

A framework for understanding community resident perceptions of Masoala National Park, Madagascar

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SUMMARY

Protected areas (PAs) represent a central strategy in biodiversity conservation worldwide. Yet many PAs are weakened by people-PA conflicts resulting from the separation of natural resource protection from human considerations. Research at Masoala National Park in Madagascar focused on the following questions: (1) What are the factors that influence residents' perceptions of the Park and restrictions on use of natural resources in the Park area? (2) How do residents of communities on the periphery of the Park perceive and interact with Park staff, and what factors influence interactions and perceptions? A multi-method qualitative research approach was taken, including individual and focus group interviews, participant observation, archival research, and an environmental education and communication workshop. From July to December 2001, 119 semi-structured individual and group interviews were conducted with a total of 181 Masoala National Park staff, employees of non-governmental conservation organizations and community residents, focusing on two villages on the periphery of Masoala National Park. Factors found to influence the perceptions of the Park held by residents living in the Park periphery included the history of Park management, the degree of awareness of Park existence, types of interactions with Park staff and actual or potential benefits received from the Park. Inconsistency in past and present Park management goals has led to community confusion regarding the Park programme. Residents were largely aware of the Park's existence but were unfamiliar with its goals. Pressures on Park natural resources came from a variety of sources and occurred across a range of spatial and temporal scales, some of which were outside the control of Park managers. A conceptual framework represented relations between Park staff and community residents. Understanding people-PA interactions and perceptions can help guide future PA management strategies to increase conservation

effectiveness, through efforts such as environmental education and communication programmes.

Keywords: protected areas, people-park interactions, resident perceptions, environmental education and communication

INTRODUCTION

Protected areas (PAs) are a primary current approach to biodiversity conservation. When PAs are established, local communities often have to change their behaviour, as natural resources they were formerly using may become off-limits (Stevens 1997). During the establishment and management of PAs, communities often have been disregarded by sponsoring organizations or individuals (for example see West & Brechin 1991; Western & Wright 1994; Stevens 1997). Conflicts may arise as a result of restrictions on natural resource use, as well as from forceful evictions or other negative relations with PA staff, lack of resident participation in conservation, and the absence of open communication and full disclosure of PA-related information (Hough 1988). Conflicts are manifested by a range of behaviours, from local expressions of anti-PA sentiments to intentional burning in PAs and threats of or actual bodily harm to PA staff (see Ite 1996; Brandon *et al.* 1998; Tello *et al.* 1998; Peters 1999).

PA managers face the dilemma of managing for both conservation of the biodiversity within their jurisdiction and local community interests and resource needs. People living in and around PAs often impact the ability of the PA to meet conservation objectives. The attitudes of local residents as well as the interactions, level of local participation, and conflicts between people and PAs have become a concern of PA effectiveness (West & Brechin 1991; Wells & Brandon 1992; Western & Wright 1994; Pimbert & Pretty 1995; Kramer *et al.* 1997; Stevens 1997; Brandon *et al.* 1998). Community attitudes toward and perceptions of PAs have been shown to influence the kinds of interactions people have with PAs, and thereby conservation effectiveness. Thus, it is important to understand people-PA perceptions and interactions if PAs are to achieve their goals.

The fourth largest island in the world, Madagascar is considered a global biodiversity hotspot owing to its high levels of endemism and intense pressures on natural resources (Mittermeier 1988; Wright 1994). This study was conducted at Masoala National Park, officially gazetted as Madagascar's

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eighth national park in 1997, and one of the largest remaining contiguous blocks of rainforest (area 2300 km²) in the country. When Masoala National Park was established, it was managed as an integrated conservation and development project (ICDP), with several non-governmental organizations (NGOs) involved in park research and conservation initiatives and a development NGO overseeing park management, particularly community development efforts.

Masoala National Park is an important conservation focus because of its lowland rainforest ecosystem and endemic species, including red-ruffed lemur (*Varecia variegata rubra*), Madagascar serpent eagle (*Eutriorchis astur*), Madagascar red owl (*Tyto soumagnei*), helmet vanga (*Euryceros prevostii*), leaf-tailed gecko (*Uroplatus* spp.), the world's smallest species of chameleon (*Brookesia* spp.) and approximately 6000 species of plants, half as many as found in the entire country of Madagascar, including carnivorous pitcher plants (*Nepenthes masoalensis*) (Thorstrom & Watson 1994; Hatchwell 1999; Kremen *et al.* 1999). Each July to September, humpback whales (*Megaptera novaeangliae*) migrate to the Bay of Antongil, an important whale mating and calving area (Rosenbaum *et al.* 1997).

