

# Natural resource use, crop damage and attitudes of rural people in the vicinity of the Maputo Elephant Reserve, Mozambique

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## Summary

Participation by local communities in management is widely considered a means of sustaining protected areas. In parts of the world with a history of armed conflict, the chances of such an approach being successfully adopted might seem remote. One such area is the Maputo Elephant Reserve in southern Mozambique. The aim was to improve understanding of the local people's use of natural resources and perceptions of the Reserve's impact. Interviews and questionnaires distributed in four different villages were used to estimate the relative value of these resources in relation to the attitude of the local people towards the Reserve. The people gave a relative value rank for each specific use of each plant, animal and fish resource. On average 60% of the households exploited more than two different resource categories. The plant resources of the Reserve were used by 71% of the households and were valued more highly than animal and fish resources. Plants were used for many purposes; construction material, fuelwood and fruits had the highest relative values. Antelopes, hippopotamus and elephants were valued highest amongst a range of animal species which were hunted by 21% of households. Amongst uses of animals, consumption, use of the skins and commercial sale of the meat were especially important. When asked if they liked the Reserve, 88% of respondents answered positively. The attitude towards the Reserve was correlated with crop damage experiences; people with crop damage caused by elephants, hippos or bushpigs, were more negative. Attitude of respondents was inversely related to the number of species invading their agricultural fields. Resource use intensity, use purpose, resource value and attitude were different amongst sites and dependent on site-specific circumstances, different management strategies could be necessary for the four sites. A resource management plan should be drawn up, local people should be included in the management team and steps should be taken to improve the

relationship between the Reserve's authorities and the local population generally.

*Keywords:* resource use, crop damage, attitude, wildlife, reserve, Mozambique

## Introduction

The practice of forbidding exploitation of natural resources within protected areas (PAs) is being debated and participation of rural people is now recognized in management plans for such areas (MacKinnon *et al.* 1986; Kiss 1990; Happold 1995; Rihoy 1995; Heinen 1996). The exploitation of certain resources within a PA on a sustainable basis could contribute to higher living standards, of rural people, especially in underdeveloped countries, and decrease conflicts between the population and the park authorities.

Resources should be seen in the light of three key factors, namely availability, production and offtake (e.g. de Bie *et al.* 1987; Bodmer *et al.* 1994; McGregor 1994). Household socio-economic background also plays a role in resource utilization; poorer families depend more on natural products (Infield 1988; Newmark *et al.* 1993; McGregor 1995). The attitude of people towards a PA is influenced by the benefits which they acquire from it, and by the negative consequences of its conservation status (Parry & Campbell 1992; Heinen 1993; Newmark *et al.* 1993; Saberwal *et al.* 1994; Fiallo & Jacobson 1995; Studsrød & Wegge 1995). Negative factors are the restrictions on resource use, crop damage from the herbivore population of a PA, livestock loss and human fatalities due to wild animals. Social factors such as ethnic group, religion and education have also been shown to be important in determining whether people have a positive or negative attitude towards PAs (Infield 1988; Heinen 1993; Studsrød & Wegge 1995).

The management of the Maputo Elephant Reserve (MER) in southern Mozambique is presently under discussion. The rural communities have always relied partly on the exploitation of its natural resources in the form of plants, animals and fish. The general purpose of this study was to provide the first detailed analysis of PA-people relationships in Mozambique. One specific aim was to provide information which would be essential for drawing up a lasting management plan for the MER (Murphree 1991; Happold 1995; Heinen 1996), including quantification of natural resource

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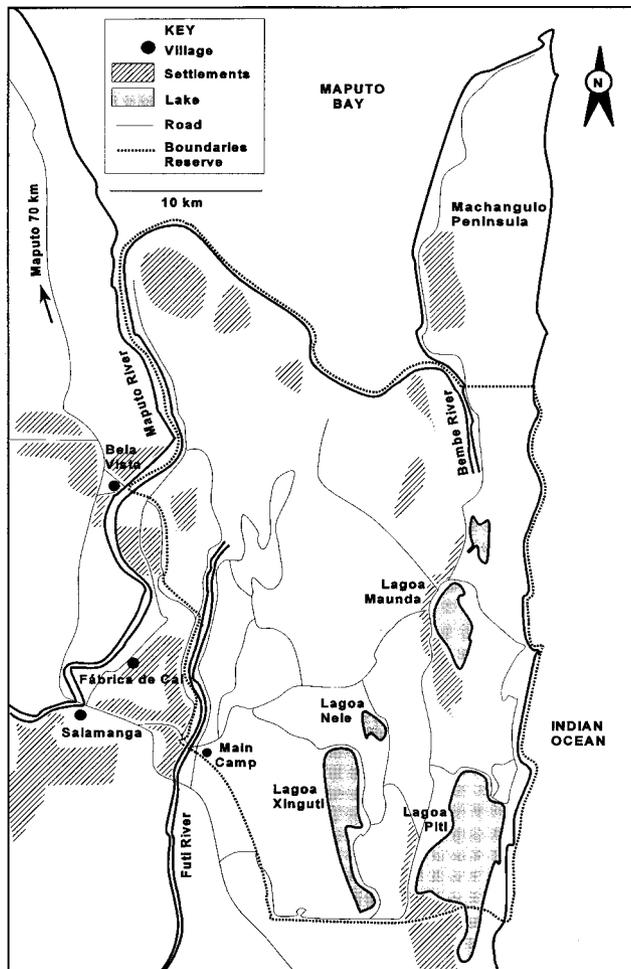


Figure 1 Map of the study area showing the boundaries of the Maputo Elephant Reserve, the water sources, the villages and settlements.

use by rural people in the MER and improved understanding of the importance attached to each resource and its specific uses by these people. It was also essential to understand better the attitudes of the population towards the MER and the factors which might influence them.

