity are protected by powerful taboos and spiritual beliefs. The relationship between sacred sites, cultural identity and biodiversity is clearly evident, and is underlined by the United Nations Educational, Scientific and Cultural Organization (UNESCO) Man and the Biosphere concept, where the human population is successfully integrated into the natural landscape [*Ed. note: See the article by Schaaf on p. 31 of this issue of Unasyilva.*]

The Andohariana plateau

The Andohariana plateau, an altimontane prairie within the Andringitra National Park, is probably the only "natural" laboratory in Madagascar where human activities have not downgraded the natural ecosystem but have actually favoured biodiversity. The plateau comprises approximately 3 000 ha of gently rolling plains to- the windward, oceanic side of the massif, at between 1 900 and 2 100 us above sea level, where the dynamic interplay between grassland, sclerophyll mountain forests and heathland results in sustainable land use. It is in the ecotone zone between two climate and vegetation types; to the east are humid forests and to the west lie dry savannah and succulent rock plants. A combination of specific edaphic and climatic factors, occasional natural or human-induced fires and cattle grazing near the tree line produce a sustainable ecosystem with a mosaic of different vegetation types and plant communities and significant biodiversity. The establishment of the Andringitra Strict Nature Reserve in 1927 served as a signal to local communities that there were other public stakeholders and helped to keep human disturbance at a moderate scale.

Madagascar does not have a natural herbivore fauna like that of the rest of tropical Africa and this niche is occupied by insects and introduced cattle. The ecological role of grazing herbivores is to maintain open vegetation and selective grazing, and this plays an important role in the species composition of a vegetation unit. The consumption of standing vegetation also reduces the risk of frequent fires and controls shading, thereby enhancing biodiversity. The key families are Poaceae (*Panicum cupressifolium*, *Pentaschistis andringitrensis*, *Panicum andringitrensis*, *Sporobolus* spp., *Imperata cylindrica*, *Craspedorachis* spp., *Rytachne* spp.), Ericaceae (*Agauria* spp., *Vaccinium* spp., *Philippia* spp.) and Asteraceae (*Helichrysum* spp., *Stoebe* spp., *Senecio* spp., *Anthanasia* spp.).

The patchy growth pattern of these species enhances the scenic value of this vegetation mosaic. For example, during the rainy season the largest known assemblage in Madagascar, of more than 30 species of ground orchids (*Cynosorchis* spp., *Disa* spp., *Eulophia* spp., *Habenaria* spp., *Satyrium* spp., *Benthamia* spp., *Lissochilus* spp., *Tilostigma* spp.), colonizes sites on the plateau that are clearly favoured by sunlight and the conditions of an open short-grass prairie resulting from the "sustainable disturbance" of fires and grazing.

Towards the eastern escarpment the mountain prairie slowly gives way to a succession of different types of mountain forest. Passing from west to east, low ericoid bush is replaced by a sclerophyll forest (*two Agauria* spp., *Philippia* spp., *Polyscias* spp. and *Ilex* spp.) interspersed with very large trees (*Agauria polyphylla*) and dense stands of large *Philippia* trees (up to 8 us high). East of the edge of the Andohariana plateau there are significant penetrations of sclerophyll mountain vegetation into the huge expanse of tropical humid forest on the flank of the Andringitra massif. This sclerophyll forest, sometimes composed of monospecific *Philippia* trees, occupies high crests and summits, while the humid forest colonizes slopes and valleys, again producing a fragmented pattern with different shades of green, distinctive scents and sounds from birds such as the Benson's rock thrush (*Pseudocossyphus bensoni*), the yellow-bellied sunbird-asy (*Neodrepanis hypoxantha*) and the grey emu-tail (*Dromaeocercus seebohmi*).

During a dry climatic cycle, when the influence of fire predominates, the Andohariana plateau develops towards the open prairie ecosystem; during a more humid cycle with fewer fires, it becomes more like the sclerophyll mountain forest. Cattle husbandry and the impact of fire may lead to sustainable disturbance or to irreversible degradation. Can the park's stakeholders manage such complexity?