A multi-method approach was used to explore people-PA perceptions and to identify factors that hinder or support conservation effectiveness at Masoala National Park in north-eastern Madagascar. The main research questions were: (1) What are the factors that influence residents' perceptions of a national park and restrictions on use of natural resources in the park area? (2) How do residents of communities on the periphery of a national park perceive and interact with park staff, and what factors influence interactions and perceptions? We developed a conceptual framework to represent factors that influence people-park perceptions, which can be used to tailor park management strategies to local attitudes.

METHODS

Research was conducted at Masoala National Park in north-eastern Madagascar (Fig. 1) from July to December 2001. The Masoala park complex consists of a large park parcel on the Masoala peninsula as well as three marine parks, three smaller terrestrial parks on the eastern side of the peninsula, and the Nosy Mangabe Special Reserve, a forested island located in the Bay of Antongil near the town of Maroantsetra. The park is divided into six management zones (Zones A to F, Fig. 1), each patrolled by four to six park Agents of Conservation and Education.

Masoala National Park's management plan outlines permissible non-commercial use of forest resources in the buffer zone, limited to collection of medicinal plants and palm leaves for house construction (Hatchwell 1999). Before the park became official, local residents were interviewed using participatory rural appraisal techniques to provide input for the Park boundary and buffer zone placement (Cooperative Assistance for Relief Everywhere [CARE] *et al.* 1995). Buffer zones were established in areas where communities existed in

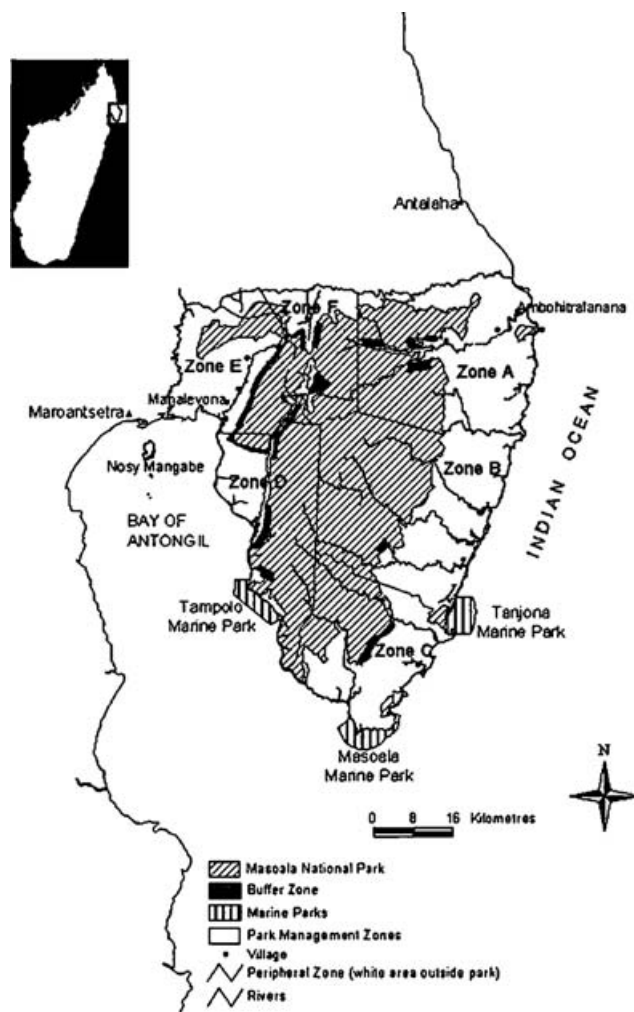


Figure 1 Location of Masoala National Park.

close proximity to the Park and where resident resource needs could not be met by existing resources in the peripheral area outside the Park (CARE *et al.* 1995).

Archival research was conducted on Park documents at the New York City office of the Wildlife Conservation Society (WCS), the current park co-manager; in Madagascar's capital city, Antananarivo, at the WCS office library as well as at the library of the Missouri Botanical Garden, which conducts botanical research in the Park; at the Masoala National Park office library in Maroantsetra; and in Antalaha at the office of CARE, a community development organization working with the Park.