## Methods

### The study area

The Maputo Elephant Reserve is located in the southern part of Mozambique (Fig. 1). The MER (total area 800 km<sup>2</sup>) was originally gazetted in 1932, but its current boundaries were determined in 1969; its ecology is described by Tello (1973). The annual rainfall is 690–1000 mm (DNFFB [Direcção Nacional de Florestas e Fauna Bravia] 1994). There is a rainy hot season from October to March and a drier and colder period from April to September. The soils are mainly sandy. The area, except for the floodplains in the north, is undulating with its highest point at 104 m. The main water source is the Maputo River. The Futi River is smaller and ends in the plains in the north. There are several large lakes, namely

Lagoa Piti, Lagoa Maunda, and the saline Lagoa Xinguti. The MER is situated in the Tongoland-Pondoland coastal mosaic, characterized by a high species diversity and a high degree of endemism (White 1983). More recently, Van Wyk (1994) has recognized it as a centre of endemism. The vegetation can be classified using six vegetation types. Mangroves are found in the north, bordering the bay and river deltas. Dune vegetation occurs along the coast. Extensive grass plains are found in the centre and northern part of the Reserve. On the older dunes dry, sublittoral sand forests occur. Savanna is found in the east, south and west and a riverine vegetation with reed beds characterizes the seasonal Futi River and lake borders. Access over sand roads is difficult and very few tourists visit the MER (< 1000 per year).

Animal numbers were severely reduced in the civil war, but antelopes are still the most common and include reed-buck (*Redunca arundinum*), bushbuck (*Tragelaphus scriptus*), common duiker (*Sylvicapra grimmia*), red duiker (*Cephalophus natalensis*) and suni (*Neotragus moschatus*). There is an elephant population (*Loxodonta africana*) of around 200 animals in the MER (Correia *et al.* 1996). Other large animals include nyala (*Tragelaphus angassii*), bushpig (*Potamochoerus porcus*), scrub hare (*Lepus saxatilis*), vervet monkey (*Cercopithecus aethiops*), samango monkey (*Cercopithecus mitis*) and hippo (*Hippopotamus amphibius*). The MER is known for its avifauna (337 species listed by Tello 1973) and the two species of marine turtles (*Caretta caretta* and *Dermochelys coriacea*) which nest on the beaches of the eastern shore. Crocodiles (*Crocodillus niloticus*) also occur in most freshwater bodies.

The MER is administered by the National Forestry and Wildlife Department. The head of the MER is in charge of the management, assisted by a warden and field staff. Exploitation of plant and animal resources is forbidden by law, although collection of plant material for subsistence needs has always been permitted. People have always lived inside the MER and their number was estimated at 5000–10 000 in the 1970s (DNFFB 1997). The main ethnic group were the *Ronga*, who practised agriculture, pastoral activities and small-scale hunting and fishing. The forced relocation of families living inside the MER to areas outside the current boundaries in the 1980s obviously worsened the relationship between the rural communities and the MER's authorities, but people soon moved in again. The control of the MER was lost during the civil war (1978–1992) and only regained in 1993, when most of the local people had moved out of the MER and fled to South Africa.

The human population is now concentrated outside the MER in Bela Vista, the district capital with around 6500 inhabitants, Salamanga (2600 people), Fábrika de Cal (600), and on the Machangulo Peninsula to the north (Fig. 1). Some people lived in the MER, in settlements such as at Lagoa Piti (300) or dispersed (probably < 1000). Only Bela Vista, Salamanga, Fábrika de Cal and Lagoa Piti were included in the present study. Bela Vista had the most facilities, such as

**Table 1** The demographic variables of the study sites and weighted means for the area as a whole, with results of statistical comparisons between the sites ( $\chi^2$  contingency tables, level of significance  $p$ ).  $n$  = sample size, \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ , NS = not significant, + = larger than expected, - = smaller than expected, BV = Bela Vista, Sal = Salamanga, FdeC = Fábrica de Cal, Piti = Lagoa Piti.

	<i>Site:</i>				<i>Mean</i>	<i>Statistics</i>
	<i>BV</i>	<i>Sal</i>	<i>FdeC</i>	<i>Piti</i>		
Large households (> 5 members)	66%	36%	98%	43%	59%	$\chi^2 = 59.9$ $p < 0.001$
Born in the district	62%	88%	82%	86%	71%	$\chi^2 = 13.1$ $p < 0.01$
Religious (Christian)	100%	82%	64%	58%	92%	$\chi^2 = 27.1$ $p < 0.001$
Households with children attending school	42%	40%	92%	28%	44%	$\chi^2 = 48.2$ $p < 0.001$
Ronga (ethnic group)	94%	94%	88%	92%	94%	$\chi^2 = 1.6$ NS
Exploiting two or more natural resource categories	46%	90%	74%	79%	60%	$\chi^2 = 25.9$ $p < 0.001$
People liking the Reserve	96%	76%	62%	75%	88%	$\chi^2 = 15.6$ $p < 0.005$
<i>n</i>	50	50	50	50		

shops, a primary school and a hospital; Salamanga had a smaller school. The Fábrica de Cal has a settlement around a stone quarry and most of the families had a member employed at the factory. The settlement around Lagoa Piti had no public facilities.

