Contributed Paper

Insights for Integrated Conservation from Attitudes of People toward Protected Areas Near Hwange National Park, Zimbabwe

CHLOE GUERBOIS,*†‡ ANNE-BEATRICE DUFOUR,‡ GODFREY MTARE,§** AND HERVE FRITZ†‡

*UMR 7204 MNHN-CNRS-UPMC, Conservation des espèces, restauration et suivi des populations, Muséum National d'Histoire Naturelle, 55 rue Buffon, Paris F-75005, France, email chloe.guerbois@univ-lyon1.fr
†CNRS HERD Programme–Hwange LTER, Main Camp research, Hwange National Park, BP 62, Dete, Zimbabwe
‡Université Lyon 1, CNRS, UMR 5558, Laboratoire de Biométrie et Biologie Evolutive, 43 bd du 11 nov 1918, Villeurbanne F-69622, France
§Zimbabwe Parks and Wildlife Management Authority, P. Bag 140 CY, Causeway, Harare, Zimbabwe
**University of Cambridge, Geography Department, Downing Place, CB2 3EN, Cambridge, United Kingdom

Abstract: *Increase in human settlements at the edge of protected areas (PAs) is perceived as a major threat to conservation of biodiversity. Although it is crucial to integrate the interests of surrounding communities into PA management, key drivers of changes in local populations and the effects of conservation on local livelihoods and perceptions remain poorly understood. We assessed population changes from 1990 to 2010 in 9 villages located between 2 PAs with different management policies (access to natural resources or not). We conducted semi-directive interviews at the household level (n = 217) to document reasons for settlement in the area and villager's attitudes toward the PAs. We examined drivers of these attitudes relative to household typology, feelings about conservation, and concerns for the future with mixed linear models. Population increased by 61% from 2000 to 2010, a period of political and economic crisis in Zimbabwe. Forty-seven percent of immigrants were attracted by the area; others had been resettled from other villages or were returning to family lands. Attitudes toward PAs were generally positive, but immigrants attracted by the area and who used resources within the PA with fewer restrictions expressed more negative attitudes toward PAs. Household location, losses due to wild animals, and restrictions on access to natural resources were the main drivers of this negative attitude. Profit-seeking migrants did not expect these constraints and were particularly concerned with local overpopulation and access to natural resources. To avoid socio-ecological traps near PAs (i.e., unforeseen reduced adaptive capacity) integrated conservation should address mismatches between management policy and local expectations. This requires accounting for endogenous processes, for example, local socio-ecological dynamics and values that shape the coexistence between humans and wildlife.*

Keywords: perception, population growth, protected areas, rural livelihoods, social and cultural values, socio ecological systems, socio ecological traps

Percepciones para Conservación Integrada a Partir de las Actitudes de las Personas hacia Áreas Protegidas cerca del Parque Nacional Hwangem Zimbabwe

Resumen: *El incremento de asentamientos humanos a la orilla de áreas protegidas (AP) es percibido como una amenaza mayor para la conservación de la biodiversidad. Aunque es crucial integrar los intereses de las comunidades circundantes en el manejo de las AP, los conductores clave del cambio en poblaciones locales y los efectos de la conservación de sustentos locales y las percepciones permanecen pobremente entendidos. Estudiamos cambios poblacionales desde 1990 hasta 2010 en 9 aldeas ubicadas entre 2 áreas protegidas con diferentes políticas de manejo (acceso a recursos naturales o no). Llevamos a cabo entrevistas semidirigidas*

a nivel de casas (n = 217) para documentar las razones del asentamiento en el área y la actitud de los aldeanos hacia las AP. Examinamos los conductores de estas actitudes en relación con la tipología de la casa, sentimientos hacia la conservación y preocupaciones por el futuro con modelos lineales mixtos. La población incrementó en 61% desde 2000 hasta 2010, un periodo de crisis política y económica en Zimbabwe. El 47% de los inmigrantes fueron atraídos por el área; otros habían sido reubicados de otras aldeas o estaban regresando a tierras familiares. Las actitudes hacia las AP eran generalmente positivas, pero los inmigrantes atraídos por el área y que usaban recursos dentro de la AP con menos restricciones expresaron más actitudes negativas hacia las AP. La ubicación de las casas, la pérdida debido a animales silvestres y las restricciones sobre el acceso a los recursos naturales fueron los principales conductores de estas actitudes negativas. Los migrantes que buscaban ganancias no esperaban estas restricciones y estaban particularmente preocupados con la sobrepoblación local y el acceso a los recursos naturales. Para evitar trampas socioecológicas cercanas a las AP (p.ej.: capacidad adaptiva reducida no prevista) la conservación integrada debe dirigirse a los desajustes entre las políticas de manejo y las expectativas locales. Esto requiere un arreglo de cuentas para los procesos endógenos, por ejemplo, dinámicas socioecológicas locales y los valores que forman la coexistencia entre humanos y vida silvestre.

Palabras Clave: áreas protegidas, crecimiento poblacional, percepción, sistemas socioecológicos, sustentos rurales, trampas socioecológicas, valores sociales y culturales

Introduction

Whereas the consequences of immigration in terms of conservation are well defined, the causes of changes in human settlement around protected areas (PAs) are not well understood (Oglethorpe et al. 2007). Wittemyer et al.'s (2008) suggestion that accelerated human population growth occurs on the edge of PAs raises the issues of the effects of conservation-related funding on PA effectiveness and on the values of PAs for local people. Using the same data sets as Wittemyer et al. (2008), Joppa et al. (2009) found no evidence of increasing human populations near PAs. This finding brings into question the use of large-scale meta-analyses to address population change on the edge of PAs. In particular, Hoffman et al. (2011) underline that by amalgamating all human communities as "populations," large-scale analyses of population growth at the edge of PAs often neglect local land tenure systems and diversity of values that may facilitate or impede migration. In a PLoS ONE "Reader Comment" (http://www.plosone.org/annotation/listThread.action?root=13%2C089), J. Igoe argues that without a better understanding of the dynamics of human communities living on the boundaries of PAs, interventions targeting these communities are likely to misfire in terms of addressing social equity and in terms of protecting biodiversity. Overall, these researchers call for critical analyses of the interactions between people and PAs for use in addressing factors relevant to conservation planning. We investigated the drivers of population changes and how attitudes toward PAs vary among different kinds of settlers near Hwange National Park and Sikumi Forest Area, Zimbabwe. We also documented the concerns of people living near these PAs for their future livelihoods.