TRAINING THE LOCAL PEOPLE IN MODERN SCIENTIFIC TECHNIQUES

The second aim of the Environmental Action Plan was to introduce modern scientific methods of research to representatives of the local people and to train them to monitor and manage resource use in the park and the surrounding area.

The Integrated Conservation and Development Project (ICDP), in collaboration with the WWP Ecological Training Programme (ETP), initiated participatory research and fostered a partnership between the indigenous population and scientists from the outside world. Local people were trained in a variety of the physical and social science disciplines in order to enable them to apply their skills in ecological and social monitoring programmes and environmental impact studies. The project administrators and scientists, working together with indigenous people, learned to appreciate the merits of traditional wisdom and the local knowledge of ecological processes and land-use patterns.

[Cyonsorchis gygas, a ground orchid common in the park](#)

One example of successful project training is the case of Sylvain Razafimandimby, an enthusiastic young local farmer from a small village near the Andringitra Park. Mr Razafimandimby started as a porter for the 1993 biological inventory on the eastern slopes of the mountains. A combination of opportunity, curiosity, sustained will, focused interest and on-the-job training transformed him into a recognized national expert on ants. In March 1998, he received the Order of the Golden Ark, an award bestowed by His Royal Highness Prince Bernhard of the Netherlands in recognition of exceptional achievements in nature conservation. Mr Razafimandimby is now receiving further scientific training at the South African Museum, Life Science Division in Cape Town.

[The transition zone between the altimontane prairie and mountain forest](#)

ESTABLISHING A LEGAL BASE FOR PROTECTION AND MANAGEMENT OF THE NATIONAL PARK

The third major goal of the Environmental Action Plan was to provide a legal base for community rights and responsibilities both inside and outside the park's boundaries.

Intensive national and international lobbying resulted in a major policy shift from centralized, top-down management of the park's natural resources towards a decentralized, bottom-up approach, focused on collaborative management. Institutional and legal frameworks are being developed to allow local people gradually to take over responsibility for natural resource management in the park.

At the national level the first significant achievement was the adoption by Parliament, in 1996, of a law favouring local management of renewable natural resources outside protected areas. The second achievement specifically concerned the Andringitra project. The government decree creating the national park stipulates that the management plan should guarantee: access to tombs and sacred sites; rights of use and passage on existing traditional trails within the park; existing customary rights for the collection of natural resource products for personal domestic consumption within the park; and, finally, that grazing of cattle on the altimontane prairies is tolerated within the limits of acceptable use - these limits to be jointly established

and controlled.

DISCUSSION AND OUTLOOK FOR THE FUTURE

Can adaptive traditional management strategies successfully evolve in collaboration with more rigid, institutional management approaches?

The Andringitra National Park Integrated Conservation and Development Project has laid the foundation for future sustainable natural resource use and participatory management in the national park and its peripheral zones. The approach has been collaborative, with the aim of developing mutual understanding and political negotiation between the local people and outside authorities. The project has demonstrated that traditional uses can be sustainable if local population pressures are low, traditional control mechanisms are applied and conflicts among the different interest groups are addressed. Now that the park is more accessible, the peripheral zone is opening up for economic development and ecotourism is being introduced. There will be new interest groups and additional potential conflicts of interest.

A park management zoning system has been developed, with specific areas designated for conservation, sustainable use, grazing, ecotourism and rehabilitation. Peripheral areas were marked for development and service facilities. The four categories of zoning were: i) banned use (no uncontrolled burning or grazing of pastures); ii) quota system with permits (for primary forest products and tourism); iii) notifiable use (for secondary forest products); and iv) unlimited access (e.g. to sacred sites).

An informal control mechanism is in operation today and the legal framework of the decree that established the national park has been put into place. The next step will be to continue to involve all stakeholders, in particular local communities, so that they develop the capacity to assume their future role as responsible and accountable co-managers of natural resources inside and outside the park. Resource management involves ecological, economic and social considerations in a dynamic interplay. To be sustainable, these three forces must evolve together in equilibrium. The Integrated Conservation and Development Project of the Malagasy Environmental Action Project will continue to play a role as mediator, facilitator, technical adviser and monitor.