Field research focused on two villages, namely, Mahalevona, west of the Park, and Ambohitralanana, east of the Park, because the two Park staff responsible for conducting environmental education are based in these villages. Mahalevona (*c.* 8000 population) is much larger than Ambohitralanana (*c.* 2000 residents). Interviews were also conducted in six other locations on the Masoala National Park periphery.

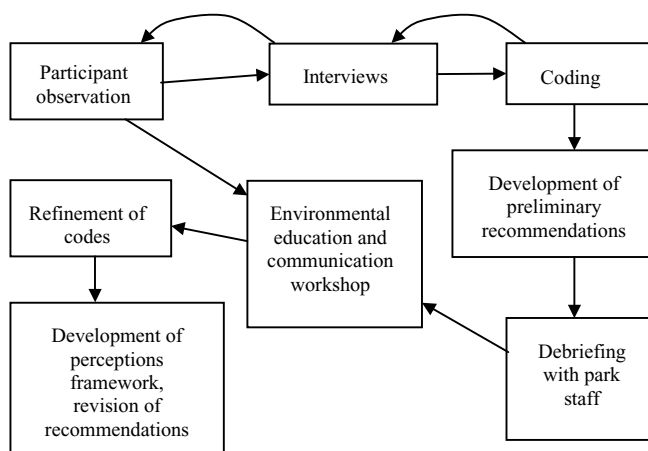


Figure 2 Flowchart of the research process.

Mahalevona is located approximately 5 km west of Masoala National Park. Homes stretch in a narrow band between wide rice fields and the Mahalevona River that runs parallel to the Park boundary. Most residents farm rice for daily family consumption. Those who have land, money and time plant vanilla or cloves for seasonal income. Ambohitralanana is situated approximately 15 km east of Masoala National Park. Rice cultivation is limited by lack of water and available land. Instead, most Ambohitralanana residents plant vanilla or other cash crops for income.

A multi-method qualitative research approach was taken, based on participatory action research and ethnographic techniques, including interviews, archival research, participant observation, focus groups, and an environmental education and communication workshop (Hammersley & Atkinson 1983; Greenwood *et al.* 1993; Weiss 1994; Brydon-Miller 1997; Greenwood & Levin 1998). The objective was to develop a method of researching people-park perceptions that moved beyond traditional participatory rural appraisal (PRA) and rapid rural appraisal (RRA) (Chambers 1983) to a more comprehensive approach that thoroughly investigated possible factors shaping park perceptions. Use of a variety of methods (Fig. 2) and settings allowed for triangulation of findings and increased the likelihood of obtaining accurate, representational information (Hammersley & Atkinson 1983; Miles & Huberman 1994; Carr & Halvorsen 2001).

Fifty individual and 17 group interviews were conducted with a total of 109 residents of the villages of Mahalevona and Ambohitralanana, as well as with residents of six other villages, Park guides, representatives of Madagascar's Ministry of Water and Forests, and 27 Park staff in the two main villages, in the Park office in Maroantsetra and at various field locations in the Park area (Table 1). Park personnel are employees of the *Association National pour la Gestion des Aires Protégées* (ANGAP, Madagascar's national park service). In addition, conservation professionals were interviewed in the towns of Antananarivo, Tamatave, Maroantsetra and Antalaha. Because the interviews were semi-structured, using

Table 1 Description of the research sample.

Interviewees	Number of individual interviews (n = 97)	Number of group interviews (n = 22)	Number of people interviewed (n = 181)
<i>Peripheral villages</i>			
Mahalevona	30	11	70
Ambohitralanana	20	6	39
Tanambao	1	1	6
Ampokafo	2	0	2
Ambatoledama	2	0	2
Masindrano	1	0	1
Ambodirafia	1	0	1
Anjahana	1	0	1
<i>Staff of Masoala National Park</i>	15	2	27
<i>Park guides</i>	5	1	8
<i>NGO staff</i>	16	1	21
<i>Ministry of Water and Forests employees</i>	3	0	3

an interview guide with open-ended questions, interviewees did not all comment on each of the topics.

