

given an example of an alternative protected area which has succeeded in meeting its biological goals and creating income opportunities for the local people, thus becoming culturally compatible and foreseeably fully viable. In areas where the economy is based on primary activities and sources of sustenance, local people cannot be excluded from resources within previously exploited areas. Instead, protected areas must be managed to benefit local people as well as wildlife and wildlands. This can be accomplished by the sustainable harvest of biological matter contained within the protected area, and by developing low-impact Nature tourism with the local populations (see Boo, 1990; Plotkin & Falmore, 1992). By giving agrarian-based people access to renewable resources, and by demonstrating that environmental organizations are willing to invest in their economic future, conservationists are giving them a stake in perpetuating a protected area's future biodiversity. The local people's future prosperity is therefore tied directly to the biological well-being of a protected area, as should be made clear to them educationally.

It is essential that international environmental organizations dedicate more time, money, and research, to ethnobiological surveys in order to understand relationships between protected areas and the surrounding human populations. By doing so, environmental researchers will be able to make improved management decisions which incorporate local people's needs, at the same time helping them to manage their resources in a sustainable fashion. Unless these investments are made on a broad scale in areas where humans compete with protected areas and need their produce, there can scarcely be any chance that an area labelled a 'park' will represent anything more than a park on paper. And a park existing only on paper will do little if anything to preserve biodiversity.

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MICHAEL STEINBERG  
4000 North Morris Boulevard, Nr 10  
Milwaukee  
Wisconsin 53211  
USA.

## The Impacts of Tourism on Nature Reserves in Madagascar: Périnet, A Case-study

### Introduction

Madagascar is the fourth largest island in the world (587,000 km<sup>2</sup>) and exhibits a varied climate, geology, and topography. Ecosystems are correspondingly diverse, and include moist evergreen forest, seasonally deciduous forest, and xerophytic scrub (see e.g. Chauvet, 1972; Guillaumet, 1984). Evolving in isolation and in the absence of competition from mainland forms, faunal and floral species underwent extensive adaptive radiations to fill a wide variety of available niches. Consequently, species endemism is greater than 90% in many taxa (e.g. Battistini & Richard-Vindard, 1972; Jolly et al., 1984). However, an expanding human population and extensive deforestation (Olson, 1984; Green & Sussman, 1990) mean that many of the island's unique ecosystems are under threat. Therefore, Madagascar is one of international conservation's highest priorities.

Heretofore, most conservation work has concentrated on the identification and protection of key habitats and species (e.g. Mittermeier et al., 1987, 1992; Nicoll & Langrand, 1989). However, over the last decade there has been a large influx of foreign visitors to Madagascar, many of whom come specifically to see the unique fauna and

flora. The development of such 'ecotourism' is largely unregulated and unmonitored, and has arisen at sites by chance rather than planning. Recent studies have advocated the development of tourism in certain Nature reserves (Hawkins et al., 1990; Rakotoarison et al., 1993). Although an increase in tourism has potential economic benefits for local communities, it can also have potentially negative environmental effects on protected areas (IUCN/UNEP, 1986). A recent study suggests that one of the reserves which is most popular with foreign tourists (Réserve Spéciale d'Analamazaotra) may already be experiencing a loss of biodiversity at the most commonly visited sites (Stephenson, in press). Therefore, a conflict of interests may be arising. There is urgent need to assess the environmental impact of continued expansion of the ecotourist industry.

This article represents the first attempt to identify potential problems and provide recommendations for the development of ecotourism in Madagascar.

### Nature Reserves in Madagascar

The first Nature reserves in Madagascar were established in 1927. The system has since been augmented and

three types of protected area have been established to conserve natural ecosystems or threatened species. There are currently 6 National Parks (Parcs Nationaux), 11 Strict Nature Reserves (Réserves Naturelles Intégrales), and 23 Special Reserves (Réserves Spéciales), altogether covering a total of 1,121,482 ha, or 1.9% of the national territory. The initiation of a twenty-years' National Environmental Action Plan should facilitate an expanded and better-managed protected areas system in the near future.

All Nature reserves in Madagascar come under the auspices of the Ministère des Eaux et Forêts (MEF), from whom permission must be sought by all reserve visitors. Strict Nature Reserves are accessible only to MEF staff and scientists undertaking approved research. All other reserves can be visited by tourists provided a permit is purchased from MEF for a nominal fee.