Often, human communities surrounding PAs have been excluded or prohibited from using natural resources, and their needs are regarded as incompatible with conservation (Infield & Namara 2001). Conventional exclusionary approaches to conservation can have high social costs, especially when affected indigenous people and local communities were marginalized even before establishment of the PAs (Borrini-Feyerabend et al. 2004). These "fortress conservation" models have been criticized because the associated opportunity costs are borne by the rural poor and the benefits accrue to governments, national elites, and wealthy foreign tourists, especially in Africa (Brockington 2002).

Integrated conservation and development projects (ICDP) have been conducted since the early 1990s with the aim of reducing opportunity costs of conservation or reestablishing property rights for indigenous people (Naughton-Treves et al. 2005). Some of these initiatives have been successful, but in general they do not appear to improve standards of living or to match indigenous visions of development (Alexander & McGregor 2000; Brockington 2002; Naughton-Treves et al. 2005). The ICDPs can also affect peoples' decisions to immigrate to places near PAs, and immigration to such areas may threaten initial conservation objectives (Scholte 2003). Because natural resources can contribute substantially to rural incomes (Cavendish 2000), PAs may have a great effect on people living nearby (West & Brockington 2006). However, drivers of human movement, often referred to as attraction models, cannot be explained by perceived economic opportunities alone (Hoffman et al. 2011). Scholte and De Groot (2010) built on the push-and-pull framework of Oglethorpe et al. (2007) and proposed 2 models and an incidental category to describe immigration to PA edges. Their frontier-engulfment model corresponds to a situation where population increases as a result of resource extraction at the edge of the PA and subsequent development of agriculture. In the attraction model, people settle near the PA for the services it provides (employment, ICDPs, resources). Incidental

mechanisms of settlement near PAs involve movement of people toward PAs during times of conflict or natural disaster. This category also includes movement of people evicted from PAs or lands set aside for commercial development and people in need of resettlement. Because some PAs have the dual purpose of protecting biodiversity and contributing to poverty alleviation (Naughton-Treves et al. 2005), it is crucial to understand links between people and PAs, drivers of attractiveness of PAs to people, and related peoples' attitudes toward PAs (Salafsky & Wollenberg 2000; J. Igoe PLoS ONE "Reader Comment" [http://www.plosone.org/annotation/listThread.action?root=13%2C089]).

Our study area in Zimbabwe allowed us to explore the relations between population changes around PAs and peoples' attitudes toward conservation, in a context of diverse livelihood strategies and linkages to PAs, and to analyze the conditions for integrated management. The 9 villages we studied are located between 2 state-owned unfenced PAs, Hwange National Park (HNP) and Sikumi Forest Area (SFA). These areas have different histories and different restrictions on access to natural resources and hence different strategies to integrate rural communities in conservation efforts. Anyone who attempts to extract natural resources from HNP can be prosecuted; however, the boundaries of HNP are not fully controlled. On specific occasions extraction of thatching grass has been allowed under close supervision by HNP staff. In contrast to HNP, access to natural resources in SFA is more formally permitted and organized. Following severe drought in the early 1990s, local communities were authorized to graze cattle up to 3 km within the SFA boundaries. Firewood collection (dead wood only) is allowed but regulated, and wood harvesting can be authorized by the Forestry offices. In the early 2000s, coinciding with the Zimbabwean economic crisis, the veterinary fence separating SFA and the villages (households and associated fields) was dismantled. This led to an increase in encroachment of rural communities into the PAs and created major sources of conflict among stakeholders.

We investigated population changes in the 9 study villages and expected that, under the attraction model, immigrants would preferably settle close to the PAs on a gradient of distances. We tested correlations between level of immigration per village and proxies of attractants to PAs, including level of employment, access to facilities, and access to natural resources. We assessed whether people benefited living near the PAs and how their derived benefits were associated with a positive perception of the PA and conservation in general. We expected that people attracted to the area and that benefited from the PA would have a more positive perception of the PA than those who did not benefit. We explored plausible explanations for the negative perceptions of immigrants toward PAs by testing candidate variables related to 3 hypothetical sets of drivers: household typology, feelings and expectations toward conservation and future livelihoods, and location of settlement relative to PAs.

Methods

Study Area

Located in a communal area (i.e., an area dedicated to human settlement with lands allocated by traditional authorities) within the Hwange District (Matabeleland North, Zimbabwe), our study area (200 km^2) included 9 villages bordered to the southwest by the Main Camp area of Hwange National Park (HNP) (14 651 km^2), to the east by Sikumi Forest Area (SFA) (1100 km^2), and to the south by the town of Dete (26°87'E, 18°62'S) (Fig. 1). First designated as a game reserve in 1928, HNP is now under the management of the Zimbabwe Parks and Wildlife Management Authority, whereas SFA, designated in 1968, is under the management of the Forestry Commission of Zimbabwe. Human settlements are on the edge of SFA, whereas a small portion of land (i.e., a buffer area) used by people and wildlife exists between HNP and the communal area (Fig. 1). Hwange National Park and SFA are part of the Kavango–Zambezi Trans Frontier Conservation Area (TFCA), and HNP hosts one of the highest densities of free-ranging elephants in Africa, particularly in the Main Camp area (Chamaillé-Jammes et al. 2009).

