CHAPTER 1

General Introduction

The relationship between people and the environment is increasingly recognized as a set of complex and interdependent interactions. While natural ecosystems and human societies have co-evolved for thousands of years, our understanding of the relationship initially moved from one of human survival based on natural resource use, to one of societal development based on exploitation of resources for maximum human economic growth and prosperity (Diamond, 1998). The 20th century witnessed rapid advancement in scientific knowledge and the emergence of an environmental protectionism movement. Focus then shifted from notions of earth stewardship as a moral and ethical human obligation to the mainstreaming of 'sustainable development' into policy and prescription (UN, 1992). Current theory has moved further by envisioning the environment not as a simple bundle of natural resources to be managed; rather, it views biodiversity as a set of ecosystem services that provide raw materials (*i.e.* food, timber) and associated processes (*i.e.* water purification, soil fertility). Subsequently, the dialogue has come full circle. The use of nature by humans is not simply a tool for economic development; biodiversity and ecosystems are fundamental to human survival (*i.e.* physical, social, cultural and spiritual) (MA, 2005).

As perceptions of the society-environment nexus change, theory and practice of how to manage and conserve biodiversity and ecosystems services for human development have evolved simultaneously. There has been a historical progression from 'conservation *or* development' (*i.e.* preservationist style fortress parks) to 'conservation *and* development' (*i.e.* integrated symbiotic management programs) to what I term 'conservation *through* development'. The latter has emerged as protected areas, particularly in the developing

world, are perceived to be threatened by impoverished neighboring rural communities whose subsistence livelihoods endanger parks. A 'conservation through development' praxis seeks to protect natural resources by using them to stimulate local economic development thus reducing degrading behaviors and relieving pressure on park resources.

These varied theoretical approaches, framed under the broad catchall term of conservation and development, have been subject to intense scrutiny and debate. The 2003 World Parks Congress hosted in Durban, South Africa, recognized that 'many costs of protected areas are borne locally – particularly by poor communities – while benefits accrue globally and remain under-appreciated' and that protected area management should strive to reduce poverty, but at the very least must in no way exacerbate it (IUCN, 2003). These statements highlight conservation's historical, and in some places on-going, negative impacts on local people via forced removals from protected areas and lost access to land and natural resources. By acknowledging historical trends and current conditions in the developing world, one of the primary stated goals of conservation and development schemes has been poverty alleviation. However, there are questions as to whether conservation and poverty alleviation goals should be coupled or if parks are in the business of contributing to local economic development (Ferraro, 2002; Kiss, 2004). Others maintain that addressing poverty is critical to the long-term success of conservation (Roe, 2004). The ultimate ability of conservation, specifically protected areas, to contribute to rural economic development is unknown, and the expectance for it to do so remains a contentious subject.

In tandem with poverty alleviation, the Durban Accord issued at the 2003 World Parks Congress also urged for a 'commitment to involve local communities, indigenous and mobile peoples in the creation, proclamation and management of protected areas' (IUCN, 2003). The accord recognized that inequitable approaches to conservation often exclude local people. Current theory advocates a rights-based approach that empowers local people's access to protected area management and allows for increased benefits stemming from conservation. Subsequently, conservation projects throughout the world today, whether rhetorically or actually grounded in practice, promote paradigms of 'local' and 'community'.

Such projects may be politically correct, but often ignore epistemological differences in the very conception of conservation. Many programs are based on global (*i.e.* stemming from the developed world) constructs of protecting nature. Global priorities tend to focus on indirect and nonuse values associated with biodiversity and ecosystem services' contribution to human well being (MA, 2005). Local conservation priorities are likely to focus on direct use values that support rural livelihoods (Vermeulen, 2004). Programs, particularly 'community-based conservation', may be implemented at the local level, but global epistemologies of natural resources continue to dominate. Community-based conservation is framed as a quintessential mutualistic form of conservation and development- biodiversity protection with local participation resulting in direct income flows to local communities- but has many detractors. Biologists worry about the small size of many projects and their temporal uncertainty, while social scientists deal with the

complexity and heterogeneity intrinsic in local people that project donors and park managers tend to lump together as 'community' (Brockington, 2005).

An Interdisciplinary Research Approach

Any dialogue about conservation and society raises many questions. While biodiversity and poverty alleviation are distinct and laudable goals, should they necessarily be intertwined? Is it the job of conservation to contribute to local economic development and does poverty need to be mainstreamed into all aspects of environment? What are the benefits stemming from conservation (*i.e.* economic, material, spiritual, and cultural)? How should costs and benefits be distributed? What role should local people and local epistemologies play in conservation? How will current landscapes of rural poverty and inequitable power versus global economic expansion and governance structures affect future conservation?

There are no simple answers to the questions posed, and indeed, each question raises several others. A single thesis could never hope to tackle such a myriad of loaded issues in one small and neat package; but it can attempt to shed light by examining the concepts in context of each other. Thus, dynamics of conservation and society must be explored holistically using multiple disciplines across spatial and temporal sales. Too often a division among the sciences and their methodologies has resulted in biologists researching patterns and processes of biodiversity in isolation while social scientists explore macro socio-economic drivers or local livelihoods. Regardless if conservation is solely perceived as either a biodiversity issue or a development issue, the one constant is

the human component inherent in both: humans are users, shapers, consumers, recipients, managers, and protectors of the environment. However, the respective approaches are rarely merged as a research process and applied to a single case study. The goal here is to employ an interdisciplinary research methodology to examine the drivers and impacts of the conceptualization and implementation of conservation and society in Maputaland, South Africa.

