Title: Conservation as Disturbance: Upheaval and Livelihood Diversification near Tarangire National Park, northern Tanzania

Author Names: Timothy D. Baird[ab*] (tbaird@unc.edu), Paul W. Leslie[ac] (pwleslie@unc.edu)

[a] Carolina Population Center, University of North Carolina at Chapel Hill, Campus Box 8120, Chapel Hill, NC 27516-2524

[b] Department of Geography, University of North Carolina at Chapel Hill, Campus Box 3220, Chapel Hill, NC 27599-3220

[c] Department of Anthropology, University of North Carolina at Chapel Hill, Campus Box 3115, Chapel Hill, NC 27599-3115

***Corresponding Author:** Timothy D. Baird (tbaird@unc.edu); mobile: +1 (919) 360-2933; fax: +1 (919) 966-6638; present home address: 105 Fidelity St., Unit B-10, Carrboro, NC 27510, USA

Abstract: Recent studies have identified poverty reduction near parks and protected areas (PAs), findings that challenge an extensive literature on the social burdens associated with PAs. These studies move the discussion on the social dynamics of conservation forward, however, they do not offer insight into the *underlying mechanisms* that shape household-level outcomes such as income and wealth. By focusing on PAs as centers of uncertainty, upheaval, and disturbance, this study examines the character and incidence of livelihood diversification within communities near Tarangire National Park (TNP) in northern Tanzania compared to communities far from the park. Livelihood diversification is well understood as a coping and/or risk mitigation strategy pursued in response to various types of shocks, and uncertainty more generally. This study draws on mixed methodologies to construct multivariate statistical models to estimate the effect of proximity to TNP on measures of livelihood diversification. The results indicate that proximity to TNP is strongly correlated with livelihood diversification, suggesting that households near the park are seeking to reduce variance in income and wealth in response to disturbances and uncertainty associated with the park.

1. Introduction

The proliferation of parks and protected areas (PAs) around the world has spurred extensive research and a general consensus that the fates of local livelihoods and local environmental protection are linked (Adams et al., 2004, Cernea and Schmidt-Soltau, 2006, West et al., 2006, Wilkie et al., 2006, Agrawal and Redford, 2006, Barrett et al., 2011). Despite this consensus and a wealth of research on the social costs associated with biodiversity conservation (West et al., 2006, Coad et al., 2008), much remains unknown about how PAs create constraints and opportunities for people, and how people adapt to these effects creating new conservation and development concerns in the process (Miller et al., In press). Some recent studies have found measures of poverty reduction on the borders of parks and PAs (Andam et al., 2010, Sims, 2010, Ferraro and Hanauer, 2011, Naughton-Treves et al., 2011, Barrett et al., 2011). These findings run contrary to much of the literature on the social dynamics of conservation, which have focused on the social burdens created by PAs (West et al., 2006, Brosius et al., 2005, Brockington et al., 2008). Recent studies showing poverty reduction near PAs, however, lack convincing theories of change and have struggled to describe the mechanisms that underlie these phenomena. Andam et al. (2010) noted that "research to understand these mechanisms is a clear future priority" (9999).

This paper examines the mechanisms that *underlie* changes in wealth and income measures among agro-pastoralist households living near Tarangire National Park (TNP) in northern Tanzania. Here, parks and PAs are conceptualized as centers of disturbance and upheaval, to which households respond in ways to spread risk, reduce variance in household income and wealth, and improve welfare. Following this approach, our paper

examines the character and incidence of livelihood diversification in agro-pastoral communities near TNP compared to control communities.

2. Conceptual Framework

In this paper, we offer a conceptual model of change which views: (1) parks and PAs as centers of disturbance in social/ecological systems (SESs); and (2) livelihood diversification at the household level as an adaptive response to park-related disturbances. A common definition of disturbance used by ecologists is "any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment" (White and Pickett, 1985, p. 7). Gallopín (2006) broadened this definition by suggesting that perturbations (i.e., disturbances) are "the external or internal processes interacting with the system and with the potentiality of inducing a significant transformation in the system, be it slow or sudden" (2006, p. 295). In the literature on the social aspects of disturbance, scholars have focused on: (1) humans as drivers of disturbance in ecosystems (Dale et al., 2001, Hobbs and Huenneke, 1992); or (2) human responses to natural disturbances such as droughts (Block and Webb, 2001) or hurricanes (McSweeney and Coomes, 2011), though in the later cases ecological definitions that stress pronounced changes in resources are generally adopted. In looking at adaptive capacity and response to forest disturbance in the developing world, Coleman focused on "disturbances which alter the flow of forest resources essential for community livelihoods" (2011, p. 855). Here we adopt Coleman's conceptual approach to disturbance.

Parks can be centers of disturbance. By disrupting established relationships between resources and resource-users, introducing new constraints and opportunities, recruiting new resources, and creating the space for new learning, new relationships, and new feedbacks, parks resemble in character and function more commonly regarded disturbances such as hurricanes and economic or political crises. Yet parks do not constitute singular disturbances, bound in time neatly around the period of each park's creation, when local residents may be evicted and change is pronounced and easily observable. Rather, parks can foster a type of repeat disturbance where ongoing phenomena and punctuated events, centered on the park, introduce novelty and catalyze processes of change and response. These events can take place years after the creation of a park and can take many forms, including: park expansion, political contests over land-use restrictions around parks, and the attraction of development and conservation NGOs to communities along park borders.

Much of the scholarship on the mechanisms that affect the social consequences of conservation has focused on fast-moving processes such as the eviction of local residents from land (Brockington and Igoe, 2006), the alienation of resources from local residents (Ghimire and Pimbert, 1997), the implementation of programs including community-based conservation initiatives (Goldman, 2003, Berkes, 2004), and the attending political processes involved in each of these projects (Brosius et al., 2005, Igoe, 2003). Furthermore, recent studies on the household-level outcomes associated with human/park interactions have again focused on fast-moving variables such as income and wealth (Andam et al., 2010, Sims, 2010, Ferraro et al., 2011, Barrett et al., 2011, Naughton-Treves et al., 2011). Change, however, is shaped by the interaction of slow and fast

variables (Holling and Gunderson, 2002).

Slower processes of social change associated with parks, PAs, and households have received comparatively less attention. Over time, parks can "grow" into the landscape becoming more normalized or established components within the SES. This happens over the course of years as social institutions and ecosystem components adapt to it. During this process, political administrations change, programs or initiatives can come and go, and generations pass – but, like a K-strategist in ecological selection theory, the park endures and can become more fixed in the landscape and in the minds of local people. And yet, despite this process of establishment (or normalization) which evolves over decades, the park can also remain a center of disturbance, or creative destruction (Schumpeter, 1950). This role is demonstrated directly and indirectly in a number of possible ways:

- Conservation and development NGOs attracted to communities bordering the park can provide financial and/or infrastructural resources to groups and individuals dramatically improving access to key resources such as water and education (Baird, 2012);
- Markets for tourism and ecosystem services can expand beyond the park to nearby communities who can collect rents to support local development (Nelson et al., 2010, Sachedina and Nelson, 2010);
- Government officials can impose new, or alter existing, land-use restrictions surrounding PAs to limit economic activities (Nelson et al., 2007, Davis, 2011, Neumann, 1997);

- Park and government officials can expand park borders into adjacent areas (Nkwame, 2011); and
- The promise, or threat, of shocks may shift local perceptions of opportunities or risks respectively in dramatic ways that lead to behavioral changes (Baird et al., 2009).

Each of these examples, which represent disturbances subsequent to the formation of a park, can unfold in acutely punctuated events or more drawn out periods (Gallopín, 2006). There are two conceptual representations of the profile of disturbance that parks may facilitate. First, parks can be conceptualized as a single disturbance event around the time of park formation with a gradual reduction in the disturbance level as time goes by (Curve 1, Figure 3.1.). This is the representation implied in much of the scholarship on the social consequences of conservation (though the language of disturbance is not commonly used). Second, several periods of disturbance following park formation may occur where shocks and corresponding attenuations follow from park-related phenomena (Curve 2, Figure 3.1.). This can be thought of as the repeat disturbance associated with parks.

Subsequent disturbances, separated in time but not space from the initial creation of the park, can help to create an atmosphere that amplifies variance in the returns to certain household economic activities – an alarming prospect in areas where annual variance is already high and people live close to the subsistence level and a modest reduction in household income could be disastrous. Land-use restrictions can reduce the expected return from agricultural activities, whereas park expansion and further alienation of forage and water resources can severely undermine pastoralist activities by

taking resources out of production. Alternatively, some households may be motivated by opportunities associated with new markets (including labor markets) and new connections with outside organizations attracted to the area. Over time, this continual upheaval can cause households to seek to reduce variance in their own wealth and income and insulate themselves from future shocks by supplementing traditional economic activities with new, less familiar activities that may serve to spread risk (Barrett et al., 2001b), including: off-farm wage labor, migrant labor and remittances, and sharecropping. This often protracted shift from traditional economic activities to normative, diversified livelihood strategies can be seen as an important part of gradual, socio-cultural shifts and is correspondingly exemplary of the types of "slow" processes that are often overlooked in studies of the social dynamics of conservation.