The study area, classified as agroecological region IV, is characterized by low-fertility soils (mostly Kalahari sands) and erratic annual rainfall (606 mm, interannual CV = 25%). The villagers rely primarily on subsistence farming and natural resource harvesting. Maize (*Zea mays*), sorghum (*Sorghum bicolor*), and pearl millet (*Pennisetum glaucum*) are the main crops. Economically, the area has historically benefited from tourism (safaris), which declined during the Zimbabwean economic crisis in the 2000s (Bond & Cumming 2006).

In the communal area, access to natural resources and land use are ruled internally and enforced primarily by traditional leaders. There was no ICDP in place that could have affected people's use of natural resources (Scholte 2003; Wittemyer et al. 2008), except CAMPFIRE (Communal Areas Management Programme For Indigenous Resources), but this program has not yet been particularly successful in this area (C.G., unpublished data; see also Alexander & McGregor 2000 for a study of the distrust of CAMPFIRE in neighboring districts). The few local non-governmental organizations that operate in this area concentrate on food security, medical assistance, and education.

Data Collection and Processing

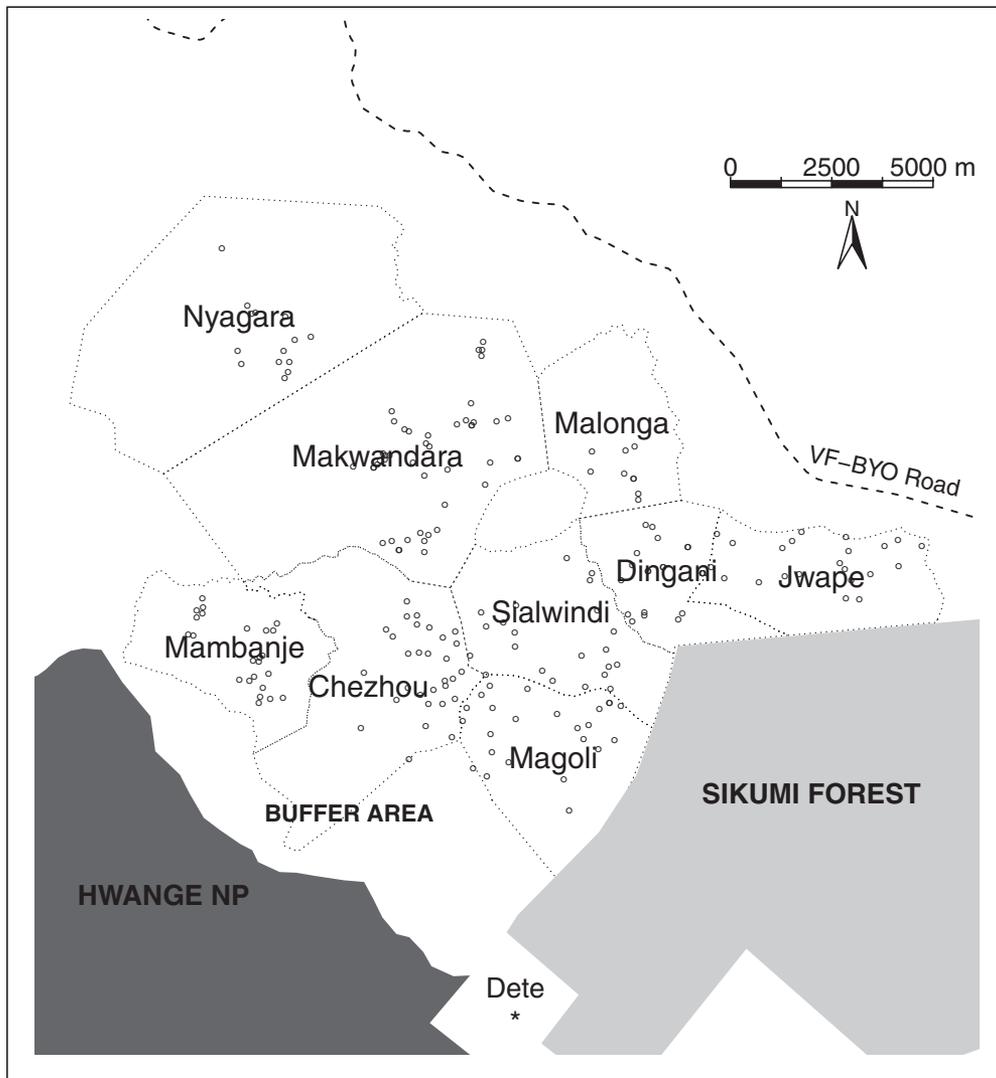We collected village histories through group discussions with key informants (village heads, headmen, and

Figure 1. Map of the study area in Hwange District, Zimbabwe (circles, sampled households [n = 217]). Hwange National Park and Sikumi Forest Area are the 2 protected areas.

elders). The number of households per village in 1990, 2000, and 2010 was extracted from records provided by the local traditional leaders (village heads and headmen [Supporting Information]). From 1990 to 2000, the Zimbabwean economy was growing, whereas 2000–2010 was characterized by high inflation and economic recession. We conducted semi-directive interviews from May to July 2011 following a stratified random sampling of 217 households in 9 villages distributed at different distances from HNP and SFA (Fig. 1). The interviews focused on livelihoods made at the periphery of PAs, peoples' history, education, perceptions of conservation and PAs, and concerns for the future; production systems used; and natural resources used. Interviews were conducted in local languages (Nambiya, Tonga, or Ndebele) by trained local assistants. The position of each household was recorded with a geographic positioning system.