Dynamics of Conservation and Society in Maputaland, South Africa

Maputaland, in the northeast of KwaZulu-Natal, South Africa (Figure 1) provides an exemplary opportunity to explore the dynamics between people and nature across scale and time. The region contains some of the world's most important biodiversity and was recently designated a globally important conservation "hotspot" (CI, 2005). This designation indicates not only its high biodiversity value, but implies it is under severe threat of degradation. Currently, 27% of the landscape is formally protected in fenced reserves managed by the provincial conservation agency. Outside of the parks, the landscape is dominated by poor rural communities that reside on communal land under the guidance of tribal leadership. Economic development is severely lacking in the region and between 70%-80% of residents live below the national poverty line (Fenske, 2004).

Figure 1:   The Maputaland study area in northeast KwaZulu-Natal, South Africa,

bordering Mozambique and Swaziland.
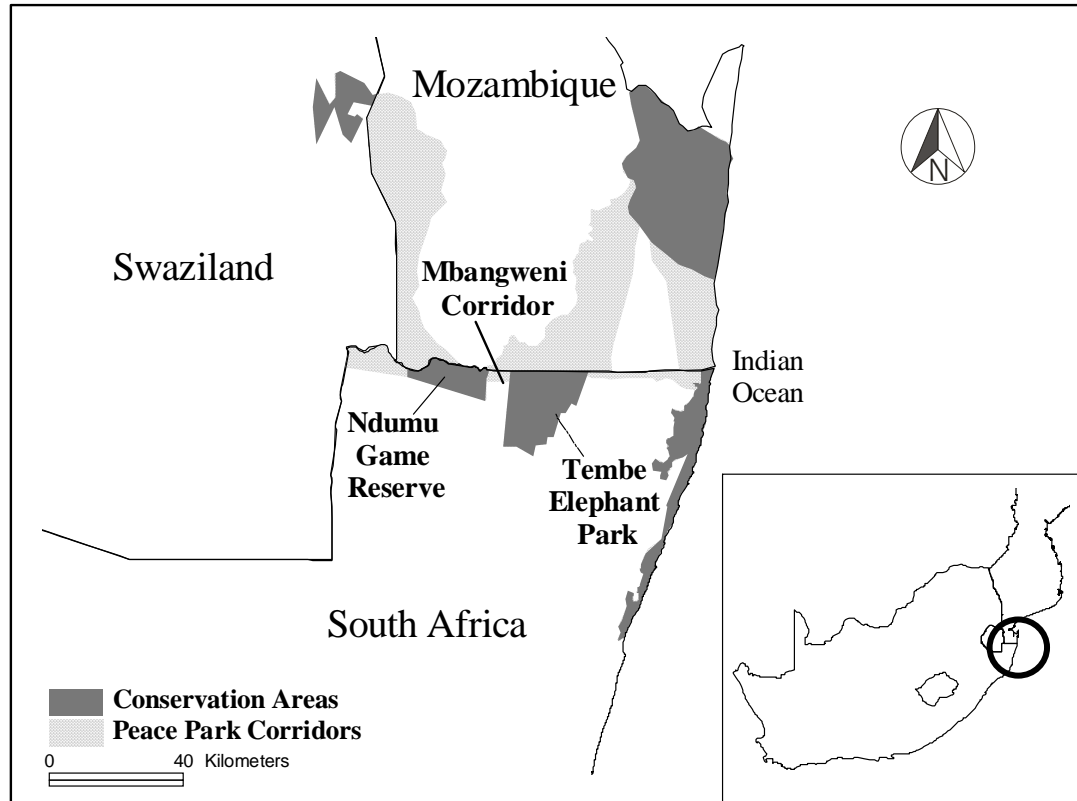
Livelihoods in Maputaland are primarily dependent on subsistence agriculture, a small informal economy, and government grants (*i.e.* pension and child care payments). The region has one of the highest HIV/AIDS prevalence rates in South Africa with up to 38% of the total population infected (Hlongwe, 2003). Unsurprisingly, Maputaland's high biodiversity and broad-scale poverty have been the subject of various conservation and development schemes.

To provide a comprehensive treatment, this thesis presents a group of independent, yet interlinked chapters that cover a wide range of issues. The research and results presented are based on more than five months of fieldwork in the region conducted between late 2001 to late 2003. While each chapter stands individually, together they provide a holistic view from an interdisciplinary approach. **Chapter two** introduces the novel use of Community-integrated Geographic Information Systems (CiGIS) methodologies to study conservation and land reform in South Africa. CiGIS is employed as a research process, not necessarily a research product. By incorporating participatory methods and advanced geospatial technologies, CiGIS supports the merging of 'local' and so-called 'expert' knowledge. Participatory aerial photograph interpretation and other CiGIS techniques were useful for uncovering hidden political ecologies driving the struggle for land between conservation and local communities. While the chapter demonstrates the CiGIS process by investigating land reform in Maputaland, the CiGIS methodologies presented are used as interdisciplinary research tools in subsequent chapters.

Chapter Three focuses on the political ecology of biodiversity in Maputaland. It explores the social, ideological, economic, and political drivers of conservation across scales and examines their implementation at the local level. In Maputaland, nature-based tourism has been touted as the primary tool for economic growth. However, its ability to provide significant returns is debatable. Control over resources, epistemological disparities, and differing levels of power, capital, and capacity have resulted in uneven benefit distribution further complicating the conservation and development debate.

Chapter Four explores misconceptions about the relationship between local people and biodiversity. High human population densities are generally thought to occur in regions of high biodiversity and protected areas are often perceived to be under threat from neighboring dense and rapidly growing communal areas. To examine the livelihood and demographic drivers of land use in Maputaland, statistical analyses were conducted using human population density, land tenure, land cover, and biodiversity values. Results were contrary to popular expectations; high population growth on communal lands or areas in close proximity to parks is not always the norm. Households throughout the region are declining in size, leading to increased resource use per capita. The chapter concludes by exploring the biggest threat to both biodiversity and economic development in Maputaland- the HIV/AIDS pandemic.