The transition to a more diversified portfolio of economic activities, or livelihood diversification is common throughout the developing world (Barrett et al., 2001b, Ellis, 2000), however, its application as a strategy in communities near PAs is not well understood. To address these concerns, this study asks the following research questions (RQs): (RQ1) How do household-level measures of wealth, income, and livelihood diversification in communities near TNP compare with communities distant from any parks? and (RQ2) What is the effect of proximity to TNP on measures of livelihood diversification when controlling for other factors?

3. Livelihood Diversification

Ellis defined livelihood diversification as "the process by which rural families construct a diverse portfolio of activities and social support capabilities in order to

153 survive and to improve their standards of living" (1998, 4). Research on the factors that
154 influence the decision to diversify has tended to stratify them into two broad categories
155 which Barrett et al. refer to as push and pull factors (2001b). In some cases, individuals
156 or households will be pushed into diversifying by constraints whereas in other cases,
157 opportunities may pull decision-makers towards new opportunities. Framing this divide
158 in terms of "necessity" and "choice," Ellis (2000) points out that these factors often
159 operate in concert with each other. The literature on rural livelihood diversification in
160 the developing world has also tended to focus on two general types of households:
161 agricultural households whose primary source of income has been farming, and
162 pastoralist households who have traditionally relied on livestock production. These two
163 types of households are typically separated by larger ethnic and cultural divides and are
164 often discussed independently of each other.

165 Research on livelihood diversification among farming households in the
166 developing world have tended to discuss it in terms of off-farm or nonfarm employment.
167 Ellis (2000, 1998) and Barrett et al. (2001b) provide thorough overviews of livelihood
168 diversification, framing its determinants in the largely economic terms of rationality by
169 focusing on: credit market failures, varying returns to land and labor (which can be
170 related to seasonality), labor market opportunities, *ex ante* risk mitigation strategies, and
171 *ex post* coping strategies.

172 Among many pastoralist groups, diversification *into* agriculture is the most
173 common form of livelihood transition (McCabe et al., 2010, Little et al., 2001), though
174 new types of diversification are emerging including waged employment and labor
175 migration (Homewood et al., 2009). Similar to farming households, diversification

among pastoralists is generally seen as a coping and/or risk mitigation strategy with poorer households being pushed into new strategies and wealthier households diversifying to mitigate their exposure to risk (Brockington, 2002, Homewood et al., 2009, Little et al., 2001). Studies have linked diversification to land privatization and reduced access to grazing areas (Galaty, 1994, Homewood, 2004), market integration (Little, 2003), education (Berhanu et al., 2007), and NGO-sponsored development (Igoe, 2003). Others have noted that diversification into agriculture is also a way for herders to generate income without selling livestock – thus insuring the persistence of pastoralist livelihoods (McCabe, 2003, McCabe et al., 2010).

The role of disturbances, or shocks, in shaping diversification strategies in the developing world is an important theme in the literature on diversification. Studies have shown that climatic and geologic shocks including droughts (Block and Webb, 2001), hurricanes (McSweeney and Coomes, 2011) and tsunamis (Mills et al., 2011) can serve as ex post drivers to diversify. Similarly, diversification has also been observed following extreme economic crises as an adaptive response to boost household incomes (Priebe et al., 2010). Other studies have found ex ante diversification strategies to buffer local households from shocks associated with policy changes (Barrett et al., 2001a) and extreme weather events (Adger et al., 2005). And while the notion that parks constitute disturbances in SESs has not been explored, a small number of studies have drawn connections between conservation and livelihood diversification (Homewood et al., 2009, Brockington, 2002, Goldman, 2003). Generally, these studies have provided qualitative assessments, have not included proper controls, or have stratified households economically, not geographically (see Trench et al., 2009). As such, the effect of

proximity to parks and protected areas on livelihood diversification remains under-explored. As developing areas become more integrated in a globalizing world and efforts to protect biodiversity increase, understanding the connections between conservation and livelihood diversification will be critical to many areas of social and environmental concern.

4. Study Area and Data Collection

4.1. Study Area

The Tarangire-Manyara region of northern Tanzania is one of the most diverse grassland ecosystems on the planet (Olson and Dinerstein, 1998). Geographically, it connects a larger network of protected areas that extends from Serengeti National Park in the west to Kilimanjaro and Mkomazi National Parks in the east. TNP, however, protects only 15% of the larger Tarangire-Simanjiro ecosystem which extends far into communities in Simanjiro District. Concerns over biodiversity protection and land-use surrounding the park have driven conflict between local communities and conservationists since TNP was gazetted in 1970.

Before park establishment, the areas that are now TNP and Simanjiro District comprised portions of the traditional territory of the Kisongo Maasai. This group's economic activities have traditionally centered on transhumant pastoralism, a culturally engrained activity that is well suited to this area's semi-arid climate and high degree of rainfall variability. In the past few decades, however, the Maasai throughout East Africa have begun to adopt agriculture (Cooke, 2007, McCabe, 2003). Prior to eviction from the park, local Maasai faced many risks in their daily livelihood activities, including human

and livestock diseases, livestock predation, limited access to water, and drought. New concerns have evolved since the creation of TNP.

Beyond the major shock to local communities when TNP was created and residents were evicted and access to forage and water resources within the park was cut off (Igoe and Brockington, 1999), several subsequent events associated with TNP could be characterized as disturbances. These events were unexpected, affected the resources on which local livelihoods were based, shifted perceptions and led to new relationships. Beginning in the 1980s, land tenure conflicts arose between communities near the park and federally sanctioned hunting companies attracted to wildlife on community lands (Nelson et al., 2007, Baldus and Cauldwell, 2004). Pressured through tense interactions with communities and mandated by government regulations, these hunting companies eventually began to make contributions to local infrastructural development (Baird, 2012) beginning around 2000. Even before this time, however, communities near TNP also began leasing land to photographic safari companies, soliciting Tanzania National Parks (TANAPA) for financial assistance, and actively cultivating relationships with locally entrenched religious organizations, and new foreign donors and NGOs to procure new resources to support community development projects (Baird, 2012). In some cases, the draw of organizations to park-side communities has been directly related to their proximity to the park, as with TANAPA and hunting and tourist companies. In other cases, however, the pull or draw of some outside organizations, especially certain religious organizations and NGOs, to communities near the park is less straightforward (Baird, 2012).

Shocks to the SES associated with the park have been both positive and negative. In some cases, new schools and water access points have been built with support from conservation organizations (Baird, 2012). In other cases, events have added uncertainty to livelihoods (Davis, 2011, Sachedina, 2008, Igoe, 1999). In 2005, communities near the park received a letter from the Regional Commissioner stating that agriculture near the park should cease (Sachedina, 2008). The stated rationale was that the expansion of agriculture near the park was harmful to wildlife, though no evidence of this was presented. While this edict lacked jurisdictional authority, it confirmed longstanding and widespread concerns in the communities that land tenure and land-use rights were insecure (Baird et al., 2009). Since 2005, some efforts have been made to reduce uncertainty and support local livelihoods. A consortium of conservation, development and tourism organizations has signed agreements with two communities near the park to pay for the protection of ecosystem services near the park (Nelson et al., 2010, D. Peterson personal communication, 2010) and ensure the persistence of quality grazing lands. These efforts to build capacity and ease local conflict, however, may be undermined by TANAPA's plans to review the boundaries of the 15 national parks in Tanzania, beginning with TNP, which have touched off panic in some communities near the park (Nkwame, 2011). Prior research in this area has shown that even the perceived threat of park expansion can lead to the conversion of rangelands into agriculture to demonstrate private ownership (Baird et al., 2009).

This study focused on four communities located near the eastern border of TNP (i.e., two adjacent to the park border and two near the park but not adjacent) and two control villages much farther from the park (see Figure 3.2.). Throughout the paper the 4

267 communities adjacent to and near the park will be collectively be referred to as “near” the
268 park unless explicitly stated otherwise. Communities far from the park will generally
269 referred to as “distant”. Table 1 presents basic statistics on communities’ populations and
270 proximities to TNP.

271 Study communities were selected to examine the effect of proximity to TNP on
272 community and household outcomes while controlling for the effect of proximity to
273 urban centers and markets. Daily transportation to the large urban area of Arusha is
274 available in each of the 4 communities near the park, though for how long this has been
275 the case is unclear. Regular transportation is available 3 days a week in one of the distant
276 communities and only once a week from the other community. These differences are not
277 related to differences in physical distance to Arusha which are all easily within a few
278 hours commute on roads of reasonable quality. Instead, differences are associated with
279 availability of vehicles providing bus service – which appears to be driven by local
280 demand.