To avoid a priori biases in data collection, responses to open questions were recorded exhaustively in writing. For the statistical analyses, we classified the responses a posteriori to minimize the number of modalities in each variable but glean as much information as possible. Thus, our results may be partly affected by our interpretation of the responses because qualitative analyses are always liable to subjectivity. However, having lived within the community for several years, we believe our qualitative assessment is meaningful (Drury et al. 2011; for the debate on qualitative data in conservation research) and reflects the complexity of drivers of the diverse local attitudes toward PAs.

Ethnolinguistic categories were Nambiya, Ndebele, Dombe, Shona, Tonga, and other. Where respondents' parents lived was recorded and used to build a binary variable such that respondents whose parents lived in the same village or in HNP and SFA were considered

locals and those whose parents lived farther away were considered immigrants. We separated settlers into 3 categories on the basis of their responses to the question, why do you live here? We considered that people who mentioned the area was a good place to live because natural resources are more available than elsewhere lived in the area because of its attractiveness. People who were evicted from the PAs or were removed from other places and resettled by local authorities lived in the area due to resettlement. Some people lived in the area because family land was available or to be close to relatives. Eight respondents mentioned other reasons for living in the area, and we removed them from our analyses because they did not constitute a substantial or homogeneous group. Education level categories were no education, primary education, and secondary education.

Over 25 different classes of natural resources were mentioned by respondents. We used access to wood products (i.e., timber and firewood) as a proxy of natural resources access because wood products were harvested where people collected most natural resources. Places of collection were communal areas, SFA, HNP, and buffer area.

We categorized people's perceptions of PAs as good or bad and the reasons for this perception as services, tourism, conservation, no benefit, problem animals, and restrict access. Because 95% of the respondents answered positively when asked if protecting wildlife was important, we focused on why they thought so and categorized their answers as tourism, heritage, conservation, and protect people. We asked villagers their main concern for the future and summarized the answers into 5 categories: water, natural resources, overpopulation, problem animals, and development. We included a no-idea category when questions were not answered.

Data Analyses

We described the relative proportion of immigrants versus locals according to the reasons for settling at the periphery of HNP (attractiveness, resettlement, and family land) and used chi-square tests to examine differences in contingency tables. We used Spearman tests to assess rank correlations between village characteristics and apparent attractiveness of the area per village. We expected attractiveness to be negatively correlated with distance to PAs (used as a proxy of access to natural resources) and to distance to roads (proxies of access to facilities) but positively correlated with the level of employment per village.

A multiple correspondence analysis (MCA) was performed on household-wealth characteristics (ownership of goats, cattle, and transport vehicle; ploughing practice; employment; and access to meat). We used the first 2 principal axes, which explained 47% of total variance, to build livelihood indices: PC1 (axis 1) was level of assets

owned by the households (assets) and PC2 (axis 2) was level of poverty of the household (poverty). Details of this analysis are in Supporting Information.

We computed distances of household to SFA and HNP (distance from the center of the yard to the edge of the PA) and distances of villages to the closest dirt, tarred, and main roads (A8 Bulawayo-Victoria Falls) (distance from the center of the village to the road) with geographic information system (GIS) software (Quantum GIS 1.6, 2010 Quantum GIS development team). For each village, we defined the type of edge shared with PAs as hard (no buffer area between settlement and PA), soft (buffer area between settlement and PA), and no boundary (no boundary shared with a PA) (Supporting Information).

We performed an MCA to investigate the link between people's access to natural resources and their attitude toward PAs to illustrate how different settler types were represented. We expected access to natural resources within the PAs would correlate with a better attitude toward PAs, in particular when access was officially authorized (i.e., SFA), and hence with a better integration of community functioning in the management of PAs. Because households were nested within villages, we used a mixed linear model (village as random effect) to investigate determinants of negative attitudes toward PAs. In this analysis, we tested 3 hypothetical sets of attitude drivers that related to household typology (e.g., education, history, assets), feelings toward conservation and concerns for the future, and location of household. To avoid overdispersion in the MCA, we did not include no-idea responses in any model. Less than 15 households provided this response.

We performed statistical analyses with R software (version 2.13) (R Development Core Team 2011), in particular the package ade4 for multivariate analyses (Dray & Dufour 2007).

Results

Village History, Population Growth, and Drivers of Immigration

Most of the villages in the study area were created after Nambiya were forcibly resettled by colonial authorities, first to allow for European settlers to farm the land and second to create the PAs (DNPWLM 1999) (Supporting Information). Except for Jwape village, which had a 35% decrease in population from 2000 to 2010, village populations increased 16% (SD 9) from 1990 to 2000 and 61% (SD 42) from 2000 to 2010. Household density ranged from 2.05 to 16.1 households/km^2 in 2010 (Supporting Information).