Ormsby conducted semi-structured, open-ended interviews in French and Malagasy with the aid of local translators, using an interview guide. All interviewees were asked the same questions. Selection of interviewees, who were adult heads of households, was purposeful and stratified according to neighbourhood, occupation and membership of local organizations (Creswell 1994; Weiss 1994). An effort was made to conduct interviews and focus groups in a variety of settings and during different times of the day, with different age groups, with a nearly equal number of male and female interviewees, and also during different harvest seasons and times of the school calendar. In some cases, people were interviewed twice, both individually and in a focus group.

Using the method of participant observation, the daily activities of Park staff and community residents were observed and recorded (Bernard 1988; Miles & Huberman 1994; Stringer 1999; Kellert *et al.* 2000). Focus group methodology was used at several points in the research process with residents, such as local women's or vanilla farmers' associations, and with Park staff, as an approach to gather qualitative information about attitudes, motivations, participation and behaviour (DiCamillo 1995). The focus groups provided an important opportunity to validate the identification of key community issues (Krueger 1994; Morgan 1997; Jacobson 1999; Carr & Halvorsen 2001).

Near the conclusion of the field research period, Ormsby conducted participatory debriefings with Park staff and assisted with an environmental education and communication workshop for Park staff. This workshop was a forum through which to gain additional insight on Park issues and staff interactions with communities, either directly by observing reactions to the workshop activities or through informal conversations in the course of the event.

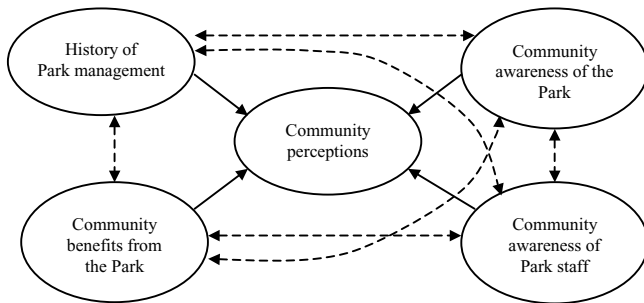


Figure 3 Framework of the factors that influence Park perception.

A thematic analysis approach was used to develop codes and generate theory from the data collected in interview field notes (Glaser & Strauss 1967; Boyatzis 1998). Codes were created for each topic that emerged from interviews to analyse and quantify the data (Creswell 1994). Finally, the framework of people-park perceptions was developed based on the results.

RESULTS

Based on interview data from residents living on the periphery of Masoala National Park, the main factors found that influenced residents' perceptions of the Park were: history of Park management, community awareness of the Park, community awareness of Park staff and community benefits from the Park (Fig. 3).

History of Park management

Answers to questions such as, 'What was the area like before the Park was established?' and 'For whom and what purpose was the Park established?', revealed that Masoala National Park's history of involvement of different NGOs and related shifts in project priorities had created confusion and, in some cases, unrealistic community expectations of current Park management in general and of Park staff specifically. Some residents were unaware that the Park no longer had community development as a primary objective. Residents of peripheral villages voiced the perception that community development projects are part of Park staff responsibilities, probably because the previous Park projects involved construction of many of the wells, latrines and schools in villages near the Park. Interviewees posited that community development efforts have to accompany conservation. In the words of a Park manager, 'in order to maintain the Park, it is necessary to have development for local communities.' A local town official said, 'if people don't have benefits, they won't change their behaviours.' Interviewees supported the use of alternative livelihood methods that could minimize pressures on Park resources by providing community-level benefits. While the past development focus

of the Masoala integrated conservation and development project attempted to increase community benefits, it may also have been a cause for later misunderstanding of park staff by residents.

Community awareness of Masoala National Park

Asked 'What is your opinion of Masoala National Park?', residents' responses ranged from confusion over the Park's existence to sentiments of general support. Generally, residents who expressed greater Park awareness also expressed positive sentiments toward the Park, and residents with minimal or no knowledge of the Park expressed ambivalent, but not necessarily negative, attitudes toward the Park.

The majority of residents interviewed in Mahalevona (65 of 70, 93%), the village closer to the Park, were aware of the Park's existence and expressed positive opinions of the Park, voicing support because of its utility in providing necessary goods for daily life. For example, one Mahalevona resident noted, 'if the forest disappears, there will not be any medicinal plants. If we do not have trees, there will be erosion.' In contrast, 26 of 39 individuals (67%) interviewed in the more distant village of Ambohitalanana stated that they did not know of the Park's existence and only two interviewees in Ambohitalanana provided specific details about the purpose of the Park or mentioned the Park's positive values.