281

282 4.2. Data Collection

283 Fieldwork included mixed methodologies of data collection including group
284 interviews (n=64), participant observation, and a structured survey of households
285 (n=216). In the absence of reliable census records, and the resources to construct
286 exhaustive sampling frames in each community (which each contain several hundred
287 households widely distributed across the landscape) an opportunistic sample was drawn
288 wherein individuals from each age-group, wealth status, and geographic location within

each community were included. Local leaders were enlisted to assist in the identification of households to meet these sampling criteria.

Qualitative and quantitative methods of data collection were integrated to address each research question (RQ1 and RQ2). Qualitative semi-structured group interviews were conducted with community members, administrators, and leaders in each community to: (1) assess the character and value of livelihood decisions and their effects on household wealth, income, and livelihood diversification; (2) inform the development of a household survey instrument; and (3) yield information on the monetary value of livestock and agricultural products to facilitate the conversion of survey measures (i.e., livestock sales, agricultural yield, etc.) into income measures for analysis. This method allowed for open discussion around generally framed questions about household economics and decision making as well as more targeted questions about seasonal market prices. Participants were selected for their daily participation in livestock and farming activities and knowledge of current livestock and agricultural markets. The interviews solicited information on a range of topics including the market prices of livestock and agricultural products, farming strategies, issues of bringing products to market, off-farm employment, strategies for herd management and networks of exchange between households. All group interviews were conducted by one of us (TB) with the assistance of 1 or 2 Maasai assistants/translators.

To procure quantitative data on household economic measures for use in statistical analyses and comparison across communities, a structured household survey was conducted with 36 household in each of the 6 study communities (n=216) between September and December, 2010 (post 2010 harvest). Data were collected on: livestock

holdings including breed types, gender and age; purchases and sales of livestock in previous 12 months; land allocation; area of land farmed; species farmed; farming techniques; agricultural yields in 2010; off-farm employment by household members; remittances to the household; and household demography. Surveys were conducted by trained Maasai enumerators between September and December, 2010.

5. Analysis

Our examination of the effects of proximity to TNP on measures of wealth, income and livelihood diversification included two main analyses, each comprised of multiple steps as described below in the following paragraphs. The goal of the first analysis was to conduct a general comparison of wealth, income and livelihood diversification measures in the communities near TNP with communities far from the park (RQ1). The second analysis involved the estimation of regression models to examine the relationship between four measures of livelihood diversification and proximity to TNP when controlling for other factors (RQ2). Descriptions of the variables used in each analysis are presented in Table 2.

The values for many of the variables used in these analyses were reported directly by survey respondents themselves. Some measures, however, were derived from a combination of information captured on the survey and information collected during semi-structured group interviews. Specifically, measures of income (i.e., monetary value) from livestock sales, income from agricultural harvest, and total income were calculated by multiplying household livestock sales and harvest numbers (i.e., number of

100kg bags of maize) respectively by the prices of each[1]. To estimate the prices, one of the authors conducted semi-structured group interviews with local residents throughout the study area in Jun/Jul and Sep/Oct to capture seasonal variation in market prices for agricultural products (e.g., maize and various species of beans) and livestock with attention to differences across species, breeds, genders, and ages (i.e., sizes). These interviews revealed notable variability in prices across space and time especially for livestock, which is consistent with observations from livestock transactions in Kenya (McPeak and Barrett, 2001) which point to weak spatial correlation in price movements. Ultimately, values from different times and places were averaged to produce a single value used in income estimations across communities. This was done to shift the focus of livestock and harvest valuation away from markets and spatial differences and towards livestock and harvest numbers described in monetary terms.

5.1. Comparison of wealth, income and livelihood diversification measures

Study communities, were stratified into two categories to compare household wealth, income and diversification measures near and far from the park: one category of 4 communities located near TNP and a second category comprised of 2 communities located far from the park (see Figure 1. and Table 1.). Communities were stratified in this way because prior studies in the area found that households in the 4 communities near the park perceive it as a source of risk in their lives whereas households in the control communities do not (Baird et al., 2009). For each stratum (i.e., near and far)

[1] In other studies, measures of Maasai household income have included the value of all milk sold, however, Homewood et al. (2009) have shown that income from the sale of animals constitutes more than 96% of the total income from livestock (2009, 227). For this reason, data on milk sales was not collected and is not represented in these measures.

means of diversification measures were calculated and differences between strata were tested for significance while accounting for clustering at the community level. Variables included one measure each of wealth and income commonly used in research on the Maasai; and several measures of livelihood diversification (see Table 2) (Homewood et al., 2009).

5.1.1. Wealth & Income

Per capita household wealth was measured using an index of livestock holdings at the time of the survey interview which accounted for differences in species type (see Table 2). Income was measured by summing all income sources in the 12 months prior to the time the survey was administered to the respondent (see Table 2). This measure includes the value of all livestock sold, crops harvested, household head employment, remittances to the household from migrant workers, and income from leased land during that period. The monetary value of household head employment, remittances, and income from leased land were estimated directly by respondents. The calculation of income variables related to livestock sales and agriculture is described above.

5.1.2. Livelihood Diversification

Measures for livelihood diversification included dichotomous variables for whether the household kept improved breeds, farmed at all, farmed multiple species, used a tractor, and earned income beyond livestock and agriculture sources (i.e., other income). Further proxies for livelihood diversification included size of land allocation (land allocations are applied for and distributed through community government

structures), acres in cultivation in 2010, and yield per acre (for maize), total number of income sources, and percentage of total income coming from each of the following categories: livestock, agriculture, and all other sources. Values for yield per acre, and percentage of total income coming from livestock, agriculture, and other sources were constructed by drawing on survey questions for total acre acres cultivated, total harvest, total livestock holdings, and total income from other sources (including all sources mentioned above). All other diversification proxies were reported directly by survey respondents.

5.2. Regression Models

Ordinary least squares (OLS) regression models were estimated to investigate the effect of proximity to TNP on four measures of livelihood diversification while accounting for other factors. The measures of livelihood diversification included: *percentage of total income from livestock; percentage of total income from agriculture*; *percentage of total income from other sources*, and *total number of income sources*. These measures of livelihood diversification are well established in the literature on the determinants of diversification (Block and Webb, 2001, Minot et al., 2006, Homewood et al., 2009). Each of the dependent variables that measures a proportion of total income is censored at 0 and 1. Values for the variable *total number of income sources* are whole numbers ranging between 0 and 4. Tobit and Poisson models were also estimated where appropriate to account for censoring or a count distribution, however, results in each case were not meaningfully different than the OLS models.

Proximity to TNP is represented by the variable *community* which identifies each respondent's community of residence. As noted in Table 1, two communities are located adjacent to the border of TNP (i.e., Loiborsoit and Emboreet), two communities are located near the border (i.e., Terrat and Sukuro), and two communities are located far from the park border (i.e., Landanai and Kitwai). Predictors controlled for include household head characteristics and household wealth characteristics (see Table 2). Means and standard deviations for all variables used in the regression models are presented in Table 4. All models were adjusted for clustering at the level of the community (Angeles et al., 2005), which corrects for any community-level correlation arising from the clustered sampling strategy. A supplementary set of models were also estimated to test for interactions between livestock holdings (i.e. TLU) and household size (i.e., AE) and non-linearity in the relationship between diversification measures and livestock holding and household size, but these were not significant, did not change other coefficients, and were consequently excluded from the final models.

5.3. Strengths and weaknesses of approach

The comparative design of this study controls for the fact that poverty is ubiquitous in the study area and not restricted to areas near the park. Many studies that look at the effect of parks and PAs on social outcomes focus only on areas near parks and therefore cannot separate the effect of the park from other factors (Andam et al., 2010, Barrett et al., 2011, West et al., 2006). Furthermore, this case-study was researched over the course of a full year in the field using quantitative and qualitative methods. Qualitative group interviews greatly enhanced the quality of the household survey by

alerting us to what measures of diversification were most important within communities and helping us to understand why communities were diversifying and how new activities were integrated in larger social processes of exchange and reciprocity, issues that will be raised again in the discussion. Several recent studies on household-level outcomes associated with proximity to parks and PAs have been large, secondary data analysis projects and consequently offer a more limited understanding of the casual mechanisms underlying and the local implications of their findings (de Sherbinin, 2008, Andam et al., 2010, Sims, 2010, Ferraro and Hanauer, 2011).

The central weaknesses of this approach are that the sample size is small and the sampling strategy was not random. Mean measures of household wealth obtained in this study, however, are consistent with measures from much larger studies of Maasai households in Tanzania that utilize random samples (Homewood et al., 2009), suggesting that this sample is not necessarily skewed.

6. Results

6.1. Comparison of wealth, income and livelihood diversification measures

Overall the results from the proxies for wealth and income (see Table 3) were not broadly consistent with recent studies that found poverty reduction near parks and PAs compared to control areas (Andam et al., 2010, Sims, 2010, Barrett et al., 2011). Differences between community strata were not significant for either the measure of wealth or income. This is consistent with recent findings that proxies for poverty (e.g. infant mortality rates) in developing countries were no higher in areas near parks compared to national averages (de Sherbinin, 2008).