Of the 209 households included in our analyses, 72% were locals ($n = 151$). Seventy-six percent of locals were in the family-land category, 13% were in the resettlement
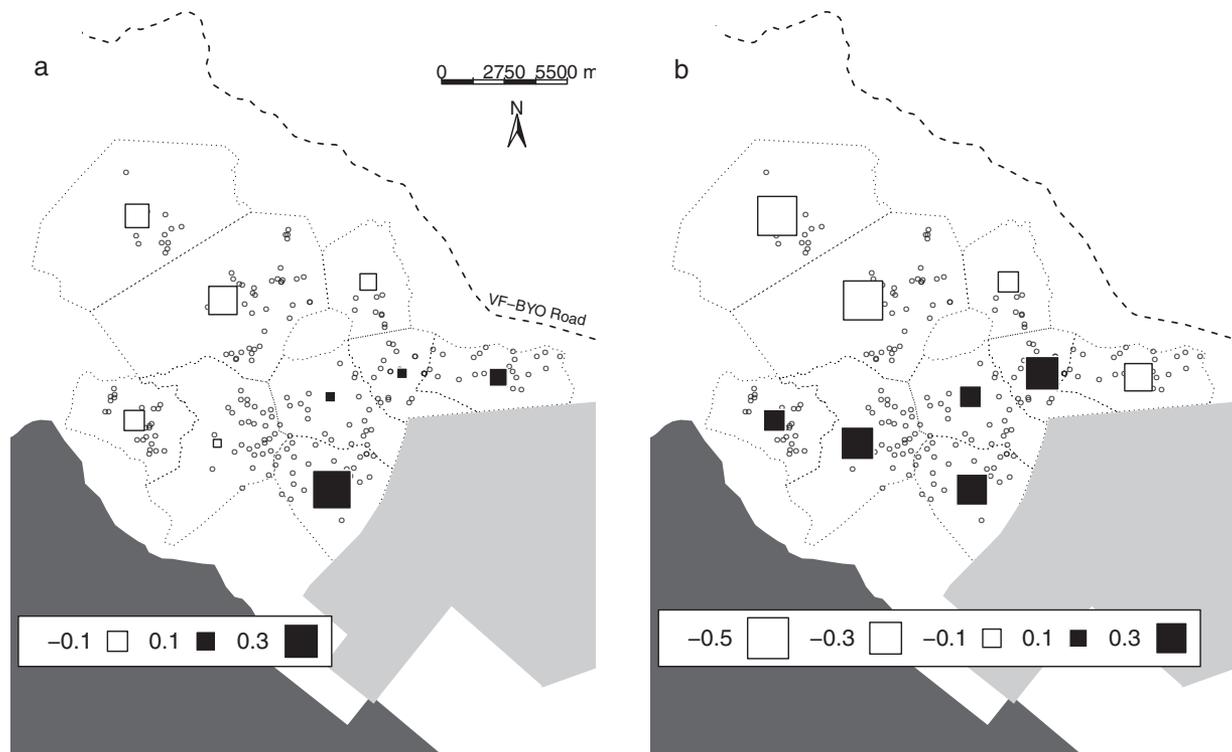
Figure 2. Relative proportion of (a) sampled households (n = 209) per village citing attractiveness of the area and (b) immigrants citing attractiveness as a driver of settlement decision (black squares, villages with higher relative proportions of households mentioning attractiveness; white squares, villages with lower relative proportions of households mentioning attractiveness; circles, sampled households).

category, and 11% were in the attractiveness category for the reason to settle in the area. Immigrants ($n = 58$) said they moved to the area due to family land (32%), resettlement (21%), and attractiveness (47%). The proportion of attractiveness respondents was higher in villages close to SFA ($\chi^2 = 14.96$, df = 2, $p = 0.0006$) and higher in villages close to either of the PAs for attractiveness migrants ($\chi^2 = 12.28$, df = 2, $p = 0.0021$) (Fig. 2). Magoli and Chezhou had the highest population growth from 2000 to 2010 (133% and 103%, respectively), and household density was highest in villages closest to PAs (up to 16.11 household/km^2 for Dingani) (Supporting Information).

The proportion of immigrants in the villages was negatively correlated with distance to PAs ($r_s = -0.71$, $p < 0.05$) and particularly with distance to SFA ($r_s = -0.83$, $p < 0.05$). Correlations between the distance to SFA and the proportion of respondents mentioning attractiveness per village ($r_s = -0.72$, $p < 0.05$) and between the distance to PAs and the proportion of attractiveness migrants per village ($r_s = -0.71$, $p < 0.05$) were significant and negative. Neither employment level per village nor distance to roads (access to facilities) were significantly correlated with proportion of immigrants, attractiveness, or attractivenes migrants per village. Level of employment was significantly correlated with the proximity of households

to the main Victoria Falls-Bulawayo road ($r_s = -0.79$, $p < 0.05$).

Attitudes Toward PAs

Respondents had on average a good attitude of the PAs, and there were significant differences in relative perception among the 3 categories of settlers for both PAs (HNP: $\chi^2 = 13.26$, df = 2, $p = 0.0013$; SFA: $\chi^2 = 7.801$, df = 2, $p = 0.0203$). Twenty-seven percent of those who were attracted to the area, 15% who resettled, and 4% living on family land had a negative attitude toward HNP, whereas 32%, 12%, and 11%, respectively, had a negative attitude toward SFA. Immigrants had a higher proportion of negative attitudes than locals (respectively 17% vs. 8% for HNP and 22% vs. 12% for SFA).