Conservation-induced resettlement is the focus of **Chapter Five**. Contrary to the forced and often violent displacements of the past, future resettlement schemes in Maputaland are hoped to voluntarily entice local communities away from their land to make way for

expanded conservation and potential benefit sharing. Resettlement research in developing countries has traditionally used simple economic cost-benefit analyses for large development programs, such as dams, while ignoring impacts on local livelihoods. To explore potential voluntary resettlement of the Mbangweni community in Maputaland, a two-stage analysis was conducted on both quantitative and qualitative household impacts. First, Geographic Information Systems were used to spatially model household locations before and after displacement based on a set of parameters from existing settlement patterns and dimensions of the proposed conservation expansion. To qualify the spatial results, the Impoverishment Risks and Reconstruction (IRR) model developed for the World Bank was employed. Results indicate that, in addition to disruption of economic livelihoods, resettlement is likely to have significant social implications in the community and throughout the greater region.

Chapter Six investigates transboundary protected areas, mega Peace Parks that cross international borders, as one of the latest conservation and development paradigms in Southern Africa. Peace Parks have gained considerable financial donor support, but their ability to create sustainable local economic development has been little researched. This chapter provides an empirical case study of the Lubombo Peace Park encompassing areas in South Africa, Mozambique, and Swaziland. Impoverished rural communities whose livelihoods are directly linked to local nature and dependent on porous international borders could face decreased access to social, economic, and natural resources.

The final chapter, **Chapter Seven**, presents a general discussion drawn from the thesis. The dynamics of conservation and society in Maputaland are reviewed as independent and interlinked components. A review of the interdisciplinary case study approach highlights the complexity inherent in understanding the human-environment nexus.

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CHAPTER 2

Using Community-integrated geographic information systems to study land reform

in South Africa

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Abstract

South Africa has one of the most sophisticated infrastructures for Geographic Information Systems in Africa. This has proven to be quite valuable for post-1994 development planning that necessitates fundamental change in the nation's space-economy. Development planning in South Africa is also increasingly employing participatory field methods that incorporate community perspectives about land use. Unfortunately, there are few examples of participatory methods being merged with advanced geo-spatial technologies. Here I present a case study to demonstrate Community-integrated GIS applications to study post-apartheid land reform in the province of KwaZulu-Natal, South Africa. Community-integrated GIS methodologies are envisaged as a process, not as a final product. Of particular focus was the relationship between rural societies and biodiversity conservation. Traditional participatory rural appraisal techniques, as well as the more novel use of community interpretation of aerial photographs, complemented spatial analyses in geographic information systems. In KwaZulu-Natal, the CiGIS process revealed that seemingly clear relationships between people and parks are not always as they seem. Current political ecologies, shaped by past discrimination, are embedded in the ideological, cultural, economic, and ultimately, spatial struggle for land between rural communities and conservation authorities.

Introduction

Geographic Information Systems (GIS) in South Africa have their origins with the military; racial segregation in apartheid South Africa was, of course, an intensely geographic project. As a result, control over space was viewed within a military domain. Geo-spatial technologies, in their multiple and evolving forms have, therefore, been an important part of the politics of space in contemporary South Africa.

In the late 1980s, the South African state began to privatize, and the state-GIS industry dissolved into multiple consulting and NGO entities. Many government parastatals (i.e. semi-autonomous government agencies such as the Center for Scientific and Industrial Research) also further developed their GIS capabilities. During the same time, ESRI (the leading international GIS software company) came to southern Africa. At this time, there was also a rapid change away from REGIS software, which was developed by the South African military, to ESRI products that were already globally competitive. As a result, when Nelson Mandela took power in 1994, South Africa was well equipped with the infrastructure and human capital to implement sophisticated GIS applications. Land reform was one of many GIS applications that the new state endorsed.

The case study presented here demonstrates how Community-integrated GIS (CiGIS) methodologies might contribute to land reform research and implementation. As such, CiGIS is envisioned as a process, not a product. Most land reform research has been conducted by means of independent academic disciplines; anthropologists collect ethnographies and detail local histories while geographers collect spatial information for mapping and analysis. Rarely have different disciplines been integrated to provide a

holistic assessment of the struggle for land in South Africa. Therefore, the central theme here is to highlight a multidisciplinary experience of merging participatory rural appraisal techniques, community interpretation of aerial photographs, and GIS analysis to explore the relationships between residents of a poor rural community and neighboring protected areas from which they were forcibly removed in the past. The case study presented here is the result of more than two years of biodiversity conservation and land reform research in the region. While a few analytical results about these relationships obtained using the CiGIS process are presented, they simply illustrate the techniques for employing CiGIS methodologies for land reform research. The primary aim of the paper is to highlight the potential benefits of a CiGIS method and demonstrate their application in field-based research of land reform issues in KwaZulu-Natal. I begin with a review of the GIS and Society literature and then introduce land reform in South Africa and the study site. The remainder of the paper highlights the methods used and lessons learned.

Background of GIS and Society

Concerns over the social implications of GIS are certainly not new (Harley, 1990; Yapa, 1991; Smith, 1992; Sheppard, 1993; Lake, 1993; Pickles, 1995) and an exhaustive review of them is outside the focus of this chapter. However, it is necessary to address the importance of understanding technology "as a social process" (Sheppard, 1995, p.7). Traditionally, GIS technology has been accessible mainly to scholars, technicians, and bureaucrats of developed countries due to high costs of operation, complex design, and a steep learning curve. Public participation was minimal and usually limited to the final

steps in a project (*i.e.* feedback). In the context of underdeveloped regions, this reality is magnified, and entire segments of the population are excluded from GIS technologies and related map and spatial analysis products (Harris et al., 1995).