### Data collection

The data were collected between July and December 1994. A preliminary study, which included a literature survey, field visits, discussions with village heads and meetings with civil servants and the MER staff (both local and national level), was conducted to gain an idea of the problems involved.

Written questionnaires (copies available from the authors) were then completed in 50 randomly-chosen households in each of the four villages. Standard questions were asked by one of the authors (D. S. Baquete) in the local language, Ronga, and the answers were written down. Approximately 70 questions were formulated in such a way that some answers could be double-checked and related to basic demographic variables such as household size, religion, education and economic activity. The utilization and importance of the natural resources of the MER formed the second part of the questionnaire, after which the problem of crop damage was discussed. The last part of the questionnaire was directed at obtaining insight into the personal opinion of individuals regarding the MER, as well as some topics addressing management, control, and conservation. The term 'liking' in the text is synonymous with a positive attitude towards the MER, agreeing with its existence.

After the 50 interviews were completed, every fifth person was asked to fill in several different matrices (Guijt & Neefjes 1991; Whiteside 1994). The matrices comprised drawings of the different resources in relation to their possible uses.

Special matrices were made to investigate seasonal importance. Three broad categories of natural resources were defined, namely plants, animals (mainly mammals), and fish. People valued use per resource by placing 0–10 matchsticks in the corresponding cell. The mean number of matchsticks in a cell was the preference rating (relative value rank) of that resource for a specific purpose.

During the fieldwork, which required three weeks per village, daily observations were conducted to validate the answers given by the local population.

### Data analysis

Resource use and demographic variables were compared amongst sites using  $\chi^2$  tests. Confidence limits were employed (Wonnacott & Wonnacott 1990) for multiple comparisons. A weighted average for each questionnaire answer was calculated for the study area as a whole, taking into account the differences in the population sizes of the four sites.

Attitude data were statistically analysed using proportion-tests with continuity correction ( $z$ -test, Zar 1984). Linear regression was used to determine the relationship between attitude and number of invading species.

Non-equitable use of resource categories in the matrices were analysed using a  $\chi^2$ -test. Cell residual analysis (discrepancies between observed and expected values) was used to test for differences of individual cells (Siegel & Castellan 1988).

## Results

### Demography

Household size was not equal amongst sites (Table 1); it was significantly larger at the Fábrica de Cal, and smaller in

Salamanga and around Lagoa Piti. Most of the household members had been born in the district, but there were some significant differences ( $p < 0.01$ ) amongst villages (Table 1). The majority of the people were Christians, with differences amongst sites. In Bela Vista, all of the people said they were Christian, but in Lagoa Piti, only 58% of the households practised religion. Ethnic background was similar for the sites, most (94%) of the people were Ronga. The level of formal education also varied significantly amongst sites; a higher proportion of households had children attending school at Fábrika de Cal, and at Lagoa Piti this level was lower.

Agriculture was the main activity and all families had access to land. The main crop was maize, together with (in order of importance), cassava, beans, groundnuts, pumpkin, sweet potatoes, papaw, rice and onions. The most important crops for marketing were sugar cane, tomatoes, onions, bananas, and melons. Agricultural production was low, because of the sandy soil with low fertility and low annual rainfall.

Thirty-two percent of the households possessed chickens, 31% ducks, 12% one or more goats, and 3% cattle; 28% had no livestock. A low percentage of households (< 3%) had pigs, doves or guinea pigs. Before the civil war, pastoralism had been important, but cattle numbers had been decimated.

None of the people contacted during the study exploited more than four different resource categories (fish, fuelwood, animals, construction material, fruits, etc.) intensively. The percentage of people exploiting two to four different categories was significantly higher at Salamanga and lower at Bela Vista (Table 1).

### Plant use

Plant resources were exploited more than animals and fish, but there were significant differences amongst sites (Table 2;  $\chi^2 = 24.7$ ,  $p < 0.001$ ), with people living in Bela Vista relying significantly more on plant resources than elsewhere. When asked if they wanted to exploit plant resources within the MER, 96% of the respondents said they did want to (Table 2); there were no differences amongst sites ( $\chi^2 = 12.3$ ,  $p > 0.05$ ).

On average, fruit consumption and the use of plants for construction purposes (mostly trees and thatch grasses) were the most important plant-resource uses (Table 3). The utilization of resources was significantly different amongst sites ( $\chi^2 = 54.8$ ,  $p < 0.001$ ) for four reasons. At Lagoa Piti,

**Table 2** The percentage of households exploiting natural resources of the MER in the four sites ( $n = 200$  households), as well as the weighted mean for the area. The mean percentage of respondents (combined sites) wishing to exploit the resource is also given (Desire). BV = Bela Vista, Sal = Salamanga, FdeC = Fábrika de Cal, Piti = Lagoa Piti.

	Site:				Mean	Desire
	BV	Sal	FdeC	Piti		
Plants	88%	32%	68%	54%	71%	96%
Animals	16%	22%	46%	60%	21%	50%
Fish	30%	40%	28%	58%	33%	62%

**Table 3** The percentage of households ( $n = 200$ ) in the four sites mentioning the collection of plant material for specific purposes and the weighted mean for the area. BV = Bela Vista, Sal = Salamanga, FdeC = Fábrika de Cal, Piti = Lagoa Piti.