Residents' levels of awareness of Masoala National Park were reflected by their unsolicited comments about the Park boundary. Many residents held the underlying assumption that the Park's boundary could be moved as needed, and its resources used in the future. This represented a gap in residents' perceptions and awareness of the conservation goals of the Park, and limited knowledge of the purpose and permanence of the Park boundary. We found that residents living closer to the boundary were more aware of the Park and more concerned about the boundary location.

Community awareness of Park staff

Residents who had experienced positive interactions with Masoala National Park staff tended to also be aware of the existence of the Park and were more likely to be supportive of it than residents who had past negative experiences with Park staff. Positive interactions between residents and Park staff included regular neighbourly contact, agricultural or community development assistance, or more formal education and awareness activities, including community meetings. Negative interactions involved enforcement of Park rules, such as reporting individuals involved in illegal activities in the Park, or unneighbourly (rude or inappropriate) behaviour.

Residents gave a range of responses when asked about the Park staff living in their village. Only five of 69 (7%) Mahalevona residents interviewed did not know the Park agents. In contrast, several Ambohitalanana residents (nine of 39, or 23%) were unaware of the Park agents in their

village. Furthermore, seven of the 39 (18%) Ambohitralanana residents interviewed expressed at least minimal knowledge of the existence of the agents but were unclear about their job responsibilities.

Based on responses to the question, 'What do Masoala National Park staff/ANGAP agents do?', Park staff and residents identified the main staff role as enforcement and forest protection, although staff responsibilities include environmental education. Six of 40 (15%) Mahalevona residents interviewed expressed support for the conservation enforcement activities of Park staff, with statements such as, 'The Park should be protected. Before the Park was official, people destroyed the forests, and at that time the officials could not control the destruction, but now ANGAP is here to enforce the rules.' Seven of 39 (18%) Ambohitralanana residents interviewed identified the job of the Park staff as 'to protect the forest.' One Ambohitralanana resident said, 'the agents have to defend the forest from people cutting wood and doing *tavy*' (swidden agriculture).

Community benefits from the Park

Based on interviewees' responses to the questions, 'Do you use any plants or animals from the Park, or did you use these resources in the past, before the Park was established?' and 'What would you like to see the Park offer to you and/or to the community?', residents with legal access to resources associated with the Park perceived the Park as valuable, whereas residents further from the Park with limited resource availability negatively perceived use restrictions. In interviews, Mahalevona residents noted the Park proximity and buffer zone still containing resources. The main resources used by residents were plant species that have explicit functions, for example, in house construction, beverage preparation and medicine.

Residents with access to community development projects, income from ecotourism and forest resources demonstrated positive attitudes toward the Park. Furthermore, benefits were affected by stochastic market prices for cash crops and hurricane events that created temporal fluctuations in pressures on the Park's natural resources.

Interviews with Park staff, individual residents and archival research revealed that pressures on the Park's natural resources differed among Park management zones, specifically with respect to lemur hunting in the north-west (Zones E and F, Fig. 1), *tavy* in the south for subsistence farming and raising of cash crops (Zones B, C and D) and extraction of valuable wood species in the north-east (Zones A and B).

Several Mahalevona residents asserted that the forest was valuable to them, providing useful products such as firewood, leaves for roofs, honey and wood planks, resources that were difficult to find outside the Park. These interviewees also expressed support for forest protection so they could continue to collect resources; however, the Park and its small remaining buffer zone areas were far from Ambohitralanana, and several other villages were closer to the resources. In

contrast to the majority of Mahalevona residents interviewed, Ambohitralanana residents remarked that it was difficult to obtain the wood they needed. One Ambohitralanana resident remembered, 'before the forest was close, you did not have to go as far to reach it.'

Interviewees indicated that community residents and other parties benefited from two main types of lucrative illegal Park resource use, namely lemur hunting and timber harvest (particularly of rosewood, *Dalbergia maritima*). Valuable timber was mentioned in five interviews (19%) in Ambohitralanana, but was not mentioned by residents of Mahalevona. An Ambohitralanana resident indicated that people wanted easy money, especially the youth, so they went into the park to cut rosewood. Another Ambohitralanana resident stated, 'people from all over come to this area to cut rosewood, there is no other way to get money than from valuable wood.'