To fill the gap, Community-integrated GIS and the more generalized 'Participatory GIS' were conceptualized to incorporate community perceptions, ideas, and multiple realities into subsequent analyses. Weiner and Harris's (2003) South Africa research also showed how research questions could even be shaped by community involvement. They integrated GIS into a South African community with a history of land struggles, noting that it can both empower and marginalize communities. For example, elders, youth and women's groups were able to identify where land dispossession took place (processes of empowerment), but local planning agencies were unable to adequately use the information to promote the types of land reform that many community members desired. Some politically connected community members (mostly elders connected to the tribal authority) received land, while others did not. The processes of empowerment and marginalization with Participatory GIS are complex and are only now being understood (Craig et al., 2001). But there are many cases where the intersection of GIS and community development has been beneficial, such as indigenous community perspectives on mapping and GIS in Canada (Bird, 1995; Kemp and Brooke, 1995) and ethnographic data incorporated into GIS to assist indigenous communities in Panama (Chapin et al., 1995).

In addition to addressing equity, democratization, and social justice through the inclusion of communities in GIS analyses, indigenous knowledge can enhance our understanding of the environment, underpin culturally appropriate development

opportunities, and provide a more holistic perspective for planning and policy (Harmsworth, 1998). But local knowledge, particularly those regarding values and perceptions, should not be construed as discrete and homogenous. Kottack (1985 in Hutchinson 1993, 454) critiqued 68 World Bank projects and concluded most of the projects reviewed were not successful due to "a tendency to see participants in projects not as heterogeneous actors… but as undifferentiated 'beneficiaries' or 'target groups'". Instead, local knowledge should be viewed as consisting of a set of multiple realities of the landscape, resulting from variations in culture, gender, race, politics, ethnicity, location, history, etc., which capture the everyday life experiences of a diverse social grouping (Weiner et al.1995; Ceccato and Snickars 2000). However, when attempting to represent socially differentiated knowledge, there is still the risk of overrepresentation for certain sampled groups to the detriment of others that must be considered (Ceccato and Snickars, 2000). It is also important to recognize that formal GIS data can be inaccurate and communities can help to improve such traditional databases. GIS is not always value free since it is dependent upon human choices and constraints regarding the selection of coverages, attributes, scale, analytical procedure, and the resulting decisions (Harris and Weiner, 1998). When researching human-environment relations, such as land use, spatial technologies cannot always relieve the researcher or policy-maker from determining whether possible impacts stem from social, economic and/or political factors (Brodnig et al., 2000).

Using GIS in the land reform process is relatively new. Only a few studies have documented how engaging beneficiaries with land information helps to shape their perceptions, knowledge, and use of their newly obtained resource (see Macdevette et al.,

1999; Jordan, 2002; Weiner and Harris, 2003). In fact, few beneficiaries have even seen a map or aerial photograph of their land. GIS can assist in land reform by merging local knowledge with expert information. In an earlier paper, Weiner and Harris argue that

> *linking narratives, oral histories, photographs, moving images, and animation to GIS provides enormous capability to increase not only the richness and diversity of the information available but also more closely parallel the manner in which communities know or conceive of their space. We propose, therefore, not a replacement of existing agency responsibility for local GIS but a redefining of what such systems might "look" like and how they might be extended into communities to achieve greater public participation and ownership* (Weiner and Harris, 2003, p.63).

A community-integrated GIS in which local stakeholders share their knowledge can assist land reform in the planning phase by incorporating a more detailed understanding of local needs and in long-term sustainability by ensuring that the mechanisms local people have to operate within are actually palatable to them. Land reform projects based upon a local understanding of local needs are much more likely to be sustained by local people.

Land Reform in South Africa

Land alienation in South Africa did not begin with the 1913 Native Lands Act, but that act did codify previously disparate laws and statutes into an overarching and draconian system that facilitated African land dispossession. In reality, alienation had

been occurring since the first colonial wars in the Cape. In the late 19th and early 20th century, the concentration of power into the hands of the white minority and the process of consolidation of state authority into the rural areas gave rise to fears among white farmers over lack of labor. At that time, the range of agricultural activities open to Africans was considerably wider than after the enactment of the 1913 and 1936 land acts. Africans could engage in peasant agricultural production on land titled to them or on communal land, become a labor tenant, sharecrop, become a farm laborer, or occupy and farm state land.

The concrete expression of the various land laws was forced, and often, violent removals of Africans from their land ensued. In many cases, this was ancestral land and in other cases it was land individuals and communities had 'purchased' prior to the 1913 alienation. The timbre of the forced removals was sharpest from the early 1960s to the mid-1970s. The 1927 Bantu Administration Act, described above, gave the state sweeping powers of removal. Generally, the landlessness currently experienced by so many people is a result of the enforcement of that act.

Africans were either physically forced into homelands or homeland boundaries were redrawn to incorporate Africans into them, a process of forced nationalization. All land in South Africa was scheduled for specific racial groups. Where residents did not coincide with the ascribed racial-geographic classification, the state stepped in to 'correct' the situation. Of course, the 'correction' was always at the expense of Africans. The process of consolidation of the homelands (and later 'independent' states) in the 1970s further aggravated the already acute problem of landlessness.

With the framework for land reform in South Africa laid in the early 1990's, the formal process of redressing one of apartheid's most grossly obvious distortions, land distribution, began in 1994. Immediately the new government realized the need for reform in three areas. The restitution program sought to compensate individuals and groups for land that had been illegally seized during apartheid, usually through forced removals, while the redistribution program sought to correct the historical land imbalance in the country through a 'willing-buyer, willing-seller' program. The third reform program centered on land tenure. Conflicting tenure arrangements are the norm in the former homelands and little action has been undertaken in sorting out the contradictory authorities, claims, and occupants. A new communal land tenure bill might begin to address some fundamental tenure issues, but has been criticized for giving too much power to traditional authorities and insufficiently providing for women's rights (Cousins and Claasens, 2003).