	Site:				Mean
	BV	Sal	FdeC	Piti	
Construction material	92%	84%	68%	42%	86%
Fruits	54%	78%	50%	60%	60%
<i>Sura</i> , beverage	24%	0%	0%	24%	16%
Fuelwood	16%	14%	10%	16%	15%
Honey	16%	16%	0%	22%	15%
Charcoal	14%	16%	10%	12%	14%
Medicinal use	2%	0%	2%	2%	1%
Other use	26%	18%	0%	0%	22%

less use was made of plant material for construction. Honey was less exploited at the Fábrika de Cal. Palm trees, used for the production of the alcoholic beverage *sura*, were more exploited at Lagoa Piti and less exploited in Salamanga (Table 3).

Plants had more use categories, and were on average valued more highly, than animal and fish resources (Table 4;  $\chi^2 = 48.8$ ,  $df = 2$ ,  $p < 0.001$ ). Significantly higher value ranks for plant resources were given for fruit and construction materials, significant lower values were attributed for charcoal, for medicinal use and crafts (Table 4). There was a considerable discrepancy between the 1% exploitation of medicinal plants (Table 3) and the value of 7.1 attached to them (Table 4).

**Table 4** The mean relative value rank for usage of the three main resources, based on results of the matrix questionnaires ( $n = 40$ ). + = larger than expected, - = smaller than expected, \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ .

	Plants	Animals	Fish
Fruits	9.7 +***		
Construction material	8.8 +**		
Fuelwood	8.6		
Charcoal	6.7 -**		
Domestic utensils	7.0	0.8 -***	
Crafts	6.5 -**	2.3 -***	
Consumption	8.1	7.4 +***	8.0 +***
Commercial sale	7.0 -*	6.3 +***	8.4 +***
Medicinal use	7.1	4.4	2.3 -***
Other use	8.4	5.3 +**	0.6 -***
Average	7.8 +**	4.4 -**	4.8 -**

**Table 5** The mean relative value rank for usage of animal species and the mean relative value rank of animal species per site, based on the results of the matrix questionnaires ( $n = 40$ ). \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ ; += larger than expected, -= smaller than expected.

	<i>Animal:</i>							<i>Mean</i>
	<i>Antelopes</i>	<i>Hippos</i>	<i>Bushpigs</i>	<i>Elephants</i>	<i>Monkeys</i>	<i>Crocodiles</i>	<i>Others</i>	
Consumption	8.2	7.7	7.5 +***	7.7 -*	7.0 +***	0.3 -***	7.3 +***	6.5 +***
Commercial sale	7.2 +*	4.6 -***	7.2 +***	3.3 -***	3.2 -***	2.2 +**	5.6 +***	4.7 +***
Skin	6.2 +***	4.6	0.1 -***	2.7 -***	5.2 +***	1.8 +***	3.8	3.5 +***
Teeth & ivory	4.4	3.9	3.9 +***	7.1 +***	0.7 -***	0.8	0.6 -***	3.1
Medicinal use	2.1 -***	4.1	2.9	4.8 +*	1.7 -***	2.1 +***	3.8 +***	3.0
Social use	1.5	1.5	0.5 -***	1.8	0.8	0.8 +***	0.8	1.1 -***
Crafts	1.8	1.5 +*	0.4 -**	3.3 +***	0.1 -***	0.0	0.0 -***	0.9 -***
Other use	2.7	2.6	1.2 -**	2.7	2.1 +**	0.6	1.4	1.9 -***
Lagoa Piti	4.4 -***	4.2 -*	3.1 -**	4.6	3.0	3.4 +***	3.5	3.7 +**
Salamanga	2.0	2.3	1.9 +*	3.1 +***	1.4	0.0 -***	1.5	1.7 -***
Fábrica de Cal	3.9 +***	3.0	2.5 +*	2.6 -*	1.9	0.0 -***	1.9	2.3 -***
Bela Vista	3.1	2.7	2.0	2.9	2.0	0.0 -***	2.4 +**	2.1 -***
Mean	4.2 +***	3.8 +***	3.0	4.2 +***	2.6 -***	1.1 -***	2.9 -*	

A small difference was found in resource use between winter and summer ( $\chi^2 = 18.8$ ,  $p < 0.025$ ), caused mainly by greater fruit consumption in summer than winter ( $p < 0.05$ ).

### Animal and fish use

On average, 21% of the people said they hunted animals. Within this group, about one fifth were indifferent to which species were exploited. The majority preferred (in order of preference) bushpigs (*Potamochoerus porcus*), reedbuck (*Redunca arundinum*), common duiker (*Sylvicapra grimmia*), red duiker (*Cephalophus natalensis*), suni (*Neotragus moschatus*) and scrub hare (*Lepus saxatilis*).

Half of the people said they wanted to exploit animal resources (Table 2), although only 21% said they actually did. For animal resources, commercial sale, consumption and other uses had the highest relative value ranks (Table 4). Relative value rank for animal resources were significantly lower at Bela Vista and Salamanga ( $\chi^2 = 61.7$ ,  $p < 0.001$ , cell differences significant at  $p < 0.01$ ) and higher at the Fábrica de Cal. No difference was found in resource use between winter and summer.

Use purpose depended on species (Table 5;  $\chi^2 = 1167.9$ ,  $p < 0.001$ ). Some of the animals, such as hippo and elephant, the hunting of which is prohibited by traditional and official

laws, were highly valued for certain uses, but were not mentioned as preferred species. Antelopes, hippos and elephants had significantly higher value ranks than expected (Table 5). The value rank for bushpigs was equal to that expected, whilst monkeys, crocodiles and other animals had significantly lower preference ratings.