The PC1 of the MCA explained 29% of the total variance and distinguished people with a negative attitude toward PAs who benefited from SFA from others (Fig. 3a). Individuals attracted to the area were more likely to express a bad attitude of the PAs (Fig. 3b). This result was mainly due to extreme values for attractiveness migrants (Fig. 3c). For most of the respondents, the perceived benefits of HNP were related to the conservation of natural resources (Table 1). The distribution of
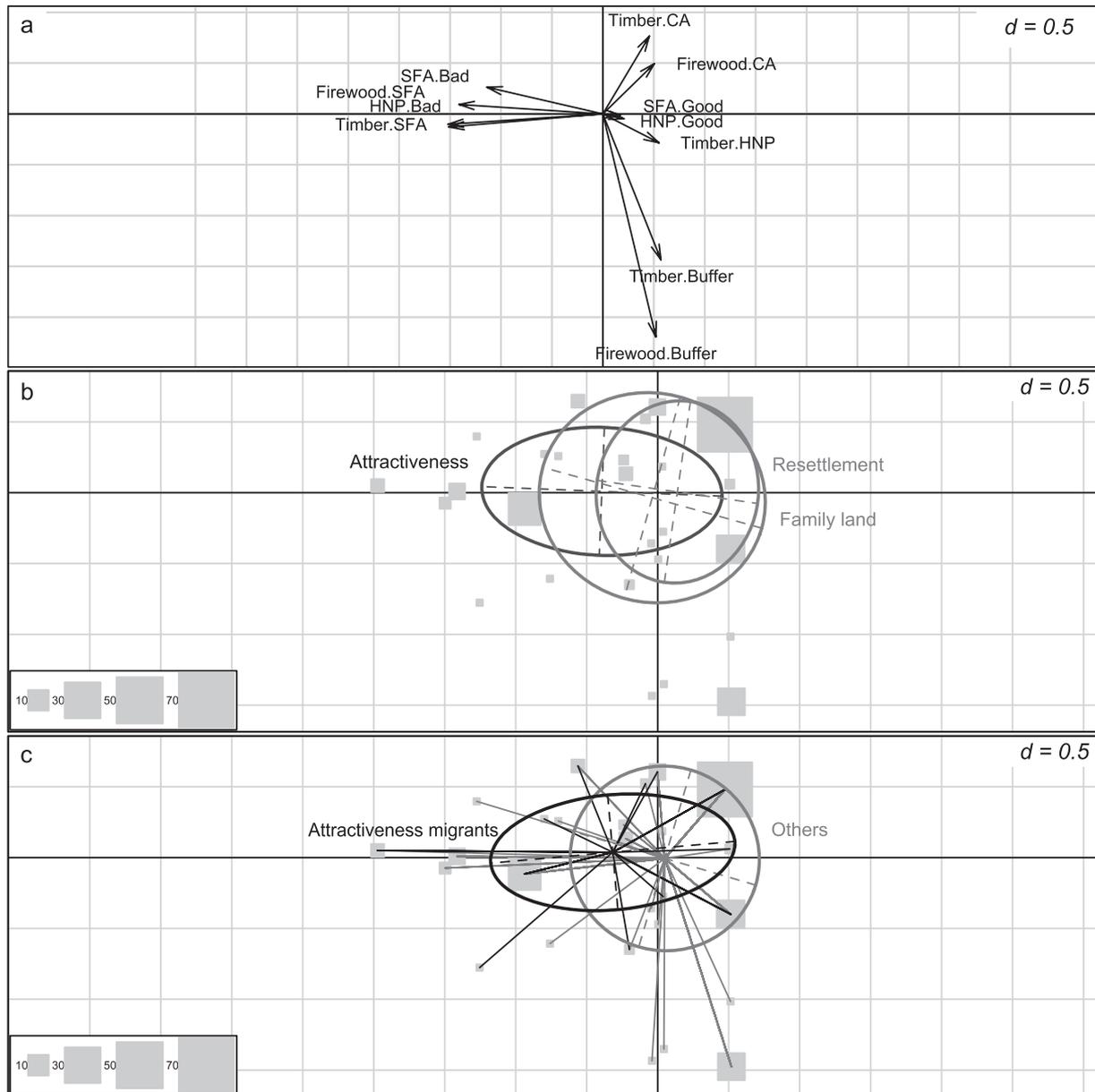
Figure 3. Results of multiple-correspondence analysis of attitudes toward protected areas (HNP, Hwange National Park; SFA, Sikumi Forest Area) and places of natural resource collection (CA, communal area; buffer, buffer area) (n = 185): representation of (a) attitude to protected areas (good or bad) and places of collection of wood and firewood on the first 2 axes explaining 51% of the total variance, (b) number of individuals on the first 2 axes with reason of settlement as an illustrative variable (circles), and (c) individuals on the first 2 axes with attractiveness immigrants as a driver of settlement decision as an illustrative variable (gray squares, individuals; size of square indicates relative number of individuals with similar coordinates).

answers among settler categories ($\chi^2 = 3684$, df $= 12$, $p = 0.0002$) and their immigration category ($\chi^2 = 15.91$, df $= 6$, $p = 0.014$) differed significantly, particularly due to negative perceptions associated with problem animals that were more frequent than expected for immigrants and attractiveness settlers (Table 1). Attitudes toward SFA did not differ significantly among respondents, and positive attitudes were related to conservation and

services (such as providing access to natural resources). Feelings about wildlife protection differed significantly among settlers of different types ($\chi^2 = 15.91$, df $= 6$, $p = 0.014$) (Table 1). Resettlement respondents primarily mentioned the importance of protection for tourism purposes, whereas other types of respondents mainly said wildlife was part of their heritage (Table 1). Respondents attracted to the area thought protecting wildlife also

Table 1. Attitudes of villagers to protected areas and wildlife protection and concerns for the future as a proportion in each category of settlers and immigration status (*n* = 209).

| Attitude element | Modalities | Reason for settlement | | | Locals | Immigrants |
		Attractiveness	Resettlement	Family land		
Hwange National Park	services	0.09	0.06	0.03	0.03	0.09
	tourism	0.14	0.03	0.14	0.12	0.14
	conservation	0.39*	0.68*	0.66*	0.64	0.52
	no idea	0.11	0.06	0.13	0.14*	0.05*
	no benefit	0.07	0.00	0.01	0.01	0.05
	problem animals	0.20*	0.13	0.02*	0.05*	0.16*
	restrict access	0.00	0.03	0.00	0.01	0.00
Sikumi Forest Area	services	0.20	0.42	0.28	0.27	0.31
	conservation	0.36	0.42	0.46	0.46	0.38
	no idea	0.18	0.10	0.18	0.18	0.14
	no benefit	0.02	0.00	0.02	0.02	0.02
	problem animals	0.11	0.00	0.02	0.03	0.07
	restrict access	0.11	0.06	0.04	0.05	0.09
Wildlife protection	conservation	0.11	0.13	0.16	0.15	0.16
	tourism	0.11*	0.45*	0.28	0.30	0.21
	heritage	0.43	0.23*	0.46*	0.42	0.41
	no idea	0.00	0.00	0.02	0.01	0.02
	protect people	0.34*	0.19	0.07*	0.13	0.21
Concerns for the future	water	0.16*	0.35	0.48*	0.45*	0.24*
	development	0.11	0.16	0.13	0.15	0.10
	no idea	0.07	0.06	0.04	0.04	0.07
	natural resources	0.41*	0.29	0.25*	0.26*	0.36*
	overpopulation	0.16*	0.13	0.06*	0.07*	0.16*
	problem animals	0.09*	0.00*	0.04	0.04	0.07