The case study presented here focuses on restitution of land in KwaZulu-Natal that was forcibly seized during apartheid for nature conservation. In northern KwaZulu-Natal, the government established the Ndumu Game Reserve in 1924 on land it claimed had always belonged to the state (previously the province of Natal). The region contained exceptional natural features and wildlife, including an important hippopotamus population. Customary to conservation trends of the era and inline with Apartheid policies, the park was designed as a nature reserve devoid of permanent human settlement and was to be managed by provincial authorities with no involvement of local people or neighboring communities. By invoking racially discriminatory laws and practices between the 1940s and 1960s, conservation authorities forcibly removed local people

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from the land inside the newly proclaimed protected area (Tong. Ca. 2002). The creation of nature reserves where local settlements previously resided continues to have an important impact on land relations in the area. In recent years under the new land restitution laws, local people have bitterly contested the forced removals and have sought legal redress.

Study Site

The Tembe Traditional Authority (TTA), the largest communal area in South Africa, was part of the former KwaZulu homeland. All land in the TTA has communal tenure under the leadership of the patriarchal Tembe chief (*inkosi*) who overseas 42 communities managed by his sub-chiefs (*izinduna*). The region is characterized by extreme poverty and sparse rural development. Most residents are dependent on local natural resource utilization for at least a portion of their livelihood. Several large protected areas that cover 24% of all communal land dominate the TTA landscape (Jones, 2005a). The parks are fenced in reserves mostly devoid of human settlement. Local people have minimal and highly regulated access to collect resources inside the parks, mainly fish and reeds for construction.

Residents of the Mbangweni community (Figure 1) were forcibly removed from Ndumu Game Reserve during the 1940s-1960s and a style of fortress conservation ensued which limited access to natural, social, economic, and cultural resources inside park boundaries (Tong, ca. 2002). Today, 118 Mbangweni households occupy a 45km² piece of land between Tembe Elephant Park and Ndumu Game Reserve (Jones, 2005b).

Figure 1:   Ndumu Game Reserve and land use in the Mbangweni community.
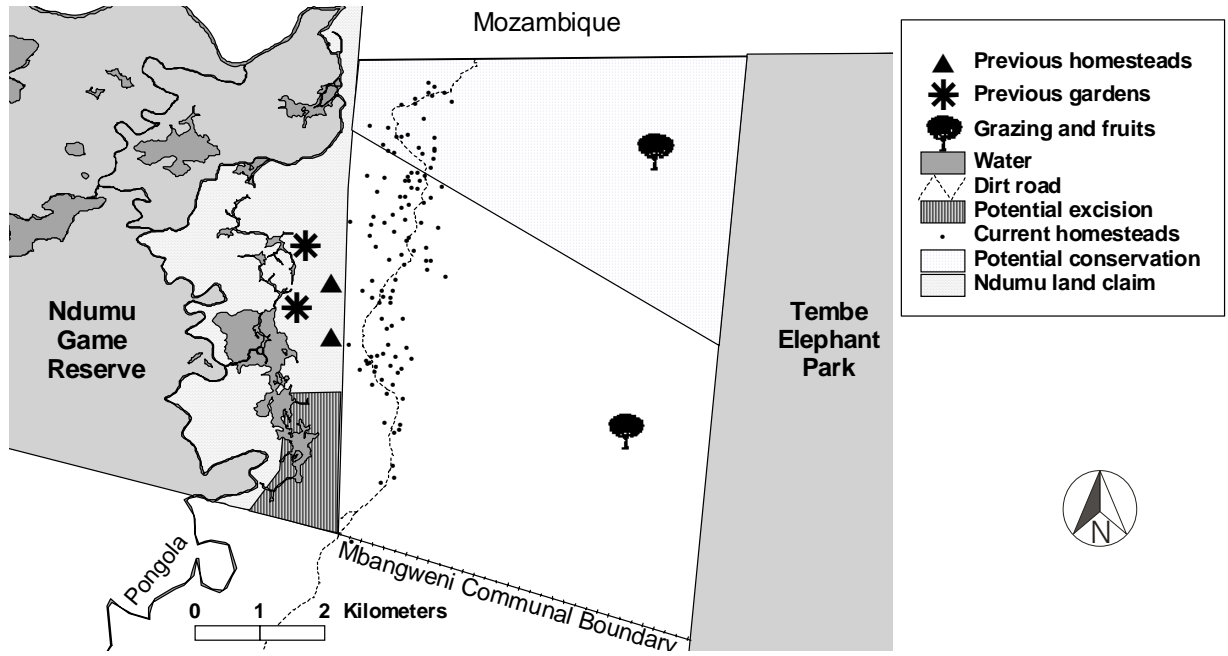
Subsequent to post-democratic land reform legislation, the Tembe Traditional Authority filed a land claim for parts of the game reserve. The claim was investigated by the Department of Land Affairs who analyzed historical documents and conducted local interviews. Although the community was awarded legal ownership of some land in a 2000 settlement, the land was required to continue as conservation under the guidance of the provincial conservation agency, Ezemvelo KwaZulu-natal Wildlife (Tong, ca. 2002). The settlement also stipulated that in the future the parties would agree to a separate management arrangement to determine the sharing of revenue and benefits stemming from the claimed area. Furthermore, they agreed to negotiate turning a portion of currently occupied Mbangweni land into a conservation corridor linking Tembe Elephant Park and Ndumu Game Reserve. The consolidated Tembe-Ndumu Park would then become part of the larger transboundary Lubombo Peace Park linking conservation areas in South Africa, Mozambique, and Swaziland (PPF, 2002). Conservation authorities hope the mega park will provide increased biodiversity protection and attract much needed tourism revenues to the region. Implementing the conservation corridor to link the two parks would require resettling households off the land so it could become a fenced conservation area. In exchange, the community would get a portion of highly productive agricultural land to be excised from Ndumu Game Reserve as well as additional incentives, such as nature-based tourism concessions (Jones, 2005a). Since 2000, negotiations have not produced a final management agreement for the land claim area inside Ndumu or determined the details of a potential conservation corridor. Protracted negotiations have become increasingly hostile and contributed to ongoing land struggles.