There were significant differences in value rank amongst uses (all species combined,  $\chi^2 = 2249$ ,  $p < 0.001$ ). Skins, commercial value and own consumption had significantly higher relative rank values than expected, but social use, other uses and crafts were significantly lower (Table 5). Medicinal value and the value for teeth and ivory were as expected.

All animals had high relative value ranks for consumption except crocodiles (Table 5). However, the crocodile's medicinal value was mentioned by several people; its skin and internal organs (e.g. liver) were used. Elephants and other faunistic resources (e.g. birds) had high relative value ranks for medicinal use (Table 5). Elephant faeces were used as a medicine for various illnesses and were burned to repel mosquitoes. The skins of antelopes and monkeys, which were used for bags, mats, ornaments, dancing robes and for medicinal purposes, were considered especially important. Elephants were highly valued for their ivory and were less important for consumption, commercial sale or for their skin (Table 5). Bushpig meat was highly appreciated and bushpigs

**Table 6** The percentage of respondents (all sites combined) mentioning different reasons for liking or disliking the MER, with total number of given reasons *n*.

Reason:	Attitude:		
	Liking	Disliking	No opinion
Part of the tradition	39%	2%	20%
Source of conflicts		20%	
Invading species causing crop damage	1%	51%	33%
Employment opportunity	2%	2%	
Prohibition of exploitation		10%	20%
Part of education	5%		
Possibility of resource use	10%		
Protection	7%		
Natural heritage	3%		
Living museum	26%		
Indifferent	7%	15%	27%
<i>n</i>	175	41	15

had a high commercial-sale preference rating; bushpig teeth also had significantly higher relative value ranks than expected (Table 5). The highest value ranks for antelopes were for skins and for commercial sale. In the case of monkeys, the skin and own consumption had significantly higher relative value ranks (Table 5).

The average value rank per species was significantly higher in Lagoa Piti than at the other three sites (Table 5). The relative value rank per animal clearly differed amongst sites ( $\chi^2 = 665$ ,  $p < 0.001$ ); the largest differences were for antelopes, elephants and crocodiles (Table 5).

Fish were caught using lines, gill nets, seine nets, boats, harpoons and traps made of reeds. When sold, the fish was cleaned, salted and dried and marketed in Salamanga or Bela Vista. Thirty-three percent of respondents fished inside the MER, but the majority (62%) said they wanted to fish there (Table 2). The five main fish species harvested (*Tilapia* spp., *Carcharinus leucas*, *Anguilla* spp., *Clarias gariepinus* and *Synodontis zambensis*) did not differ in their use ( $\chi^2 = 20.9$ ,  $p > 0.05$ ). The most important usages were consumption and commercial sale (Table 4). People at Lagoa Piti fished more (Table 2) and valued fish more highly than at other sites ( $\chi^2 = 44.7$ ,  $p < 0.001$ ).

### Attitude and crop damage

On average, 88% of households had a positive attitude towards the MER (Table 1), but attitudes differed amongst sites ( $\chi^2 = 15.7$ ,  $p < 0.005$ ). The site with the highest positive attitude was Bela Vista, whilst the Fábrica de Cal showed the lowest positive attitude. The most important reasons given for liking the MER (Table 6) were that it was part of their tradition and they appreciated it as a living museum. The most important reason mentioned for not liking the MER was the invasion of animals responsible for crop damage (Table 6). Although some people refrained from ex-

pressing an opinion about liking or disliking the MER, they did mention their reasons.

When asked who at present benefits from the MER's natural resources, 33% referred to people from outside the area, including charcoal burners, fuelwood harvesters with truck transport to Maputo, salesmen, and hunters with cars and automatic rifles. A total of 7% indicated rural people as the main beneficiaries and 24% thought that both local and non-local people benefited. When asked who should benefit from the MER's natural resources, 55% indicated that the rural people should benefit, 18% said rural people together with people from elsewhere should, 19% did not answer the question and 8% referred to other groups. When asked how the exploitation should be controlled, 35% of the people suggested there should be closed seasons varying amongst resource categories, 25% said it should be controlled by licences, 27% had no opinion, 7% referred to traditional laws, 4% said that the National Wildlife Department should stay in charge and 2% opted for exploitation without any control. Regarding the management of the MER, the majority (67%) suggested there should be participation by the rural communities in the management of the MER, 18% had no opinion, 6% indicated the National Departments, and 9% said they thought that it would, in any event, be impossible to manage the resources.

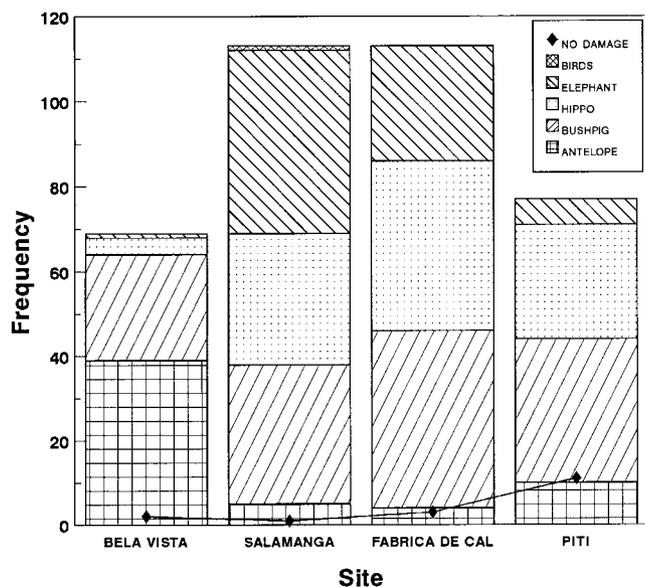
In this study household size, ethnic group, religion, sex, or educational level had no significant influence on attitude (Table 7). In addition, livestock possession as a measure of affluence, and the distance between the MER and the settlements, did not influence attitude. Those exploiting MER resources less than average were somewhat more positive in attitude (86%) than those with above-average resource use (77%) but this was not statistically significant (Table 7). However, people who had suffered crop damage had a less positive attitude than people who had not suffered crop damage in relation to both elephant and hippo (Table 7). Antelope crop damage did not affect attitude, nor did that of other animals. Another important aspect was the location of the settlements; people living west of the Maputo River had a more positive attitude regarding the MER than the people on the east side, and people originally from the district were significantly more negative than people from elsewhere (Table 7).