446 Measures of livelihood diversification, however, were significantly different in
447 most cases (see Table 3). Results show that while most households in the study area
448 were farming, very few far from the park were farming multiple species compared to
449 households near the park. The mean number of acres farmed per household was similar
450 across the strata despite the difference in land allocation which was significantly higher
451 near the park. Yield per acre was also higher near the park, but a notable difference in
452 tractor use was not significant due to community-level clustering (i.e., high variability in
453 tractors use *between* distant communities). Regarding livestock, a significantly greater
454 proportion of households near the park were keeping improved breeds compared to
455 distant households.

456 Differences in the components of total household income (i.e., livestock,
457 agriculture, and other) were all significant ($p < 0.1$) between the two groups of
458 households (see Table 3). The mean percentage of total household income coming from
459 the sale of livestock far from the park was almost double what it was near the park.
460 Correspondingly, the mean percentages coming from agriculture and other sources were
461 much lower for households far from the park compared to households near the park.
462 These differences were consistent with differences in: (1) the proportion of households
463 deriving income from sources besides livestock and agriculture; and (2) the average
464 number of sources of income for each household, which were both significantly higher
465 near the park.

466 These results point to an ambiguous relationship between the park and poverty
467 reduction but a positive association between proximity to the park and livelihood
468 diversification.

469

470 6.2. Regression models

471 The results of the regression analysis for the control variables (see Table 5) are
472 consistent with previous research from East Africa which found that geographic measures
473 generally were better predictors of diversification than socio-demographic measures, with
474 the exception of education (Trench et al., 2009).

475 At the individual level, measures of age, education, and church membership were
476 only significant in the models estimating % of total income from livestock sales and total
477 number of income sources. Members of the youngest age-set (i.e., aged 20-34) got more
478 of their total income from the sale of livestock compared to the reference category (i.e.,
479 aged over 64). The effect of education was negative in the model estimating the
480 percentage of income from livestock and positive in the model estimating total income
481 sources, findings that are consistent with each other. Respondents who reported
482 membership in "other" churches (i.e., not Lutheran or Catholic) derived more of their
483 total income from livestock sales than respondents who were not members of any church.

484 At the household level, measures of wealth (i.e., ln(TLU)), household size (i.e.,
485 ln(AE)), and wealth per capita (i.e., ln(TLU/AE)) were only significant in the model
486 estimating the percent of income coming from livestock (see Table 5). Wealth was
487 positively associated with percentage of total income from livestock and household size
488 and wealth per capita were negatively associated, results broadly consistent with other
489 findings from Africa (Barrett et al., 2001b).

490 Consistent with the descriptive results in Table 3, proximity to TNP, as measured
491 by the respondent's community, was significantly associated with the dependent variable

492 in each model. Furthermore, the coefficients for the communities near the park were in
493 the opposite direction of the coefficients for the communities far from the park when
494 compared to the reference community (i.e., Sukuro; near the park, but not adjacent).
495 Respondents in Loiborsoit and Terrat, near the park, derived a lower percentage of their
496 household income from the sale of livestock compared to Sukuro whereas the
497 communities far from the park derived a much higher percentage. In the models
498 estimating the percentage of total income from other sources and total number of income
499 sources, communities near the park had positive coefficients or coefficients not
500 significantly different from Sukuro, whereas communities far from the park had
501 significant negative coefficients. Only the model for percentage of total income from
502 farming did not follow these patterns. The magnitudes of these effects, which are
503 generally large, suggest that major differences in economic diversification exist between
504 the communities near to and far from TNP.
505
506 **7. Discussion**
507 7.1. Livelihood diversification
508 Taken together, the results provide strong evidence that proximity to TNP affects
509 livelihood diversification (RQ2), and weak evidence that wealth and income measures are
510 not significantly different between communities near the park and distant ones (RQ1).
511 The most convincing evidence of livelihood diversification is that households near the
512 park derive a much smaller percentage of their total household income from the sale of
513 livestock than control households, findings consistent with other studies in this area
514 (Trench et al., 2009). Controlling for other factors, households far from the park generate

most of their income through livestock sales. For this group, agriculture is limited primarily to maize and yields per acre are low. Furthermore, few households in distant communities pursue income generating activities beyond livestock and agriculture. With this strategy, the benefits of diversification are reduced as livestock and agriculture are each dependent on precipitation, and therefore returns are covariate (Barrett et al., 2001b, Ellis, 2000).

In the communities near the park, the basic household economic infrastructure that underlies measures of wealth and income is categorically different. Survey results show that these households derived a smaller percentage of their income from livestock sales than the control communities. Group interviews revealed that households have been adopting and/or expanding other income generating activities including agriculture, off-farm employment, labor migration, and share-cropping for years. Survey results also show that the scope of agriculture near the park is broader than in control communities, with households cultivating varieties of beans in addition to maize and generally attaining higher per acre yields.

While quantitative findings are cross-sectional and comparative across space, and therefore do not account for baseline differences between communities, they nonetheless provide important insights into the household strategies that underlie wealth and income outcomes in communities near parks and PAs and consequently shed light on recent findings of poverty reduction near parks (Andam et al., 2010, Sims, 2010, Barrett et al., 2011). In this case, the mechanisms that generate income and wealth vary across space even where income and wealth themselves do not. It may be that livelihood diversification is a precursor to higher incomes as other studies have found (Bigsten and

538 Tengstam, 2011, Bezu et al., 2011). However, maximizing income, in these
539 communities, was not the central purpose of diversification. Group interviews and
540 participant observation in the study area pointed to several reasons why households had
541 been diversifying: to reduce the need to sell livestock (see McCabe et al., 2010), to
542 protect privately held land from park expansion (see Baird et al., 2009); to insure
543 themselves against loss, and to build the capacity to handle problems independently. In
544 this way, poverty measures, such as wealth and income, can be seen as the outcomes
545 associated with risk-sensitive adaptations, not simply the barometers of park-related
546 opportunities and constraints. In light of this, the potential connections and feedbacks
547 between livelihood diversification and other risk management strategies, such as
548 traditional social networks of exchange are called into question.

549 Historically, Maasai have managed risk collectively through common property
550 regimes and longstanding institutions of exchange and reciprocity that both rely on and
551 support strong, dense social networks. As groups increasingly embrace risk management
552 strategies at the household level corresponding shifts in the structure and function of
553 broader social networks could be expected. Ellis notes that "the concept of livelihoods
554 seeks to convey the non-economic attributes of survival, not just the economic ones; it
555 therefore includes, inter alia, the social relationships and institutions that mediate
556 people's access to different assets and income streams" (2000, p. 290-91). This
557 perspective, taken with the findings presented here, point to the need for new research on
558 the relationship between diversification and social networks.

559 Over time, the Maasai have developed complex social networks that revolve
560 around livestock and commonly managed rangelands (Spear and Waller, 1993). During

group interviews, community members described an earlier time when people relied almost exclusively on livestock to provision their households. When a family's herd suffered major losses to drought or disease, or the family faced other problems for which cash was not available, they relied on social networks of exchange and reciprocity for loans or gifts to carry them through. As households diversify into new income generating activities that reduce risk and consequently the importance of traditional reciprocal exchanges of social insurance, networks may ultimately erode reducing adaptive capacity, community cohesion, and resilience (Adger, 2006). Alternatively, networks may expand or evolve as households are able to engage with new groups, and expand the assets and resources through which exchanges can be conducted and networks can be based. These competing hypotheses, or consequences (Agrawal and Chhatre, 2011), offer new directions for research on the social dynamics of conservation and should be examined more closely.