As economic development in the Maputaland region is largely promoted through the use of nature-based tourism, other land claims have arisen against existing protected areas by local communities seeking to capitalize on potential economic development. In 2002, The Tembe Traditional Authority filed a land claim against Tembe Elephant Park. The park resides on communal land that was 'willingly' designated as a conservation area in the 1980s. However, the traditional authority claims the apartheid-era negotiations were not equitable and that they have received minimal benefits since the park's creation. Subsequently, they called for a moratorium on all development inside the park (including road and tourism facility expansion) while they seek acknowledgment and restoration of co-management rights, as well as increased access to future tourism concessionaire opportunities inside the park (Tembe, 2003). Such 'conservation and development' land tenure issues highlight the need to understand and incorporate local histories, epistemologies, settlement patterns, and land use paradigms for equitable and sustainable future land use decision-making in the Tembe Traditional Authority.

Community-integrated GIS in Practice

The Community-integrated GIS process uses a suite of complementary methods to collect qualitative, quantitative, spatial, temporal, and participatory data. Traditional community research methods often fall under Participatory Rural Appraisal (PRA), a widely used bundle of tools, including mapping, modeling, diagramming, matrix scoring, transect walks, and seasonal calendars (Chambers, 1994; Binns, et al., 1997). Over the course of more than 20 weeks in the study region visited periodically throughout 2002-3, I built on PRA and other well-documented qualitative methods by using aerial

photographs and GIS analysis to investigate the socio-spatial components of land reform and biodiversity conservation in South Africa. Images are rarely used as participatory tools in the field, but taking the images to the communities for participatory interpretation, provided complex histories, narratives and spatial articulation of the local dynamics driving land claims and the relationship between local actors. Before detailing the use of community interpretation of aerial photographs, I briefly describe the other PRA techniques upon which the CiGIS methodological process was built.

Geo-referenced surveys

In 2002, geo-referenced surveys were gathered for all 118 households in Mbangweni. The survey was composed of both qualitative (*e.g.* perceptions and values) and quantitative (*e.g.* resource consumption and cash expenditures) questions regarding local livelihoods and their relationships to the neighboring parks. The surveys were completed by research assistants employed from the local communities who used a semi-structured interview technique to record the answers to compensate for poor literary skills in the communities. One family member at each household was interviewed based on availability allowing the collection of socially differentiated knowledge by age, gender, position in household, etc. (*i.e.* first wife, daughter, father). Global Positioning System (GPS) coordinates were gathered at each of the 118 homesteads and used to map current community settlement patterns. Household coordinates were also used in conjunction with additional GPS data to perform spatial analysis.

GPS and personal observation

GPS coordinates and personal observation were useful for spatially articulating other forms of household-related activities. Throughout the field visits between 2002-3, location and observational notes were collected regarding settlement features (*i.e.* roads, schools, markets), local resource use, customs, habits, and collection methods employed. The coordinates could then be visualized and analyzed using GIS to calculate spatial patterns and distance proximities to other community features (*i.e.* distance from a household to the Mozambique border). Mapping household coordinates alongside the location of important community features provided insight into the spatial dynamics driving current community patterns. These spatial dynamics were then qualified with the participatory techniques described below.

Interviews and participatory map interpretation

After initial introduction to the study site and approval from relevant local authorities where necessary, interviews were used to identify land reform issues, collect quantitative and qualitative data and provide iterative feedback to verify survey data. In-depth interviews were conducted with dozens of community members, key informants from conservation and tribal agencies, and other regional residents. Cultural norms dictated that small group interviews of local residents usually consisted of cohorts from a community subgroup (*i.e.* old women or young men). Interviews were sometimes independent, other times they were used in combination with or as a precursory step to other methods, such as mental mapping or aerial photograph interpretation.

Mental mapping has become a common feature of PRA projects, particularly when investigating natural resource planning and management and the documentation of indigenous knowledge systems (Weiner et al. 1995; Zanetell & Knuth 2002; Mohamed and Ventura 2000). I found that the drawing of mental maps by community members proved to be useful for residents to identify the primary land and resource issues in the initial stages of research.   When possible, participants were asked to draw mental maps, either as individuals or groups, before looking at professional topographic maps or aerial photographs of the region.

Participatory techniques were also used to interpret traditional printed topographic maps (1:50,000) (Figure 2). Residents related personal narratives stemming from the maps and marked locations of historical and current land issues, such as previous community settlement patterns and areas of forced removals.

Community interpretation of aerial photographs

While there is an abundance of literature on the use of more traditional participatory techniques, community interpretation of aerial photographs has only recently become well documented (Jordan, 2002; Fox, et al., 2003; Rindfuss, et al., 2003). A unique strength of visual media is their ability to draw people into discussions. Even in areas of poor literacy, community members oriented to visual media very quickly and openly discussed ideas and information, which had been difficult to capture from normal interviews.