Species held responsible for crop damage differed significantly amongst sites (Fig. 2). Crop damage by elephants was significantly lower in Bela Vista and Lagoa Piti and higher in Salamanga ( $\chi^2 = 58.8$ ,  $p < 0.001$ ). There were significantly more reports of crop damage by hippo in Salamanga and Fábrica de Cal than elsewhere ( $\chi^2 = 27.6$ ,  $p < 0.001$ ).

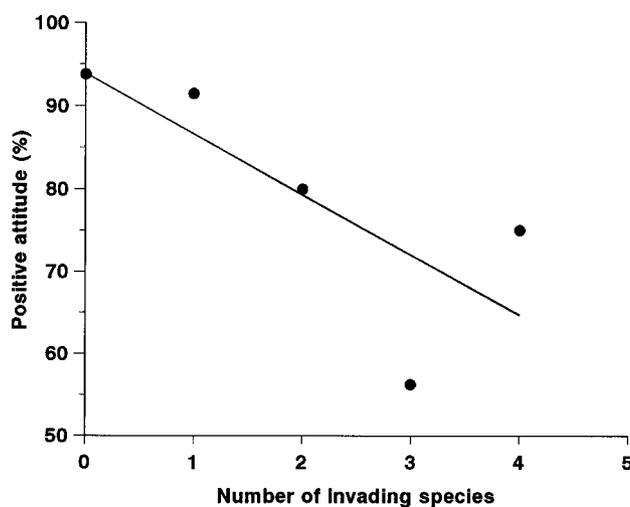
Households were grouped in five different categories according to the number of invading species, and those without any crop damage caused by animals had the highest positive attitude (94%), while there was a significant negative linear relationship ( $t = -4.23$ ,  $n = 185$ ,  $p < 0.0001$ ) between number of invading species and attitude amongst the households investigated (Fig. 3); however, only 9% of the variance was

**Table 7** The percentage of people liking the MER compared amongst different demographic categories, with *z* values and level of significance (*p*); sample size is given in brackets. NS = not significant.

Category:	Groups:		Statistics
Ethnic group	Ronga	Other	<i>z</i> = 1.800
	77% (170)	87% (15)	<i>p</i> = NS
Sex	Male	Female	<i>z</i> = 0.296
	80% (88)	76% (97)	<i>p</i> = NS
Household size	Small	Large	<i>z</i> = 0.135
	78% (81)	78% (104)	<i>p</i> = NS
Educational level (children > 4th grade)	With	Without	<i>z</i> = 0.655
	81% (89)	75% (96)	<i>p</i> = NS
Religious	Yes	No	<i>z</i> = 1.199
	80% (137)	69% (42)	<i>p</i> = NS
Location	Inside MER	Outside MER	<i>z</i> = 0.713
	75% (48)	79% (137)	<i>p</i> = NS
Origin	Local	From elsewhere	<i>z</i> = 2.327
	74% (145)	90% (40)	<i>p</i> < 0.05
Livestock	Without	With	<i>z</i> = 0.767
	81% (122)	85% (53)	<i>p</i> = NS
River side	East	West	<i>z</i> = 3.156
	71% (136)	96% (49)	<i>p</i> < 0.002
Resource use	Few	Many	<i>z</i> = 1.442
	86% (51)	77% (130)	<i>p</i> = NS
Elephant crop damage	Present	Absent	<i>z</i> = 3.879
	61% (93)	89% (113)	<i>p</i> < 0.001
Hippo crop damage	Present	Absent	<i>z</i> = 3.585
	69% (93)	87% (92)	<i>p</i> < 0.01
Bushpig crop damage	Present	Absent	<i>z</i> = 2.281
	73% (125)	88% (60)	<i>p</i> < 0.05
Antelope crop damage	Present	Absent	<i>z</i> = 1.425
	86% (57)	74% (128)	<i>p</i> = NS



**Figure 2** The frequency of crop damage reported per site. Symbols indicate the frequency of absence of crop damage. Bars give cumulative frequency of crop damage caused by different animals. Piti = Lagoa Piti.



**Figure 3** The relation between the number of invading species causing crop damage and the percentage of farmers with a positive attitude towards the MER.

explained. The origin of the species causing the crop damage also influenced attitude concerning the MER. People who did not consider the MER as the origin of the crop-raiding species were more positive towards the MER than those who thought that all or some of the animals responsible for the damage originated from the MER (93% and 71% respectively).