Even beyond social network dynamics, the implications of diversification are many. Prior studies have identified several benefits associated with livelihood diversification including higher incomes (Bigsten and Tengstam, 2011, Bezu et al., 2011), reduced environmental impact (Caviglia-Harris and Sills, 2005), greater social resilience, (Adger et al., 2002, Adger, 1999), and ability to respond to disturbance (Adger, 1999). Conversely, diversified livelihoods may increase transaction costs and barriers to information and consequently reduce access to and benefit from new technologies in agricultural settings (Sumberg et al., 2004). Furthermore, it may be that the ways in which the implications of livelihood diversification are understood are insufficient to understand diversification near a park. Diversification strategies may

584 include activities that: (1) deplete soil fertility and reduce biodiversity undermining
585 conservation efforts, as is the concern with agriculture in this area: and/or (2) support the
586 persistence of longstanding economic activities whose effects on ecosystem processes
587 are more benign, as with livestock production (McCabe et al., 2010). They may lead to
588 win-win situations (Ferraro and Hanauer, 2011), or pit social wellbeing against
589 environmental health. In either case, patterns of diversification may become normalized
590 and self-perpetuating within local cultures (McCabe et al., 2010), creating positive
591 feedbacks in livelihood strategy and land use from generation to generation.
592 While the prospects for future livelihood diversification in this area are uncertain,
593 conditions amenable to diversification are more evident near the park. Specifically, the
594 findings presented here of higher mean household land allocations in communities near
595 the park suggest that one of the barriers to diversification (i.e., gaining access to privately
596 held land) is reduced for households near the park compared to distant households.
597
598 7.2. Parks as Disturbance
599 Lastly, these findings are consistent with findings that link livelihood
600 diversification to various type of disturbance in SESs (Block and Webb, 2001,
601 McSweeney and Coomes, 2011, Barrett et al., 2001a, Adger et al., 2005, Priebe et al.,
602 2010). Taken together with the history of disturbance in the Tarangire/Simanjiro region
603 described above, these findings suggest that the hypothesis that parks and PAs support
604 repeat disturbances to SESs is tractable and should be investigated further. Ecologists
605 have found that human activities have altered disturbance regimes (Hobbs and Huenneke,
606 1992, Dale et al., 2001) and in some cases efforts to control disturbance regimes have

607 themselves created new disturbances in ecosystems. This is especially evident in cases
608 where fire suppression led to devastating crown fires (Syphard et al., 2007). This same
609 dynamic may exist where parks and PAs, seeking to reduce the effects of human
610 disturbance on ecosystems, ultimately disturb longstanding relationships between
611 resources and resource users through cascading shocks and feedbacks, leading to
612 dramatic, unanticipated changes in SESs.

613 This paper presented disturbance as a useful organizing principal for
614 understanding human/park interactions and offered a descriptive account of the effects of
615 TNP on SES parameters and local communities. Rigorously testing this park-as-
616 disturbance hypothesis, however, would require substantial further research, including:
617 (1) detailed data on the pre-park state of the SES; and (2) comparative studies that
618 examined multiple parks through time alongside control areas. Data and studies of this
619 kind would be ideal, if not difficult to obtain/conduct. Still, disturbance ecology offers
620 several insights to social studies of conservation. Disturbance interval and magnitude,
621 along with the diversity or homogeneity of the disturbance regime may have profound
622 effects on the character, incidence and diversity of human responses. While
623 measurement challenges remain, appreciation of these dynamics between parks and
624 people and the feedbacks that they engender will be critical as efforts to protect
625 biodiversity (Rands et al., 2010) and reduce global poverty (Sachs et al., 2009) expand
626 and confront increasingly dynamic conditions shaped by global climate change,
627 population growth, and globalization.
628

629 **8. Acknowledgements**

Data collection for this study was supported by a Fulbright Hays Fellowship through the U.S. Department of Education, an NSF DDRI, and a research grant through the Carolina Population Center at the University of North Carolina at Chapel Hill. Helpful comments on a previous draft of this manuscript were provided by Martin Doyle, Peter White, Tom Whitmore, and Clark Gray.

9. Tables

Table 1. Study communities' population and proximity to park (actual and categorical).

Community	*Population in 2002 (TZ Census[a])*	*Approx. Distance to Park[b] (km)*	*Near (Adjacent/Not Adjacent) & Far*
Loiborsoit	4160	27	Near (Adjacent)
Emboreet	2244	23	Near (Adjacent)
Terrat	2837	43	Near (Not Adjacent)
Sukuro	2704	34	Near (Not Adjacent)
Landanai	4993	92	Far
Kitwai	1273	96	Far

[a] The 2002 Tanzanian Census (Tanzanian National Bureau of Statistics, 2004) offers the most reliable estimate of population for these communities.
[b] Represents Euclidean distance from the community center to the eastern border of TNP.

Table 2. Descriptions of variables used in wealth, income and livelihood diversification comparison (Table 3) and regression analysis (Tables 4 and 5).

Variable	*Description*	*Table 3 (Means)*	*Tables 4 & 5 (Reg. Models)*
Household (HH) wealth and income measures			
TLU	Tropical Livestock Units (measure of livestock holdings that accounts for differences across species)[a].		Yes (Ln)
AE	Adult Equivalent Units (measure of HH size that combines members of different ages and genders to compare provisioning requirements across households).		Yes (Ln)
TLU/AE	TLU divided by AE (measure of per capital livestock holdings). This is a common measure of wealth among the Maasai.	Yes	Yes (Ln)
Total income	Total HH income in the 12 months preceding the survey interview coming from all sources including the value of all livestock sold, crops harvested, household head employment, remittances to the household from migrant workers, and income from leased land).	Yes	
Other household head (HHH) characteristics			
Age	Age-set of HHH, which is a categorical proxy for age. Age-sets are: Korianga (20-34 yrs); Landis (35-49 yrs); Irkishumu (50-64 yrs); Seuri and older age-sets (over 64 yrs).		Yes
Education (0/1)	Measure of whether or not the HHH had any formal education (i.e., attended school).		Yes
Religion	Measure of HHH membership in church (Lutheran, Catholic, Other Church, or not a member of any church).		Yes
Household diversification measures			
Improved breeds (0/1)	Measure of whether or not the household keeps any improved breeds of cattle. Improved Breeds generally grow faster and bigger, reach sexual maturity quicker, have higher fecundity, lactate at higher rates, and are considerably more expensive than the traditional zebu species.	Yes	
Farming (0/1)	Measure of whether or not the HH farmed in 2010.	Yes	

Variable	*Description*	*Table 3 (Means)*	*Tables 4 & 5 (Reg. Models)*
Farming multi spp. (0/1)	Measure of whether or not the HH farmed more than one crop species in 2010.	Yes	
Tractor (0/1)	Measure of whether or not the HH used a tractor to plow in 2010.	Yes	
Allocation	Measure of the number of acres formally allocated to household for private use as of 2010.	Yes	
Acres farmed	Total number of acres farmed in 2010 for all crops.	Yes	
Yield	Total yield/acre for maize in 2010.	Yes	
% of income (livestock)	Percentage of total HH income from the sale of livestock in the 12 months preceding the survey interview.	Yes	Yes
% of income (farming)	Percentage of total HH income from the value of harvested crops in the 12 months preceding the survey interview.	Yes	Yes
% of income (other)	Percentage of total HH income from all other sources of income (i.e., not livestock sales or harvest value) in the 12 months preceding the survey interview.	Yes	Yes
Other sources (0/1)	Measure of whether or not the HH had income from other sources (i.e., not livestock sales or harvest value) in the 12 months preceding the survey interview.	Yes	
# of sources	Total number of sources on income in the 12 months preceding the survey interview (i.e., livestock sales, harvest value, HHH employment, remittances from migrant workers, and income from leased land).	Yes	Yes
Proximity to park measure			
Community	HH community of residence (Near: Loiborsoit, Emboreet, Terrat, Sukuro; Far: Landanai, Kitwai)	Yes[c]	Yes

[a] Tropical Livestock Units (TLUs) are defined here as: 1 adult zebu cow = 0.71; adult sheep/goat = 0.17 (Homewood et al., 2009).
[b] Adult Equivalents (AE) is a measure of a group of people expressed in terms of standard adult reference units, with respect to food or metabolic requirements. An adult male serves as the reference adult with other categories measured as fractions of that reference: adult male = 1 AE; adult female = 0.9 AE; male/female 10-14 years = 0.9 AE; male/female 5-9 years = 0.6 AE; infant/child 2-4 years = 0.52 AE (Homewood and Rodgers, 1991, Sellen, 2003).
[c] Dichotomized: Near and Far

Table 3. Comparison of mean values for household (HH) wealth and income measures and livelihood diversification measures in communities near and far from TNP. Standard deviations in parentheses.

Variable	*Far*	*Near*	*P-value*[a]
HH wealth and income measures			
TLU/AE	4.9	5.6	0.515
	(0.044)	(1.024)	
Total income (x 1000 USD)	1.98	1.66	0.309
	(0.18)	(0.23)	
Household livelihood diversification measures			
Improved Breeds (0/1), %	5	20	0.095^{+}
	(4)	(6)	
Farming (0/1), %	91	95	0.226
	(1)	(3)	
Farming multi. spp. (0/1), %	8	44	0.025*
	(6)	(9)	
Tractor (0/1), %	39	91	0.120
	(28)	(5)	
Allocation (acres)†	12.2	33.1	0.020*
	(3.78)	(4.95)	
Acres Farmed	6.0	7.6	0.486
	(1.87)	(1.12)	
Yield (100kg bag)	2.2	4.3	0.044*
	(0.47)	(0.62)	
Mean % of income from livestock	74	38	0.032*
	(11)	(4)	
Mean % of income from farming	17	41	0.061^{+}
	(9)	(5)	
Mean % of income from other	6	20	0.025*
	(2)	(4)	
Other sources (0/1), %	26	53	0.021*
	(5)	(6)	
# of sources	1.9	2.5	0.001**
	(0.07)	(0.04)	

[a] Statistical significance tested using student's t-tests (continuous) or chi-squared tests (categorical).
† Two cases dropped from Landanai where value was greater than or equal to 200.
$^{+}$ $p < 0.10$
* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Table 4. Mean values of the regression predictors for livelihood diversification proxies.