Figure 2:   Standard 1:50,000 topographic map (1984 series, map #2632CD; obtained from Chief Directorate: Surveys and Mapping, South Africa) used for participatory investigation of land use issues in Mbangweni, Ndumu Game Reserve and Mozambique. Community participants related historical narratives, identified resource collection locations and shared perceptions of attitudes generated from details on the map.
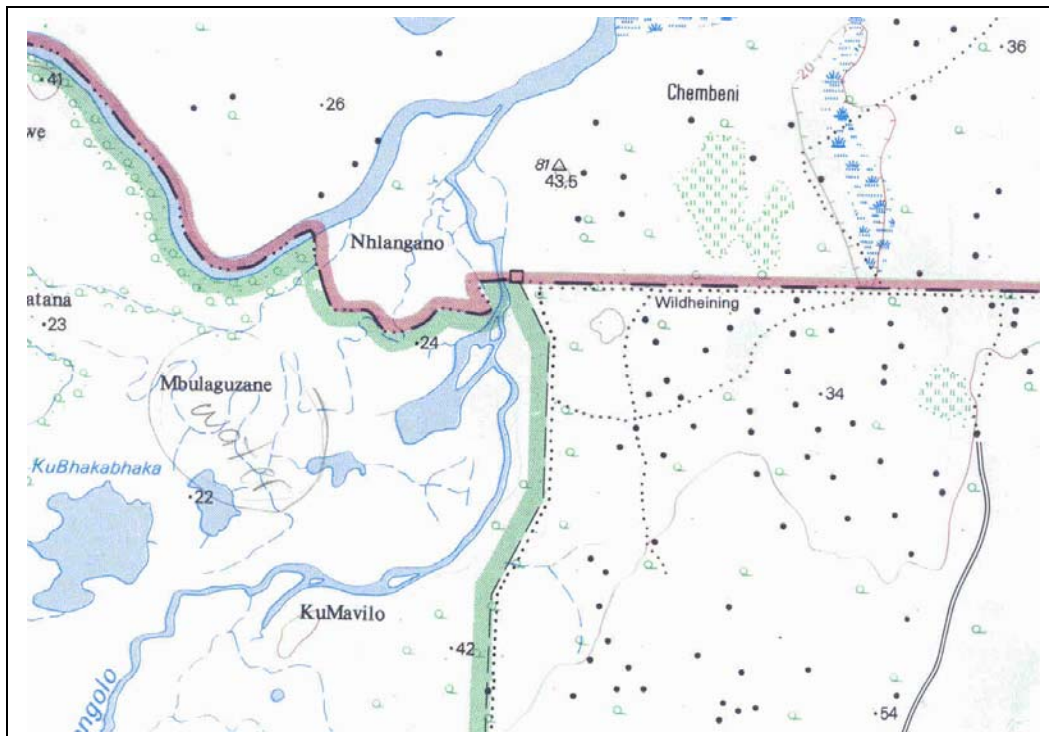
When a portion of Ndumu Game Reserve (1262ha) was restituted to the Tembe Traditional Authority in 2000, the Land Claim Commission decided the community never actually resided on the land, but had historically accessed it for resource collection (Tong, ca. 2002). Conservation authorities support this position, but community members maintain they and their ancestors did indeed occupy homesteads on the land. To explore these issues using participatory methods, archived aerial photographs were obtained (from 1942-2002 in scales ranging from 1:30,000-1:50,000) from the South African Department of Survey and Mapping for a nominal fee ($0.50 per photo). The photographs were scanned using a personal computer and digital files (JPEGs) were created. The images were printed in poster size, useful for group situations, and laminated for field use. For community interpretation exercises, the poster images were merely enlarged prints; no image processing, such as geo-rectification was necessary, and no geographic coordinate system was added to the print. Community residents evaluated resource locations and access represented on the images, related narratives of historical locations and patterns of settlement and movement, discussed land cover change, and identified communal resource conflict areas (Figure 3). Depending on the scale of the photograph and quality of the scan, participants were easily able to identify features as small as individual homesteads and dirt footpaths. For subsequent desktop analysis the digital aerial photographs were geo-rectified in GIS allowing the overlay of the locations of community features and households gathered via the geo-referenced surveys and additional GPS coordinates (Figure 4).

During aerial photograph interpretation, Mbangweni residents identified specific locations within the restituted land area they claim had both homesteads and subsistence

Figure 3:   Participatory aerial photograph interpretation with Mbangweni residents.

Figure 4:   Aerial photograph of Mbangweni, Ndumu Game Reserve and Mozambique
border. GPS coordinates of community features were added for spatial
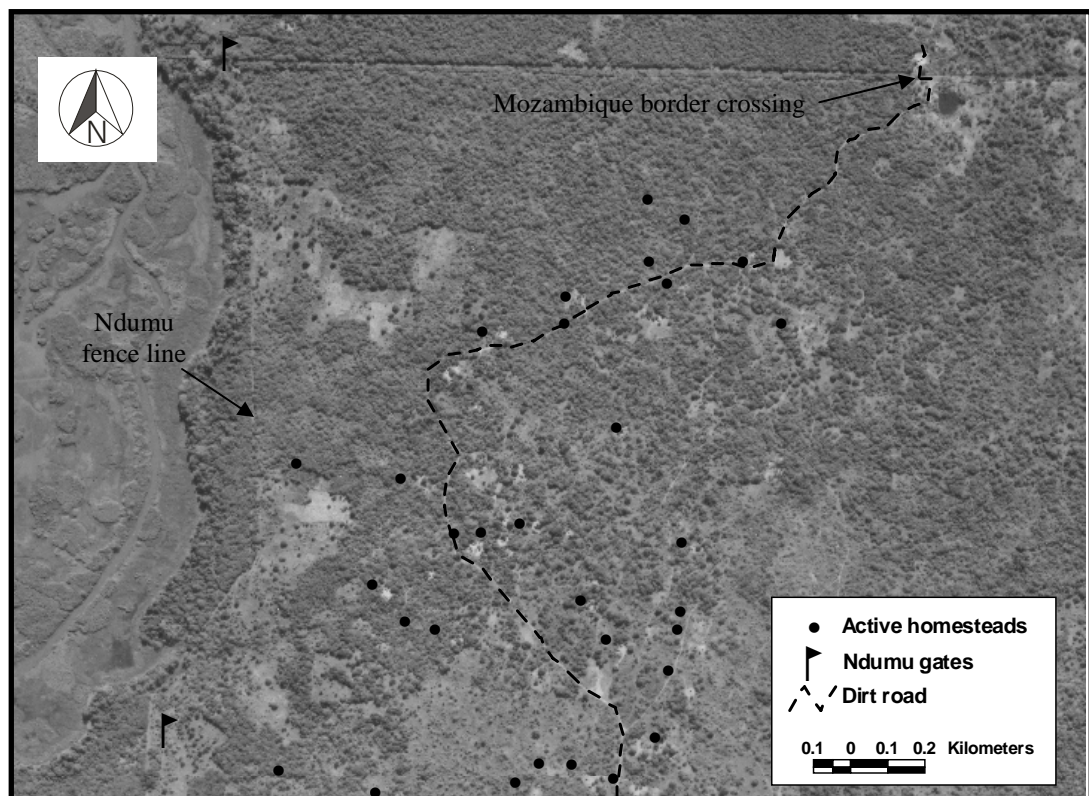
gardens. They assert these areas were occupied on a full-time basis and not just used for occasional resource collection. On the aerial photos taken before and during forced removals, residents identified what appear to be human influenced landscapes, including areas cleared for homesteads and footpaths leading to river access points. As the land claim is officially settled, the point is legally moot. But it reflects, and potentially supports, the community's larger feelings of resentment and disfranchisement over land reform issues.