Each reserve is manned by MEF staff but the number of guards and foresters is variable and, given the large areas of many reserves, sites are often accessible without permit checks. Although visitors who are not accompanied by trained guides often cause more damage to natural ecosystems than those who are so accompanied (e.g. Sinha, 1992), there is no system of monitoring the numbers and activities of tourists within most Malagasy reserves.

#### *Périnet Reserve and Tourists*

The main Eaux et Forêts reserve that is visited in substantial numbers by foreign tourists is the Réserve Spéciale d'Analamazotra (often, and hereafter, referred to as Périnet or the Reserve). Recent ecological and socio-economic studies of the Reserve (Munasinghe, 1993; Stephenson, in press) mean that it can be used as a case-study to determine the potential effects of tourism on protected areas in Madagascar.

Périnet Reserve (18°28'S, 48°28'E) is situated near the village of Andasibe, 30 km east of Moramanga in Toamasina Province. The reserve lies on the eastern escarpment between 930 and 1,040 m altitude. Although it covers an area of only 810 ha, it currently caters for the majority of foreign tourists who want to experience rain-forest habitats and wildlife in Madagascar. The reserve was initially created to protect the largest Malagasy primate, the Indri (*Indri indri*), and the main attraction for tourists is the accessibility of this and other, easily seen and adequately habituated animals. Comfortable tourist accommodation is provided by the Station Hotel in Andasibe, which is easily accessible by road and rail from the capital city and the coast. A number of local people, several still of school age, originally offered unofficial guided tours from the hotel to see lemurs and other Reserve wildlife, further encouraging the expansion of tourism at the site. There were an estimated 3,900 foreign visitors to Périnet in 1990 (Munasinghe, 1993), and the numbers are expected to increase in the future (Stephenson, in press). However, there is evidence of a detrimental environmental and socio-economic impact of ecotourism on the Reserve and surrounding area:

i) *Habitat disturbance*:— Animal biodiversity in Périnet may be reduced at sites where tourists visit regularly to watch lemurs (Stephenson, in press). Many visitors walk off established pathways in order to improve their lemur sightings and photo. opportunities, and this creates additional trails by trampling vegetation. There is a subsequent increase in herbaceous plants which may produce

microhabitats unsuitable for endemic small mammal species but favourable to exotic, introduced species such as Black Rats (*Rattus rattus*) (Stephenson, in press). Habitat disturbance may also offer access to exotic floral species (Holland & Olson, 1989). Many Malagasy vertebrates are restricted to primary forests, so that habitat alteration will cause a reduction in species' ranges and possibly local extinction (Stephenson, in press). Although disturbance in Périnet is currently limited to the south-east corner of the Reserve, increased numbers of visitors may further disturb native habitats and cause local reductions in biodiversity.

ii) *Direct interference with wildlife*:— Although only a limited number of Indri at Périnet are accustomed to, and easily approached by, tourists, guides search the forest daily to find them, and it is unclear to what extent this disturbance affects the animals' behaviour. Several species of reptiles and small mammals are regularly caught to display to tourists, though the level of disturbance rendered to these animals and their habitat is also difficult to assess. Currently, only a small number of animals are affected, and the economic benefits of tourism may outweigh the limited disturbance caused. However, as with habitat disturbance, the effects of any future increase in tourist numbers warrant investigation. Future research needs to establish behavioural and reproductive benchmarks to identify when a species is being disturbed (Duffus & Dearden, 1990).

iii) *Socio-economic disruption*:— Visiting tourists provide a source of income but it is rare for most of the financial benefits to be captured by local communities (Wells & Brandon, 1993). At Périnet, most local revenue from tourism appears to go to only a small number of people, such as forest guides, station hotel employees, and a handful of stall-owners in Andasibe. The financial imbalance can be great. For example, whilst most local villagers live off the land through shifting cultivation (Munasinghe, 1993), Reserve guides can earn very considerable sums of money from visiting tourists. For a morning's tour of the reserve, some children are able to obtain fees representing more than the national mean monthly salary!