## Discussion

This study illustrates the resource use of a typical agricultural subsistence economy, supplemented by gathering plant products and, occasionally, animal and fish products. Agricultural productivity in the study area was low, which was one of the reasons given for the importance of the natural resources available inside the MER. The natural resources of the Reserve significantly contributed to the different subsistence needs of the rural people. Construction material (poles, reeds and grasses), food, medicinal products and products for commercial sale were the most important uses, and valued highest. Although the exploitation of the MER's resources is officially prohibited, in fact all resources were used by the rural people.

The four study sites can be characterized in terms of demography and resource use. The population of Bela Vista had a larger proportion of people from outside the area and was relatively more dependent on plant resources of the MER. Families at the Fábrica de Cal were larger, because other family members were attracted to the area by people with regular employment. The income of those with employment decreased their dependence on the MER's resources, but they still exploited both plant and animal resources at a relatively high level. Lagoa Piti is situated within the MER and was deprived of public facilities. People at Lagoa Piti exploited animal and fish resources of the MER more than the people at the other sites. They also valued animal and fish resources more highly than other respondents. The exploitation of plant resources of the MER in Salamanga was low, which is partly due to the fact that the vegetation around Salamanga is similar to that in the MER. This evidently decreased the need for exploitation of these resources within the MER.

The low value rank for commercial sale of plant products can be explained by the principle that market value may reflect supply and demand. The plant resources were commonly exploited, and were readily available; local market demand was therefore low, as people were easily capable of fulfilling their own needs.

The large difference between the low number of people exploiting plant resources for medicinal purposes and the high relative value of this resource is explained by the fact that the collection of medicinal products was reserved for a small group of practitioners of traditional medicine. The region around the MER is known in Maputo for its importance to traditional medicine. Some of the traditional medicine practitioners did not wish to cooperate with us.

This probably negatively influenced the average value rank for medicinal use as well as the percentage occurrence of this practice in the population.

The difference between desire and actual exploitation was greater for animals and fish than plant resources. This is caused by the fact that hunting is prohibited and fishing is restricted within the MER. Animal species were preferred in order of decreasing body mass, with the heaviest species such as bushpigs and reedbucks highest on the list. The prevention and control of illegal hunting is attempted and is also seen as a conservation priority by the management staff of the MER. The utilization of plant resources for subsistence needs, such as the collection of construction material, thatch grasses and reeds and medicinal plants is permitted, although unofficially.

Cash was earned by selling fish, small game animals and other local products such as vegetables, honey, medicinal products, some crafts and the alcoholic beverages made from palm trees (see also Boyd 1996), but the economic value of resources gathered from the MER is probably also substantial. Shackleton (1996) calculated that the minimum combined value of products derived from natural resources in Natal (*Sclerocarya birrea* fruits, fuelwood, thatch grass and carving timber) was at least US\$10.70 ha<sup>-1</sup>, almost equal to the gross income of commercial cattle farming (US\$17 ha<sup>-1</sup>). At the moment, the wood products of the study area are not marketed to the same extent as in Natal. However, commercialization can be expected to increase as access to the area has improved with the new roads constructed in 1997.

Surprisingly, little difference in resource use amongst seasons was found, although other detailed studies have clearly described seasonal changes in resource use (e.g. McGregor 1995).

No data have been collected on the availability of resources in relation to the actual exploitation volume. But the general impression is that plant resources benefited from the absence of people during the civil war and the disappearance of cattle from the area. The vegetation of the MER has recuperated from overgrazing in the 1960s and 1970s (DNFFB 1997), but hunting has reduced animal numbers. The reedbuck and small antelope populations have been affected severely and other species are now extinct from the area, such as cheetah (*Acinonyx jubatus*), white rhino (*Ceratotherium simum*), buffalo (*Syncerus caffer*), blue wildebeest (*Connochaetes taurinus*) and zebra (*Equus burchelli*). Such local extinction as a consequence of civil war has occurred elsewhere in Africa. The introduction in 1997 of kudu and waterbuck (*Kobus ellipsiprymnus*), and scheduled reintroductions of other species, will increase species diversity and hence the attraction of the MER for tourist development.

## Attitudes towards the MER

Positive attitudes towards the MER were common in the local population. The figures (62–96%) are high, especially when the forced resettlement campaign in the 1970s is taken

into account. Traditional cultural practices aimed at the sustainable exploitation of natural resources (Infield 1988) could explain this positive attitude and acceptance of the national conservation policy.

It may be that negative attitudes are in reality more prevalent. Questionnaires do have drawbacks, as people do not willingly give negative opinions to a third party and certainly conceal illegal exploitation practices, however, questionnaires are a cost-effective method of studying resource use and attitudes of local communities. The answers of respondents were, in general, confirmed by our own observations during fieldwork, but with one exception: one-fifth of the respondents admitted they hunted, but this is probably an underestimation due to the fact that they knew hunting is forbidden inside the MER. Contingency tables have scarcely been used to assess relative values of natural resources, and in the present case offered a better picture of hunting than did the standard questionnaires.

Demographic variables in the MER area are unimportant for attitude. Ethnic group, religion, formal education, affluence, land shortage, benefits deriving from the PAs and other variables are significantly correlated with attitude elsewhere (see overview in Fiallo & Jacobson 1995). The homogeneity of the study group could, in our case, also have concealed the influence of demographic factors on attitude. This study has shown that the attitude of the local population is influenced by crop damage, and by the species and number of species responsible for the damage. Crop damage has also been given elsewhere as the main reason for disliking PAs (Parry & Campbell 1992; Heinen 1993; Newmark *et al.* 1993). Studies of relationships between PAs and people have been rare (Fiallo & Jacobson 1995). In the present case, only one factor, namely crop damage, significantly influenced attitudes of local people to the MER, and this is the first study to link the number of invading species with attitude. More such studies are needed as a basis for developing park management approaches.