*Actual value differs significantly from expected value (chi-square test on contingency table, p < 0.05).

protected people and their livestock from wild animals (i.e., manage wildlife to reduce the risks). Locals (χ^2 = 20.33, df = 10, p = 0.026) and immigrants (χ^2 = 11.94, df = 5, p = 0.036) differed significantly in their concerns for the future. Locals were more concerned with climate uncertainties and water availability, whereas immigrants were more concerned with natural resources and overpopulation (Table 1).

Factors Affecting Attitudes Toward PAs

On the basis of household typology, attractiveness settlers had significantly more negative attitudes toward PAs while accessing resources in SFA than respondents in other categories (Table 2). Conversely, the poverty index (households with no employment, low protein access) was inversely correlated with this attitude toward PAs. Other variables such as ethnic group, assets, and education level were not significant.

For respondent feelings about PAs, problem animals were correlated to negative attitudes to both PAs and restricted access to natural resources. Restricted access significantly increased negative attitudes toward SFA (Table 2). Similarly, seeing wildlife protection as a way to protect people from wild animals (i.e., spatial control) was also significantly correlated with a negative attitude

toward PAs. A negative attitude was significantly affected by respondents whose concerns for the future were centered on problem animals, natural resources, and overpopulation (Table 2).

Household location was also associated with negative attitudes of people who accessed resources in SFA. The distance to PAs was significantly and negatively correlated, which suggests respondents living closer to the PAs were more likely than respondents living farther away to have negative attitudes toward PAs despite access to natural resources. This correlation between distance and attitude seemed to be stronger for households in villages that shared a hard edge with the PAs relative to households in villages with a soft edge (Table 2).

Discussion

Population Growth on the Edge of HNP

Annual population growth in Zimbabwe was on average 1.78% and 0.06% for the 1990–2000 and the 2000–2010 decades, respectively (United Nations 2011), our results thus suggest that the huge increase in the population observed on the edge of HNP resulted from immigration. Part of this immigration was related to the national political and economic crisis that occurred in the early 2000s.

Table 2. Results from mixed linear models for explaining the negative attitudes toward protected areas of people who access natural resources within Sikumi Forest Area, with all candidate drivers of this attitude tested, including village identity as a random effect.[a]

Drivers of negative attitude	Variables	F^b	p	Modalities	Estimates[c]	SE	p
Household typology	immigrant	$F_{1,175} = 0.17$	0.679				
				family land[e]	0.006	0.183	0.974
	reason for settlement	$F_{2,174} = 4.28$	0.015	attractiveness	−0.302	0.103	0.004
				resettlement	−0.066	0.115	0.568
	attractiveness migrants[d]	$F_{1,175} = 2.37$	0.126				
	ethnic group	$F_{5,171} = 1.44$	0.213				
	assets	$F_{1,175} = 0.01$	0.926				
	poverty	$F_{1,175} = 3.69$	0.057		0.183	0.096	0.057
	education level	$F_{2,174} = 0.21$	0.808				
Attitude element	Hwange National Park	$F_{5,160} = 9.914$	<0.0001	services[e]	0.041	0.216	0.85
				tourism	−0.057	0.186	0.76
				conservation	0.064	0.171	0.711
				no benefit	−0.283	0.261	0.28
				problem animals	−0.899	0.202	<0.0001
				restrict access	−1.221	0.482	0.012
	Sikumi Forest Area	$F_{4,157} = 12.671$	<0.0001	services[e]	0.073	0.175	0.678
				conservation	0.019	0.085	0.819
				no benefit	−0.055	0.241	0.821
				problem animals	−0.821	0.172	<0.0001
				restrict access	−0.76	0.153	<0.0001
	wildlife protection	$F_{3,170} = 3.755$	0.012	conservation[e]	−0.064	0.203	0.752
				tourism	0.117	0.119	0.327
				heritage	0.01	0.116	0.93
				protect people	−0.301	0.14	0.033
	concerns for the future	$F_{4,165} = 2.039$	0.091	water[e]	0.092	0.172	0.592
				development	−0.012	0.138	0.933
				natural resources	−0.274	0.139	0.051
				overpopulation	−0.321	0.183	0.081
				problem animals	−0.465	0.206	0.025
Location	edge PA	$F_{2,6} = 10.735$	0.01	soft[e]	0.342	0.206	0.099
				hard	−0.926	0.255	0.011
				no	0.024	0.274	0.935
	distance to PA	$F_{1,175} = 22.776$	<0.0001		0.0001	0.00003	<0.0001

[a]$n = 209$, households responding "no idea" were not included in the models.
[b]The degrees of freedom of the residuals vary due to different number of households responding "no idea" and to the covariation between the variables and the random effect (Village).
[c]Negative estimates correspond to a more negative attitude toward protected areas, that is, more negative values on the PC1 in Figure 3.
[d]Migrants who settled in the area for its attractiveness (cf. "Methods" section).
[e]Modalities used as references in the intercept.

Displacement, as a political and survival strategy, constituted a major dimension of the Zimbabwe crisis given its unprecedented scale and the depths of physical, economic, institutional, social, and personal dislocation (Hammar et al. 2010). This crisis is described by Scholte and De Groot's (2010) incidental-mechanisms model in which people are pushed from towns by increasing unemployment and a worsening urban economy. Our results thus demonstrate that immigration to the edge of the PAs did not result only from the attractiveness of the area but also included resettlement and people moving back to family land.