The paying of high fees is consistent with findings that many ecotourists are willing to pay considerably for the experience of visiting a given site of interest (e.g. Tobias & Mendelsohn, 1991; Munasinghe, 1993). However, this income has fuelled rivalry and alcohol abuse among certain individuals, and may be partly to blame for the death of the most outstanding guide in 1989. The system has since been regulated to a degree, with the selection of MEF-appointed guides. Although no-one would begrudge these guides a good wage, and relatively high guides' wages may be 'an essential ingredient of success' for ecotourism projects (Brockelman & Dearden, 1990), there is need to regulate fees to reasonable proportions. There is also need to ensure a more even distribution of tourist-generated income throughout the local community.

iv) *General environmental degradation*:— Wherever people visit natural habitats in substantial numbers, there will be an associated environmental impact and some degree of degradation. Although only habitat disturbance can be clearly identified at Périnet to date (see above), a number of other effects, such as path erosion and litter deposition, can be expected over time. In turn, these may compound existing problems of habitat and wildlife disturbance. Continued monitoring of the Reserve is essential to identify potential problems as they arise.

At the moment, the environmental impact of tourists on Périnet is relatively localized, and widespread disturbance and degradation may only occur if visitor numbers grow excessively. Nonetheless, a tourist-management policy needs to be developed and implemented to control and monitor Reserve visitors and to gain a better understanding of the associated environmental impacts than currently exists. If long-term environmental degradation causes a significant decline in wildlife stocks, the Reserve will not only lose the income from tourists but will fail in its main role as a haven for threatened species.

#### *Recommendations for the Development of Ecotourism at Périnet*

A number of reserves in Madagascar are being managed and developed by MEF with the assistance of foreign agencies, and integrated conservation and development projects are under way. Most of these projects will make allowances for the development of ecotourism at appropriate sites. However, recent evidence from Périnet suggests that care must be taken to ensure that Reserve visitors do not have an adverse effect on the environment. Information which is available to date allows us to make the following recommendations for the future development of ecotourism at Périnet:

1. A programme of survey and monitoring needs to be implemented to assess quantitatively the impact of visitors on faunal and floral communities. Monitoring of indicator faunal taxa could be augmented by using standardized methodologies to measure the effects of human disturbance, such as the trampling of vegetation (Cole & Bayfield, 1993). Future work needs to monitor species populations and human activity concurrently, to determine population changes over time, and to establish cause and effect (Stephenson, in press).

2. Tourists should be directed towards certain 'honeypot' areas, i.e. specific areas within the Reserve that are suitable for visitors. Provision needs to be made for clearly-marked pathways to direct people around these designated parts of the Reserve. The cutting of new paths or clearings outside honeypot areas should be avoided, as this may facilitate access of exotic faunal and floral species. Inner-core areas of the Reserve should be left undisturbed wherever possible, to safeguard microhabitats that are favoured by the rarer endemic species (Stephenson, in press).

3. A national and regional interpretive strategy needs to be developed by MEF for the provision of suitable tourist information at accessible reserves such as Périnet. Information could be provided through such media as guides, signposts, and leaflets. Guides are already present, but should be better trained to provide an educational service to tourists. This will improve the quality of the visit for the tourists whilst simultaneously encouraging them to avoid unnecessary disturbance (e.g. straying from delimited pathways, collecting plants, etc.). Foreign donor agencies should consider the provision of funds for relevant interpretive facilities as an integral part of development programmes. In turn, the development of guidebooks and leaflets could provide an additional source of income for MEF.

4. All conservation management plans should consider not only biological objectives but should be formulated equally in a social context (Duffus & Dearden, 1990). The local community in and around Andasibe should be more actively involved in the provision of tourist facilities at

Périnet than they are at present. If more individuals were able to reap the financial rewards that are possible from ecotourism, they would be liable to have an increased respect for the Reserve and its wildlife, and a better understanding of the need to utilize natural resources sustainably (e.g. Brockelman & Dearden, 1990; Tobias & Mendelsohn, 1991). Local people are already employed as reserve guards and guides. Future expansion of hotel and catering businesses may improve tourist-related employment opportunities. Other individuals should be encouraged to establish retail outlets for local crafts and produce. There may also be scope for the development of a small-scale local transport network between Andasibe and the boundary of the Reserve. Many ecotourists at Périnet would also be willing to pay to visit the nearby Mantady National Park (Munasinghe, 1993), so there is further potential for the expansion of guide and transport services.