In response to the open-ended question, 'What is your opinion of Masoala National Park?', residents identified an additional benefit from the Park, namely its value as a source of water for rice production. In Mahalevona, nine of 40 interviewees (23%) identified the importance of the Park's forests in terms of the water resources provided for rice cultivation, whereas only two of the 39 people interviewed (5%) in Ambohitralanana raised the issue of hydrologic benefits from the Park. One Mahalevona resident said, 'the Park is important because rain comes from there and arrives in rice fields, but only when the forests are not cut down.'

The influence of hurricanes on residents' legal and illegal resource use was raised in numerous interviews. Although residents were not specifically asked about hurricanes during interviews, many interviewees described their personal experiences during and after Hurricane Hudah of April 2000. Residents indicated that use of wildlife and plants in the Park increased when subsistence and cash crops were destroyed by the hurricane.

A framework for understanding residents' Park perceptions

The four factors described above emerged as important influences on community residents' perceptions of Masoala National Park and its staff. Both these factors and their interactions influenced residents' perceptions of the Park (Fig. 3, dashed lines). For example, resident knowledge of and positive interaction with Park staff increased residents' awareness of the Park. In addition, the history of Park management included construction of community projects such as latrines and wells, currently viewed as community benefits from the Park, leading to positive attitudes toward the Park and knowledge of the Park's existence, particularly when projects had been directly associated with the Park or constructed with the assistance of Park staff. Furthermore, Park history, including Park staff conduct and attendance at Park meetings, affected current levels of awareness of, and attitudes toward, the Park. The framework offers a systematic

way to conceptualize the factors that Park managers need to address in order to foster positive Park perceptions.

DISCUSSION

Based on our study of Masoala National Park, four areas were identified that merit attention in developing PAs to minimize people-PA conflict and maximize conservation effectiveness. These include explanation of reasons for establishment of the PA, clear PA boundaries and regulations, ensured regular non-enforcement contact between PA staff and residents, and consideration of benefits from the PA to resource users at multiple scales.

Past priorities and present perceptions

The history of Park management was found to be an important factor of influence on resident perceptions of Masoala National Park. The Park is presently co-managed by ANGAP and a conservation NGO, and is no longer formally an ICDP, although community development partners are sought for specific projects as needed. This parallels a countrywide change in parks' programmatic focus from ICDPs to a regional conservation approach (Gezon 2003). The shift in Masoala National Park's focus away from community development and toward biodiversity conservation had not been fully explained to residents at the time of research, and interviewees expressed confusion over the role of Park staff. Numerous community residents expressed the belief that Park staff should be doing work similar to that done by the Park's community development representatives in the past, particularly in terms of providing new community development projects and maintaining existing ones. Confusion generated by the presence of different Park managers and shifting management priorities may have created current unrealistic community expectations of Masoala National Park. Several residents interviewed were unaware of Park representatives based in their village, which organizations were associated with the Park and the current programmatic shift away from community development. The institutional history of PAs has been found to lead to negative attitudes toward PAs and conflicts between PA staff and local residents (Hough 1988; Fiallo & Jacobson 1995; Fiallo & Naughton-Treves 1998).

During Masoala National Park's ICDP phase, community participation was generated by offering 'material incentives,' considered a mid-level of participation in PA development and management according to the continuum developed by Pretty *et al.* (1995). Our findings corroborated those of Marcus (2000, 2001), who observed that residents living around national parks in Madagascar did not always understand the connection between community development projects and conservation. Results from our research and an earlier study of Masoala National Park by Marcus (2001) suggest that people who perceived benefits from a conservation project tended to think more highly of the Park, either because they better understood

the goals of the conservation program or actually received benefits.

Knowing the Park nearby

Residents' perceptions of Masoala National Park were affected by awareness of the Park's existence and goals as well as distance of village to the Park. Some residents believed that the Park boundary could be moved and would probably need to change in the future as resource needs increase. This represents a gap in Park management intentions of conserving a fixed area and resident expectations of future resource use. Lack of clarity over the location of Masoala National Park and its boundary, and the lack of boundary markers in some locations, present an opportunity for illegal use of Park resources (J. MacKinnon, M. Hatchwell & C. Kremen, personal communication 2002). Issues of confusion over boundary location and demarcation were also found at Ankarana, a PA in northern Madagascar (Gezon 1997).