Predictor	*Full Sample*	*Far*	*Near*
Individual measures for household head			
Age 20-34 (0/1), %	18	20	17
	(1)	(2)	(1)
Age 35-49 (0/1), %	37	37	37
	(7)	(7)	(10)
Age 50-64 (0/1), %	31	34	29
	(4)	(2)	(6)
Age over 64 (0/1), %	15	9	17
	(4)	(7)	(5)
Education, %	38	35	39
	(8)	(4)	(12)
Lutheran Church, %	38	72	22
	(12)	(6)	(9)
Catholic Church, %	26	8	34
	(7)	(2)	(6)
Other Church, %	8	0	12
	(4)	(0)	(5)
No Church, %	28	20	32
	(6)	(7)	(8)
Household measures			
Ln (TLU)	3.25	3.15	3.29
	(0.21)	(0.18)	(0.29)
Ln (AE)	5.37	4.88	5.60
	(0.72)	(0.04)	(1.02)
Ln (TLU/AE)	1.55	1.44	1.60
	(0.11)	(0.07)	(0.15)
$N_{households}$	209	65	144
$N_{communities}$	6	2	4

Table 5. Variable coefficients and significance tests from the OLS regression models of livelihood diversification.

Predictor	*% from livestock*	*% from farming*	*% from other*	*# of sources*
Individual measures				
Age 20-34	0.14*	-0.08	0.05	0.28
Age 35-49	0.02	0.05	0.02	0.08
Age 50-64	0.02	-0.01	0.01	0.02
Education	-0.12*	0.02	0.08	0.29**
Church Lutheran	0.04	-0.08	0.07	0.07
Church Catholic	0.02	0.00	-0.05	-0.14^{+}
Church Other	0.19*	-0.18	-0.02	-0.11
Household measures				
Ln (TLU)	0.33*	-0.17	-0.18	0.05
Ln (AE)	-0.26*	0.18	0.17	0.36
Ln (TLU/AE)	-0.31*	0.18	0.17	-0.03
Communities (near)				
Loiborsoit	-0.15***	0.15*	0.00	0.27*
Emboreet	0.05*	-0.11***	0.06*	0.35*
Terrat	-0.06	-0.01	0.06^{+}	0.09
Communities (far)				
Landanai	0.20**	-0.10*	-0.15**	-0.31*
Kitwai	0.46***	-0.32***	-0.19**	-0.58***

Reference categories are age older than 64 and community near the park Sukuro.
$^{+}$ $p < 0.10$
* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

10. Figures

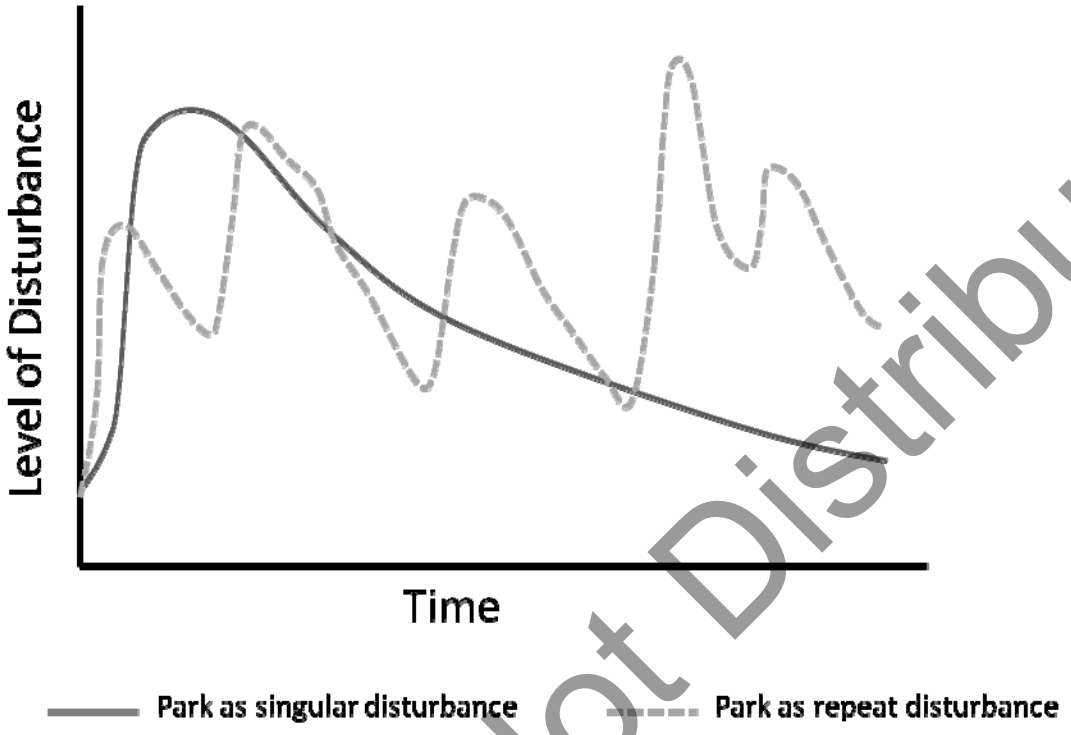

Figure 1. Conceptual model of parks as singular and repeat disturbances.

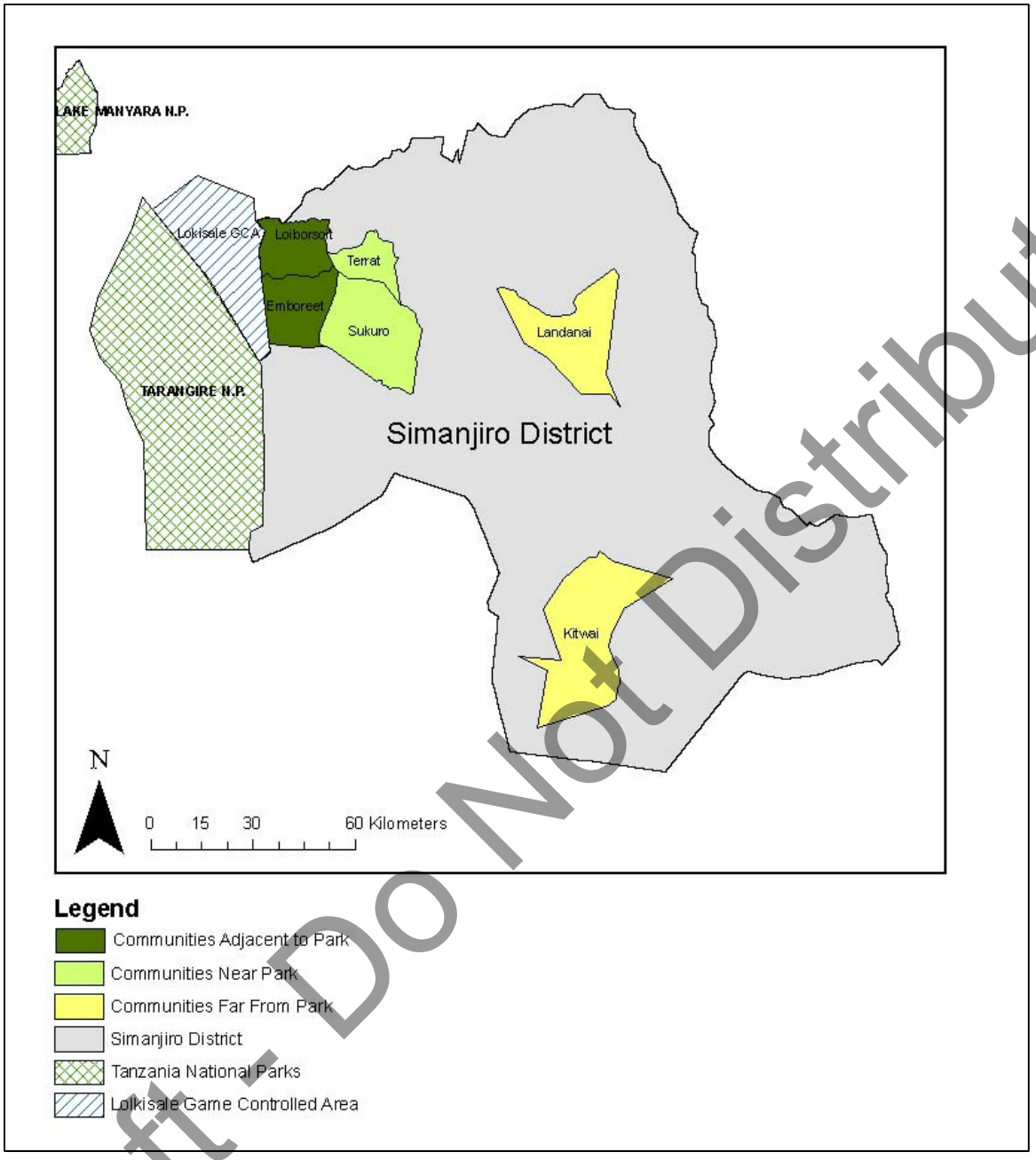

Figure 2. Map of study area.