Other reserves in Madagascar need to be developed for ecotourism by following similar principles to those outlined for Périnet. Few reserves currently offer tourist facilities, so there is a unique opportunity for investment and planning to direct visitors to appropriate sites where their presence can be controlled and any effects monitored. Managing reserves now to avoid the potential environmental impacts of tourism will probably be less costly than the later restoration of degraded habitats. Criteria need to be established for the selection of 'honeypot sites' within reserves. For example, each site needs to be supplied by a suitable transport network and to contain habitats which are appropriate for recreational use (e.g. areas containing fragile ecosystems or threatened species should be avoided). The provision of interpretive facilities, accommodation, and retail outlets, also needs to be considered.

#### *Conclusions*

The growth of the tourist industry in Madagascar should have beneficial consequences for local and national economic development and, for these reasons, should be encouraged. The industry is still in its formative years, and there are probably few significant detrimental environmental effects to date. However, 'if tourism continues to expand unchecked, protected habitats may be altered, jeopardising the conservation of endemic species diversity' (Stephenson, in press). The development of national and regional tourism policies, and the selection of key sites to be developed for ecotourism, will foster accurate and effective management planning. This should aim to maximize the benefits for local communities and tourists whilst minimizing detrimental impacts on the environment.

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PETER J. STEPHENSON, *Research Fellow*  
 Department of Zoology  
 University of Aberdeen  
 Aberdeen AB9 2TN  
 Scotland, UK.

## Physical Damage to Corals Caused by Trap-fishing on Reefs of Bonaire, Netherlands Antilles

### Background of the Bonaire Marine Park

Bonaire (see Fig. 1) is surrounded by fringing reefs which form a complicated community of many different species of fish and other marine organisms. This community is prone to damage from a number of human activities which include underwater tourism, fishing, and the removal of aggregates (sand, shells, and corals). There are many coral-reef systems in the Caribbean similar to those of Bonaire, which face the same threats, and so publication of this account is considered urgent. The prohibition of spear-fishing in 1971, and of collecting of corals and shells in 1975, were measures taken to reduce the direct exploitation of the coral-reef fauna (Hof, 1983). Due to increases of underwater tourism, management of the Bonairean marine environment became more and more needed, and some marine biologists recommended creation of an underwater park.

The World Wildlife Fund-Netherlands provided the Netherlands Antilles National Park Foundation (STINAPA) in 1979 with a grant to develop and establish a marine park in Bonaire (Hof, 1983). Several measures were accordingly taken to bring in effective coral-reef management and regulate related fisheries (Anon., 1984). Although the trap-fishery was not currently very widespread on the Bonairean reefs, there appeared to be a need for a management plan to be drawn up in case the trap-fishery should undergo sudden growth.

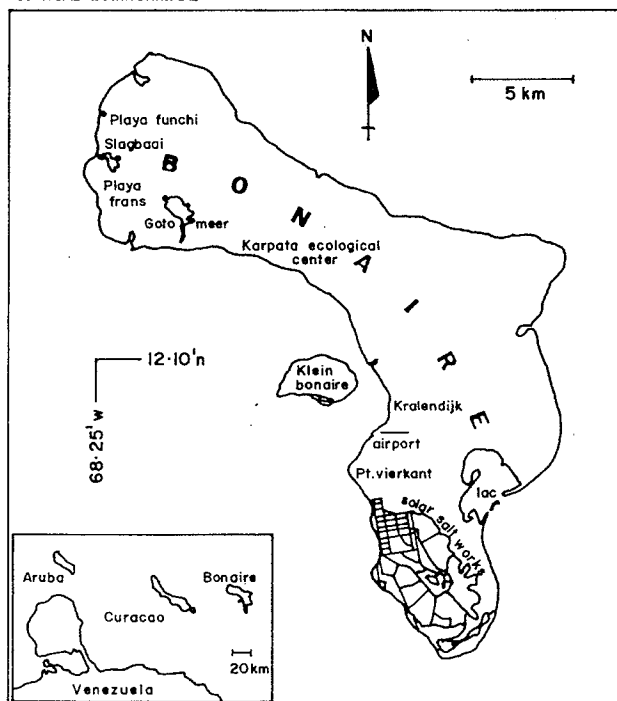


FIG. 1. Map of Bonaire, Netherlands Antilles. (Courtesy of Van 't Hof, 1983).