There are several factors that may account for Masoala National Park area residents' degree of knowledge about the Park's existence, including attendance at past meetings, interaction with Park staff, village proximity to the Park boundary, participation in Park programmes such as community development and education efforts, Park visitation and word of mouth or informal community discussions. While most residents know that Masoala National Park exists, there remains a low level of understanding of Park goals and resource use prohibitions. As a result, residents may develop negative attitudes or presume restrictions are more rigid than is actually the case.

In numerous PA settings, knowledge of conservation issues has been positively correlated with favourable attitudes toward conservation. Studies have also found a lack of awareness of the purpose and potential benefits of nearby parks. For example, Gillingham and Lee (1999) found that although many local Tanzanian residents (87%) supported the protection of wildlife, 32% of respondents did not know why the Selous Game Reserve was established. Positive attitudes toward Machalilla National Park in Ecuador were correlated with knowledge of conservation issues and the park's management goals, yet 54% of respondents in Machalilla National Park and 65% outside it did not understand why the park had been established (Fiallo & Jacobson 1995).

Park staff: friend or foe?

Resident perceptions of Masoala National Park were affected by the level of community awareness of Park staff. Differences in awareness of Park staff were related to types of local resource use, degree of valuable timber harvesting activity, level of awareness of the Park's purpose, past interactions with Park staff, and availability of and access to natural resources.

Lack of trust between park authorities and local people, and the difficulty of communication between these two groups can lead to conflicts (Hough 1988). Trust is influenced by

any history of hostility or misunderstanding between park representatives and local residents, and the background of park staff, including ethnicity, birthplace, socioeconomic status and appropriate training for interactions with communities (Hough 1988). While nearly all Masoala National Park staff are of the same ethnic group as residents of the Park periphery, there are socioeconomic discrepancies between staff and residents, as opportunities for steady income such as that offered by a Park job are rare. Our research at Masoala National Park found that community awareness of and attitudes toward staff are influenced by staff not being at their posts, lack of interaction with community residents, socioeconomic imbalance, lack of staff training and unclear job expectations.

Attitudinal studies, including this study, confirm that lack of interaction between park staff and local residents can create conflict. The interactions that do occur are often solely for law enforcement. Furthermore, at Masoala National Park, as at other PAs in developing countries, Park personnel often are not trained in community outreach or environmental education; rather, they are most frequently perceived or actually function as law enforcers. The role of Park staff is often unclear to or misunderstood by local residents. For example, at Amber Mountain National Park in Madagascar, villagers perceived that local uniformed government representatives were hostile because of their traditional law enforcement role (Hough 1994). Based on research in South Africa, Infield (1988) concluded that attitudinal change could be achieved by shifting some of the resources spent on policing to integrate local communities into the conservation programme through education and public relations programmes. At Masoala National Park, residents who were more familiar with Park staff viewed the staff as well as the Park more favourably than residents who were unaware of staff or who had had negative interactions with Park agents. Even informal contact has been found to be important in reducing mistrust between local people and PA managers; in Tanzania, as little as a park employee visit to a village for the purpose of shopping was positively correlated with favourable attitudes toward park staff (Newmark *et al.* 1993).

Scales of resource use

Residents near Masoala National Park differed in the types and degree of benefits they received from the Park, which affected their perceptions. Residents of areas with high natural resource availability expressed more support for the Park than residents with low natural resource availability, in areas with little or no Park buffer zone. It remains to be seen if awareness of declining resource availability will result in positive behavioural change, such as efforts to start tree nurseries to avoid overexploitation of the buffer zone. If nurseries or alternative harvesting techniques are not established and maintained, a likely result of the exhaustion of buffer zone resources is that residents will go into the Park itself to harvest needed materials. The complexities

of resource use regulation at the Park pose a challenge to conservation efforts and community relations.

Natural resource use at Masoala National Park was found to occur across temporal and spatial scales. Demands on park resources come from sources ranging from local individual subsistence farmers to international timber dealers. Natural resource use activities conducted locally in the Park area have varying levels of impact, consumption and actors involved.