11. References

ADAMS, W. M., AVELING, R., BROCKINGTON, D., DICKSON, B., ELLIOTT, J., MUTTON, J., ROE, D., VIRA, B. & WOLMER, W. 2004. Biodiversity Conservation and the Eradication of Poverty. *Science,* 306**,** 1146-1149.

ADGER, N. W. 1999. Social Vulnerability to Climate Change and Extremes in Coastal Vietnam. *World Development,* 27**,** 249-269.

ADGER, W. N. 2006. Vulnerability. *Global Environmental Change,* 16**,** 268-281.

ADGER, W. N., HUGHES, T. P., FOLKE, C., CARPENTAR, S. R. & ROCKSTROM, J. 2005. Social-Ecological Resilience to Coastal Disasters. *Science,* 309**,** 1036-1039.

ADGER, W. N., KELLY, P. M., WINKELS, A., HUY, L. Q. & LOCKE, C. 2002. Migration, Remittances, Livelihood Trajectories, and Social Resilience. *AMBIO: A Journal of the Human Environment,* 31**,** 358-366.

AGRAWAL, A. & CHHATRE, A. 2011. Against mono-consequentialism: Multiple outcomes and their drivers in social-ecological systems. *Global Environmental Change,* 21**,** 1-3.

AGRAWAL, A. & REDFORD, K. 2006. Poverty, Development, and Biodiversity Conservation: Shooting in the Dark? New York: Wildlife Conservation Society.

ANDAM, K. S., FERRARO, P. J., SIMS, K. R. E., HEALY, A. & HOLLAND, M. B. 2010. Protected areas reduced poverty in Costa Rica and Thailand. *Proceedings of the National Academy of Sciences,* 107**,** 9996-10001.

ANGELES, G., GUILKEY, D. K. & MROZ, T. A. 2005. The Impact of Community-Level Variables on Individual-Level Outcomes. *Sociological Methods & Research,* 34**,** 76-121.

BAIRD, T. 2012. *Conservation as Distrubance: Development, Diversification, and Social Networks Near Tarangire National Park, Northern Tanzania.* Ph.D. Dissertation, University of North Carolina at Chapel Hill.

BAIRD, T., LESLIE, P. & MCCABE, J. 2009. The Effect of Wildlife Conservation on Local Perceptions of Risk and Behavioral Response. *Human Ecology,* 37**,** 463-474.

BALDUS, R. D. & CAULDWELL, A. E. 2004. Tourist Hunting and It's Role in Development of Wildlife Management Areas in Tanzania. Dar es Salaam, Tanzania: GTZ.

BARRETT, C. B., BEZUNEH, M. & ABOUD, A. 2001a. Income diversification, poverty traps and policy shocks in Côte d'Ivoire and Kenya. *Food Policy,* 26**,** 367-384.

BARRETT, C. B., REARDON, T. & WEBB, P. 2001b. Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food Policy,* 26**,** 315-331.

BARRETT, C. B., TRAVIS, A. J. & DASGUPTA, P. 2011. On biodiversity conservation and poverty traps. *Proceedings of the National Academy of Sciences,* 108**,** 13907-13912.

BERHANU, W., COLMAN, D. & FAYISSA, B. 2007. Diversification and Livelihood Sustainability in a Semi-Arid Environment: A Case Study from Southern Ethiopia. *Journal of Development Studies,* 43**,** 871-889.

BERKES, F. 2004. Rethinking Community-Based Conservation. *Conservation Biology,* 18**,** 621-630.

BEZU, S., BARRETT, C. B. & HOLDEN, S. T. 2011. Does Nonfarm Economy Offer Pathways for Upward Mobility? Evidence from a Panel Data Study in Ethiopia. *SSRN eLibrary*.

BIGSTEN, A. & TENGSTAM, S. 2011. Smallholder Diversification and Income Growth in Zambia. *Journal of African Economies*.

BLOCK, S. & WEBB, P. 2001. The dynamics of livelihood diversification in post-famine Ethiopia. *Food Policy,* 26**,** 333-350.

BROCKINGTON, D. 2002. *Fortress Conservation: The Preservation of the Mkomazi Game Reserve, Tanzania,* Bloomington, IN, Indiana University Press.

BROCKINGTON, D., DUFFY, R. & IGOE, J. 2008. *Nature Unbound: Conservation, Capitalism, and the Future of Protected Areas,* London, Earthscan.

BROCKINGTON, D. & IGOE, J. 2006. Eviction for Conservation. A Global Overview. *Conservation & Society,* 4**,** 424-470.

BROSIUS, J. P., TSING, A. L. & ZERNER, C. (eds.) 2005. *Communities and Conservation: Histories and Politics of Community-Based Natural Resource Management,* Walnut Creek, CA: Altamira Press.

CAVIGLIA-HARRIS, J. L. & SILLS, E. O. 2005. Land use and income diversification: comparing traditional and colonist populations in the Brazilian Amazon. *Agricultural Economics,* 32**,** 221-237.

CERNEA, M. M. & SCHMIDT-SOLTAU, K. 2006. Poverty Risks and National Parks: Policy Issues in Conservation and Resettlement. *World Development,* 34**,** 1808-1830.

COAD, L., CAMPBELL, A., MILES, L. & HUMPHRIES, K. 2008. The Costs and Benefits of Forest Protected Areas for Local Livelihoods: a review of the current literature. *Working Paper.* Cambridge, U.K.: UNEP World Conservation Monitoring Centre (UNEP-WCMC).

COLEMAN, E. A. 2011. Common property rights, adaptive capacity, and response to forest disturbance. *Global Environmental Change,* 21**,** 855-865.

COOKE, A. E. 2007. *Subdividing the Savanna: the ecology of change in Northern Tanzania.* Ph.D. Dissertation Dissertation, University of North Carolina.

DALE, V. H., JOYCE, L. A., MCNULTY, S., NEILSON, R. P., AYRES, M. P., FLANNIGAN, M. D., HANSON, P. J., IRLAND, L. C., LUGO, A. E., PETERSON, C. J., SIMBERLOFF, D., SWANSON, F. J., STOCKS, B. J. & MICHAEL WOTTON, B. 2001. Climate Change and Forest Disturbances. *BioScience,* 51**,** 723-734.

DAVIS, A. 2011. 'Ha! What is the benefit of living next to the park?' Factors limiting in-migration next to Tarangire National Park, Tanzania. *Conservation & Society,* 9**,** 25-34.

DE SHERBININ, A. 2008. Is poverty more acute near parks? An assessment of infant mortality rates around protected areas in developing countries. *Oryx,* 42**,** 26-35.

ELLIS, F. 1998. Household strategies and rural livelihood diversification. *Journal of Development Studies,* 35**,** 1-38.

ELLIS, F. 2000. The Determinants of Rural Livelihood Diversification in Developing Countries. *Journal of Agricultural Economics,* 51**,** 289-302.

FERRARO, P. & HANAUER, M. 2011. Protecting Ecosystems and Alleviating Poverty with Parks and Reserves: 'Win-Win' or Tradeoffs? *Environmental and Resource Economics,* 48**,** 269-286.

FERRARO, P. J., HANAUER, M. M. & SIMS, K. R. E. 2011. Conditions associated with protected area success in conservation and poverty reduction. *Proceedings of the National Academy of Sciences,* 108**,** 13913-13918.

GALATY, J. G. 1994. Ha(l)ving land in common: the subdivision of Maasai group ranches in Kenya. *Nomadic Peoples,* 34/35**,** 109-122.

GALLOPÍN, G. C. 2006. Linkages between vulnerability, resilience, and adaptive capacity. *Global Environmental Change,* 16**,** 293-303.

GHIMIRE, K. B. & PIMBERT, M. P. 1997. Social change and conservation: An overview of issues and concepts. *In:* GHIMIRE, K. B. & PIMBERT, M. P. (eds.) *Social Change and Conservation: Environmental Politics and Impacts of National Parks and Protected Areas.* London: Earthscan.

GOLDMAN, M. 2003. Partitioned nature, privileged knowledge: Community-based conservation in Tanzania. *Development and Change,* 34**,** 833-862.

HOBBS, R. J. & HUENNEKE, L. F. 1992. Disturbance, Diversity, and Invasion: Implications for Conservation. *Conservation Biology,* 6**,** 324-337.

HOLLING, C. S. & GUNDERSON, L. H. 2002. Resilience and Adaptive Cycles. *In:* GUNDERSON, L. H. & HOLLING, C. S. (eds.) *Panarchy: Understanding Transformations in Human and Natural Systems.* Washington: Island Press.