It is possible that the influence of social factors, proven to be important in understanding attitudes in other studies (Fiallo & Jacobson 1995), were hidden by the negative influence of crop damage in the present investigation. However, a stepwise nested analysis including crop damage variables, demographic factors and degree of resource exploitation, failed to show significant correlations except for the crop damage relationship with attitude (de Boer & Baquete, unpublished data 1997). Around Bela Vista, crop damage was rarely caused by large herbivores. This is partly explained by the Maputo River, which acts as a barrier protecting the agricultural fields involved. However, it can also be explained by the relationship between mammalian size and human density: larger animals invade crops closer to reserves in areas where human densities are generally low, whilst smaller pest animals (such as rats and birds) are more frequent in more densely populated areas further away from PAs (Newmark *et al.* 1994; Studsrød & Wegge 1995). The reason why people originally from the district were more negative than people from elsewhere, is explained by their different settlement

patterns. The latter group settled mainly in Bela Vista, and therefore experienced reduced crop losses. The case of Lagoa Piti is unusual: although situated in the MER, elephant damage is rare. This is explained by the movements and distribution pattern of the elephants; they are rare around Lagoa Piti and prefer the area along the Futi River to the east, closer to the other settlements.

A reduction in the amount of crop damage attributable to the animals in the Reserve could improve the relationship between the MER and the surrounding population. MER staff must try to diminish the impact of larger species such as elephant and hippo. The majority (67%) of the population thought that elephant damage occurred more frequently than in the past as a result of less efficient control by MER staff (Boyd 1996). The fact that farmers complain disproportionately more about large pest species such as elephants and hippos, because they are more difficult to deal with and are aggressive, nocturnal, and cause more highly visible damage, however, should also be recognized. The electric fence, which is currently under construction, will probably reduce elephant and hippo crop damage considerably, but recent protests by local people opposed to the fence showed that its construction is not totally accepted. People feared resource utilization restrictions, as the fence also limits human access to the MER's resources.

The absence of a relationship between resource use and attitude (e.g. Studsrød & Wegge 1995) was surprising. The MER offered a variety and quantity of natural resource products which provided substantial benefits to the rural people. As resource access was traditionally free, it is possible that the participants did not acknowledge the ownership of the resources by the MER authorities. Both Parry and Campbell (1992) and Heinen (1993) mentioned the underestimation of free benefits and overestimation of damage.

### **Management and participation by the local people**

The data presented here are useful for management plans regarding the MER's resources. Participation by the local communities is seen by some as a key towards a successful conservation strategy (Kiss 1990; Durbin & Ralambo 1994; Happold 1995; Rihoy 1995; Alpert 1996; Heinen 1996), although actual successes seem rare (Sibanda 1995; Richards 1996). The influence of international conservation agencies which are advocating the community-participation approach in third-world countries should not be ignored.

The apparent desire of the local population to be included in the MER's management, when linked to the national policy directed at participation of rural communities surrounding PAs, poses some basic questions, such as:

- To what extent can the resources be exploited?
- Will subsistence hunting of small game be allowed in the near future?
- How should the participation of rural communities in the management of the MER be structured?

A balance must be found between conservation and sustainable utilization. It will be necessary to quantify resource availability, production and use in a carrying capacity analysis (see the tentative approach of de Bie *et al.* 1987).

The sustainable utilization by the rural people of reedbeds for thatching, palms for wine production, honey, medicinal plants, carving wood, fruits and fish could offer a new basis of collaboration between the local population and the MER authorities. The acceptance of a certain level of exploitation of these resources by both the local population and the MER authorities could result in the formulation of a mutually acceptable resource-use plan. Attention must also be paid to exploitation techniques. Which exploitation methods should be permitted? For instance, should commercial fishing practices using modern gill nets be banned in favour of traditional fishing practices? An awareness of benefits deriving from the MER, together with education programmes encouraging the sustainable use of natural resources through traditional conservation practices, could result in the acceptance of restrictions on use. The creation of associations of rural people to market local products could bring substantial benefits for the participants. The participation of local hunters in community-based wildlife management programmes may hold promise (Marks 1994).

This study showed that resource utilization, resource value and people's attitude towards the MER were site-dependent, and this might ultimately be reflected in site differences in management approach. The start of the construction of the electric fence at the west side of the MER, the area with highest elephant crop damage, is an example. A special programme should be developed to enhance benefits from fisheries at a sustainable level at Lagoa Piti for the local population, like the successful programme at Kosi Bay, South Africa (see Blaber 1997). Discussions with the different local communities should be initiated, as a first step to giving them managerial power and responsibility over the available resources. A prerequisite for such an approach would be a well-structured Forestry and Wildlife Department, with a clear conservation policy, and an efficiently-functioning and effective field staff, but these still require attention in the case of Mozambique. A complication for embarking upon community-based strategies in Mozambique is that traditional power structures, usually the doorway to local populations, have been systematically substituted by a new government administration, and are not generally accepted. This makes the implementation of wildlife exploitation and community conservation programmes, such as the Campfire projects (Sibanda 1995), more difficult. This is also the case for other areas in Mozambique, and the procedure of contacting local communities through traditional or governmental structures will depend on local circumstances. Moreover, highly-valued animal species have declined substantially in the MER, reducing the prospect for their sustainable utilization, and consequently reducing economic benefits that rural communities might gain from wildlife in the near future.

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