However, access to natural resources appeared to be the main driver of the attractiveness of the PA. We think that HNP and SFA provided refuges that allowed inventive strategies for survival, adaptation to circumstances, and prosperity in a context of what Jones (2010) called a Kukiya-kiya economy (i.e, a system that is based on opportunistic, marginally legal practices that exploit distortions of a hyperinflationary, quickly contracting economy). Moving to the PA margins thus appeared to be a coping strategy (i.e., a short-term adjustment and adaptation to extreme events for maintaining the future income-generating capacity of the household intact) (Adger 2000) for people in a subsistence economy that relied on agriculture and the use of natural resources.

Paradoxical Perception of PAs

Allendorf et al. (2006) suggest that positive attitudes toward PAs are highly correlated with a perception of benefits resulting from conservation and the management of these areas. This is consistent with our results;

attitudes toward PAs were generally good and associated with conservation benefits and tourism. However, we were surprised by the negative attitudes of people accessing resources from SFA, where greater access to natural resources is allowed. This negative attitude may be a protest response to the rules of access, but because the access to NR is greater than is officially authorized, we believe this paradoxical negative attitude arises from other causes.

Respondents who settled in the area for attractiveness reasons, in particular the wealthiest respondents, had this paradoxically negative attitude toward PAs. This suggests that if the conservation framework draws profit-seeking individuals close to PAs (Igoe & Brockington 2007), it may also create conditions for greater frustration if the expectations associated with the motivation to migrate are not met and hence promote more conflicts between PA managers and surrounding communities. Furthermore, immigration may lead to a dilution of traditional values that enforce sustainable use of shared resources (Berkes et al. 2000) and ultimately lead to more conflicts about natural resource use and conservation in general.

Our results are consistent with the thought that problem animals are the primary factor in negative attitudes toward PAs (de Boer & Baquete 1998). In our study area, elephant damage occurs up to 4400 m from the edges of the PAs (Guerbois et al. 2012). Hence, people settling close to PAs to access natural resources expose themselves to more problems with wildlife, which may lead to frustration relative to the net benefits derived from the PAs (Brockington 2002). Furthermore, respondents in our study with a paradoxically negative attitude toward PAs believed wildlife protection is necessary to protect them from wildlife through increased wildlife confinement and control. These correlations imply that problem animals may act as a deterrent to settling at the margins of PAs.

More importantly, people expressing paradoxically negative attitudes were concerned with the availability of natural resources and overpopulation. These concerns likely reflect a perceived lack of sustainability of their way of life as a result of increasing competition with wildlife and other people for space and natural resources. This conclusion is supported by the fact that restricted access significantly affected respondents' perceptions of both PAs (when access was totally banned or when it was regulated), which is consistent with the debate surrounding costs of conventional exclusionary approaches (Brockington 2002; Borrini-Feyerabend et al. 2004). From a landscape perspective, the more paradoxically negative attitude at the hard edge probably arises from the fact that hard edges are more abrupt physical transitions between wildlife areas and villages and hence promote close contacts and greater interactions between people and wild animals.

Integrated Management of PAs

Integrated protected area management implicitly borrows from management of socio-ecological systems, characterized by multiple social dimensions (conservation and development objectives), and driven by complex interrelated ecological and social dynamics. Outsiders' prominent claims and interests in forests and wildlife areas often lead to locals' claims being reformulated, sometimes modified, in regards to these new stakeholder desires (Baldus 2009). Population changes, profit-seeking migrants in particular, may ultimately dilute local and traditional value of wildlife conservation and natural resource use and thus increase social pressures on management of PAs. We believe the future trajectory of the Hwange socio-ecological system depends on its capacity to cope with changes such as population growth, aridification, dilution of local values, social crisis, and drought. In our study area, we believe that the Zimbabwe economic crisis and its associated migrations led to increased social tensions in relation to conflict with wildlife, restricted access to natural resources, dilution of local values, and overpopulation. These tensions affected the perception of PAs, creating the paradoxically negative attitude of some toward PAs. This strongly suggests that integrated conservation initiatives should consider the balance between conservation and services and disservices provided by the PAs to the neighboring communities.

Moreover, apparent attractiveness of PAs could lead to poverty or rigidity traps, defined respectively as states preventing adaptation through loose connections and poor resources or lack of flexibility induced by strong self-reinforcing controls (Carpenter & Brock 2008). In our study, we refer to these as socio-ecological traps because the benefits experienced by local communities through access to PAs may not be sustainable as a result of enforced de jure protection of PA edges (Joppa et al. 2008); weak control of problem animals which increases the costs of living at the edge of PAs; increasing population at PA edges; and a loose definition of shared values that could allow coexistence amongst stakeholders (PA managers, local authorities, and villagers). Mismatches between the scales of ecological processes and the institutions that are responsible for managing them can contribute to a decrease in socioecological resilience (Cumming et al. 2006). This decrease in resilience can also arise from the mismatch between management policies and local expectations and from mismatches between traditional values of coexistence and business-driven conservation frameworks promoting profit-seeking attitudes toward conservation areas (Igoe & Brockington 2007). Furthermore, protecting the values that shape coexistence between people and wildlife, such as a subsistence economy that is based on endogenous ecological

processes, should help strengthen resilience in socio-ecological systems including PAs.

Acknowledgments

Supporting Information

History and trends in population size of the 9 villages in which we conducted surveys (Appendix S1) and the MCA for building assets and poverty indices (Appendix S2) are available online. The authors are solely responsible for the content and functionality of these materials. Queries should be directed to the corresponding author.

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