HOMEWOOD, K., KRISTJANSON, P. & TRENCH, P. C. (eds.) 2009. *Staying Maasai: Livelihoods, Conservation and Development in East African Rangelands,* New York: Springer.

HOMEWOOD, K. M. 2004. Policy, environment and development in African rangelands. *Environmental Science & Policy,* 7**,** 125-143.

HOMEWOOD, K. M. & RODGERS, W. A. 1991. *Maasailand ecology: pastoralist development and wildlife conservation in Ngorongoro, Tanzania, revised edition,* Cambridge, Cambridge University Press.

IGOE, J. 1999. Roadblocks to Community Conservation in Tanzania: A Case Study from Simanjiro District. *W.P. No 218.* Boston: African Studies Center, Boston University.

IGOE, J. 2003. Scaling up civil society: Donor money, NGOs and the pastoralist land rights movement in Tanzania. *Development and Change,* 34**,** 863-885.

IGOE, J. & BROCKINGTON, D. 1999. Pastoral Land Tenure and Community Conservation: A Case Study from North-east Tanzania. *Pastoral Land Tenure Series.* London: International Institute for Environment and Development.

LITTLE, P. D. 2003. *Somalia: Economy Without State* Bloomington, Indiana University Press.

LITTLE, P. D., SMITH, K., CELLARIUS, B. A., COPPOCK, D. L. & BARRETT, C. B. 2001. Avoiding disaster: Diversification and risk management among East African herders. *Development and Change,* 32**,** 401-433.

MCCABE, J. T. 2003. Sustainability and livelihood diversification among the Maasai of Northern Tanzania. *Human Organization,* 62**,** 100-111.

MCCABE, J. T., LESLIE, P. & DELUCA, L. 2010. Adopting Cultivation to Remain Pastoralists: The Diversification of Maasai Livelihoods in Northern Tanzania. *Human Ecology,* 38**,** 321-334.

MCPEAK, J. G. & BARRETT, C. B. 2001. Differential Risk Exposure and Stochastic Poverty Traps Among East African Pastoralists. *American Journal of Agricultural Economics,* 83**,** 674-679.

MCSWEENEY, K. & COOMES, O. T. 2011. Climate-related disaster opens a window of opportunity for rural poor in northeastern Honduras. *Proceedings of the National Academy of Sciences,* 108**,** 5203-5208.

MILLER, B. W., CAPLOW, S. C. & LESLIE, P. W. In press. Feedbacks between conservation and social-ecological systems. *Conservation Biology*.

MILLS, D. J., ADHURI, D. S., PHILLIPS, M. J., RAVIKUMAR, B. & PADIYAR, A. P. 2011. Shocks, recovery trajectories and resilience among aquaculture-dependent households in post-tsunami Aceh, Indonesia. *Local Environment,* 16**,** 425-444.

MINOT, N., EPPRECHT, M., ANH, T. T. T. & TRUNG, L. Q. 2006. Income Diversification and Poverty in the Northern Uplands of Vietnam. *Research Report 145.* Washington D.C.: International Food Policy Research Institute.

NAUGHTON-TREVES, L., ALIX-GARCIA, J. & CHAPMAN, C. A. 2011. Lessons about parks and poverty from a decade of forest loss and economic growth around Kibale National Park, Uganda. *Proceedings of the National Academy of Sciences,* 108**,** 13919-13924.

NELSON, F., FOLEY, C., FOLEY, L., LEPOSO, A., LOURE, E., PETERSON, D., PETERSON, M., PETERSON, T., SACHEDINA, H. & WILLIAMS, A. 2010. Payments for Ecosystem Services as a Framework for Community-Based Conservation in Northern Tanzania. *Conservation Biology,* 24**,** 78-85.

NELSON, F., NSHALA, R. & RODGERS, W. 2007. The Evolution and Reform of Tanzanian Wildlife Management. *Conservation & Society,* 5**,** 232-261.

NEUMANN, R. P. 1997. Primitive Ideas: Protected Area Buffer Zones and the Politics of Land in Africa. *Development and Change,* 28**,** 559-582.

NKWAME, M. 2011. National park border lines set for review. *Tanzania Daily News* [Online].

OLSON, D. & DINERSTEIN 1998. The Global 200: A Representation Approach to Conserving the Earth's Most Biologically Valuable Ecoregions. *Conservation Biology,* 12.

PRIEBE, J., RUDOLF, R., WEISBROD, J., KLASEN, S., SUGEMA, I. & NURYARTONO, N. 2010. Rural income dynamics in post-crisis Indonesia: evidence from Central Sulawesi Tropical Rainforests and Agroforests under Global Change. *In:* TSCHARNTKE, T., LEUSCHNER, C., VELDKAMP, E., FAUST, H., GUHARDJA, E. & BIDIN, A. (eds.). Springer Berlin Heidelberg.

RANDS, M. R. W., ADAMS, W. M., BENNUN, L., BUTCHART, S. H. M., CLEMENTS, A., COOMES, D., ENTWISTLE, A., HODGE, I., KAPOS, V., SCHARLEMANN, J. P. W., SUTHERLAND, W. J. & VIRA, B. 2010. Biodiversity Conservation: Challenges Beyond 2010. *Science,* 329**,** 1298-1303.

SACHEDINA, H. & NELSON, F. 2010. Protected areas and community incentives in savannah ecosystems: a case study of Tanzania's Maasai Steppe. *Oryx,* 44**,** 390-398.

SACHEDINA, H. T. 2008. *Wildlife is Our Oil: Conservation, Livelihoods and NGOs in the Tarangire Ecosystem, Tanzania.* D.Phil., Oxford University.

SACHS, J. D., BAILLIE, J. E. M., SUTHERLAND, W. J., ARMSWORTH, P. R., ASH, N., BEDDINGTON, J., BLACKBURN, T. M., COLLEN, B., GARDINER, B., GASTON, K. J., GODFRAY, H. C. J., GREEN, R. E., HARVEY, P. H., HOUSE, B., KNAPP, S., KÜMPEL, N. F., MACDONALD, D. W., MACE, G. M., MALLET, J., MATTHEWS, A., MAY, R. M., PETCHEY, O., PURVIS, A., ROE, D., SAFI, K., TURNER, K., WALPOLE, M., WATSON, R. & JONES, K. E. 2009. Biodiversity Conservation and the Millennium Development Goals. *Science,* 325**,** 1502-1503.

SCHUMPETER, J. 1950. *Capitalism, socialism and democracy,* New York, Harper and Row.

SELLEN, D. 2003. Nutritional Consequences of Wealth Differentials in East African Pastoralists: The Case of the Datoga of Northern Tanzania. *Human Ecology,* 31**,** 529-570.

SIMS, K. R. E. 2010. Conservation and development: Evidence from Thai protected areas. *Journal of Environmental Economics and Management,* 60**,** 94-114.

SPEAR, T. & WALLER, R. (eds.) 1993. *Being Maasai: Ethnicity and Identity in East Africa,* Athens, OH: Ohio University Press.

SUMBERG, J., GILBERT, E. & BLACKIE, M. 2004. Income Diversity, Technology Choice and Agricultural Research Policy in Sub-Saharan Africa. *Development Policy Review,* 22**,** 131-146.

SYPHARD, A. D., RADELOFF, V. C., KEELEY, J. E., HAWBAKER, T. J., CLAYTON, M. K., STEWART, S. I. & HAMMER, R. B. 2007. Human Influence on California Fire Regimes. *Ecological Applications,* 17**,** 1388-1402.

TANZANIAN NATIONAL BUREAU OF STATISTICS 2004. 2002 Population and Housing Census: General Report. *In:* HTTP://WWW.TANZANIA.GO.TZ/CENSUS/CENSUS/INDEX.HTML (ed.).

TRENCH, P. C., KIRUSWA, S., NELSON, F. & HOMEWOOD, K. 2009. Still "People of Cattle"? Livelihoods, Diversification and Community Conservation in Longido District. *In:* HOMEWOOD, K., KRISTJANSON, P. & TRENCH, P. C. (eds.) *Staying Maasai? Livelihoods, Conservation and Development in East African Rangelands.* New York: Springer.

WEST, P., IGOE, J. & BROCKINGTON, D. 2006. Parks and Peoples: The Social Impact of Protected Areas. *Annual Review of Anthropology,* 35**,** 251-277.

WHITE, P. S. & PICKETT, S. T. A. 1985. Natural Disturbance and Patch Dynamics: An Introduction. *In:* PICKETT, S. T. A. & WHITE, P. S. (eds.) *The Ecology of Natural Distrubance and Patch Dynamics.* New York: Academic Press, Inc.

WILKIE, D. S., MORELLI, G. A., DEMMER, J., STARKEY, M., TELFER, P. & STEIL, M. 2006. Parks and People: Assessing the Human Welfare Effects of Establishing Protected Areas for Biodiversity Conservation. *Conservation Biology,* 20**,** 247-249.