Tropical timber such as rosewood is harvested in the Park, the majority of which is exported to international markets. This poses large challenges for law enforcement, since Park agents do not have the legal power to incarcerate loggers. Local communities receive minimal benefits from the rosewood market; it is the elites within Madagascar as well as foreign exporters and importers who reap substantial economic benefits from this lucrative trade (Stasse 2002). As a Park manager said, 'demand is driving the outside buyers of rosewood, and this is a much bigger issue than lemur hunting.' The majority of rosewood harvested is exported to China (Stasse 2002). An economic cost-benefit analysis of the potential use of natural resources at Masoala National Park showed that large-scale industrial forestry concessions bring the greatest benefits at the national level, rather than at the Park level or for stakeholders in an ICDP (Kremen *et al.* 2000). Rosewood harvest and illegal trade activities are particularly strong in the eastern area of Masoala National Park, which, based on research results, is most likely owing to a combination of factors, including presence of high quality trees, destruction of cash crops by past hurricanes, high external demand and access to ports. The timber trade is a complex system involving a permitting process, difficult harvest methods, numerous stakeholders of varying socioeconomic status and a range of spatial scales of operation. Different management strategies may be required to address the range of types of natural resource pressures. Adopting a regional approach to conservation can address non-local political-economic influences on local resource-use patterns (Gezon 2000).

Hurricane events seasonally impact natural resource availability in the Park area and affect residents of communities bordering the Park. These storm events have the potential to alter people's use of Park resources, triggering increases in hunting of wildlife, collection of food and harvest of valuable resources from within the Park. For example, Hurricane Hudah of April 2000 left 50 000 people homeless in north-eastern Madagascar. The storm destroyed rice fields and cash crops, causing famine that increased legal and illegal human pressures on the Park through lemur hunting, wild yam gathering, land clearing for cash crops and accelerated timber harvest. In the eastern area of the Park in particular, many residents who suffered from hurricane impacts turned to the lucrative trade in rosewood. The livelihood impacts of past hurricanes indicate that future Park programmes should consider the potential effects of storms on both resident perceptions of the Park and incursions into the Park for resource use.

CONCLUSIONS

Four main factors were found to influence residents' perceptions of a national park: the history of park management, community awareness of the park, community awareness of park staff and community benefits from the park. Our findings highlight the importance of positive communication between communities and park staff. As suggested by Pretty *et al.* (1995), the level of participation by community residents in conservation initiatives can affect project outcomes and resident perceptions of PAs. Management strategies need to be flexible to respond to different pressures, recognizing that, for example, some issues require solutions in terms of national-level policy changes or ecological resource recovery time.

Attitudinal studies can identify park challenges and provide guidance for the design of future conservation programmes. These studies typically have correlated attitudes, perceptions, knowledge of ecology, conservation, and the purpose and benefits of the PA with a variety of socio-demographic factors (Infield 1988; Newmark *et al.* 1993; Mkanda & Munthali 1994; Ormsby 1996; Mehta & Kellert 1998; Gillingham & Lee 1999). People-park attitudinal studies have found a correlation between positive environmental attitudes and knowledge of ecology, conservation issues and park management goals (Infield 1988; Mkanda & Munthali 1994; Fiallo & Jacobson 1995). Environmental education and communication programmes at the community level, provided by park staff, might be a way to avoid conflicts over natural resources and improve the relationship between local residents and park staff. Lack of, or negative, interaction with park staff is linked to ambivalent or negative attitudes toward conservation, both at Masoala National Park and at other PAs. Awareness programmes administered by staff could improve community relations by clarifying the purpose of the park's existence, the role of park staff and potential benefits of the park.

Each PA has its own complexities of management history and scales of resource use which affect local park perceptions and conservation challenges. Existing PAs would benefit from use of our framework to address factors that influence park perception and pressures on resources at all levels.

Park managers, whether at a long-established site or in the design phase of a new PA, would be wise to prioritize several issues. First, the highest level of community participation should be encouraged, beyond participation simply for material incentives. In the case of already established parks, it is important that current park goals are clear and that realistic benefits from the PAs are known by community residents. Park staff should have regular non-enforcement interactions with community residents. Park managers should also be aware that stochastic environmental events may cause periodic increases in natural resource demands. Awareness of the main factors that can foster positive park perceptions can aid in anticipating and avoiding situations that could cause people-park conflicts and will help increase the effectiveness of PAs.

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