This disparity in viewpoints has been a driver in the tension surrounding ongoing negotiations to implement a conservation corridor on Mbangweni land. Negotiating the land swap between the community and conservation authorities (1650 ha of communal land in exchange for 200ha of productive floodplain land) has essentially postponed joining Tembe and Ndumu parks, and thus merging them with the greater Lubombo Peace Park. They have yet to determine how the parks and the community might construct a co-management agreement, what tangible benefits the community will receive, how tourism revenues would be distributed, and numerous other factors influencing the design and implementation of an expanded conservation area. The resettlement of households out of the conservation corridor has also not yet been determined. Any household resettlement would have important impacts and consequences for local livelihoods, including disrupted access to natural resources and fragmentation of social and cultural networks (Jones, 2005a). Building on data gathered by PRA and aerial photograph interpretation, it was possible to construct potential resettlement models in GIS using the quantitative and qualitative data as modeling parameters (i.e. resettled households had to be a certain distance from the road and

arranged in a pattern suitable to local socio-cultural norms) (Jones, 2005b). Various resettlement schemes were subsequently analyzed under different sets of parameters. Specific results are presented in subsequent chapters. The point to make here is that incorporating community data into the GIS analysis provided context and depth not usually found in spatial assessment and planning.

Conclusion

Geographic Information Systems contributed to the planning of the Grand Apartheid landscape in South Africa. In the more than ten years since transformation began, the process of redressing this past of racial inequality is proceeding slowly but steadily. While redressing the past has led to an array of participatory methods for the reconstruction process in South Africa, the intersection of community participation and GIS in South Africa remains in its infancy. CiGIS moves beyond a narrow research approach and provides a process for multidisciplinary research and a holistic understanding of land reform. Employing various CiGIS methodologies in KwaZulu-Natal revealed complexities inherent in the land reform of the 'new' South Africa.

The CiGIS process is not simply used to amalgamate assorted data and interpret the results as one story. Data collected via different methodologies, while largely complementary, was sometimes contradictory. In these instances, iterative and critical analysis of all the data helped to uncover conflicting, multiple or hidden interpretations of the landscape. To that end, the CiGIS process is not conceptualized as a fixed linear progression with distinct steps to complete. The CiGIS methodological process is a holistic set of iterative techniques that may indeed produce contradictory knowledges

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representative of real-world struggles manifest in the landscape. Methods can be participatory, field-based or desk-bound and capture data that is qualitative, quantitative, spatial, temporal, and multi-scale (Table 1). The various methods can be used to confirm, contrast or explain data gathered via other steps. For example, GPS coordinates collected for households can be used to map community settlement patterns. Aerial photograph interpretation and interviews can then reveal the impacts of forced removals, cultural norms and other social customs driving settlement patterns.

Land in post-apartheid South Africa remains a fiercely contested resource. Restitution, redistribution, and tenure change are important tools to address ongoing uneven levels of development. However, research must not only focus on the institutional components of land reform, but also the local social drivers. In the Tembe Traditional Authority, the complementarity of participatory methods revealed contrasting epistemologies, attitudes and perceptions, and local histories and undercurrents between rural communities and conservation authorities. CiGIS methodologies provided a process to understand how social drivers are embedded in land struggles and to investigate the complexities of the socio-spatial conservation and development landscape. The CiGIS process revealed that the ability of conservation areas to achieve both community and biodiversity sustainability are inextricably linked to the long-term success of land reform as a tool for creating equitable land use systems. Community-integrated Geographic Information Systems, envisioned as a holistic process and not a final product, may present an opportunity for integrated analysis of biodiversity conservation and land reform research as well as the identification and mitigation of future land tenure, planning, and management issues.

Table 1: Community-integrated GIS techniques. CiGIS is conceptualized as an iterative process that produces both complementary and conflicting data representative of different interpretations of the landscape. CiGIS techniques are not inherently independent; one method can be used to confirm, contrast, or explain data gathered with a different method. For example, interviews and survey data from Mbangweni revealed strong community resentment stemming from historical forced removals from Ndumu Game Reserve. Subsequent aerial photograph interpretation by community members provided spatially explicit perceptions of historical community settlement in Ndumu that were contrary to those of conservation authorities.

Technique	Data	Type of Method
Survey questionnaire, interviews	Livelihoods: resource use, collection and management strategies; household socio-economics and demographics; attitudes and perceptions; research issue and problem identification; historical influences; ethnographies	Participatory, quantitative, qualitative, temporal
Aerial photograph, GPS locations	Land cover/use; land cover/use change; settlement patterns; resource use areas	Spatial, temporal
Aerial photograph and topographic map interpretation	Livelihoods; attitudes and perceptions; historical influences; ethnographies; resource use and land conflict issue identification	Participatory, qualitative, spatial, temporal

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