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Unevenness in scale mismatches: Institutional change, pastoralist livelihoods, and herding ecology in Laikipia, Kenya

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ABSTRACT

This paper focuses on how political, economic, and biophysical factors shape institutions that mediate how livelihoods and ecological processes align and interact at Koija, a pastoralist group ranch in Mukogodo Division, Laikipia, Kenya. While there is currently a high-profile emphasis on landscape conservation and maintenance of wildlife mobility in East Africa, pastoralist herding range fragmentation is less often considered within conservation planning or assessments of ecological change. To address this, we asked, how have institutional changes interacted with the alignment of livestock husbandry livelihoods and ecological dynamics? We identified institutional changes that formed due to state intervention during the colonial and post-independence eras, and recent changes that have occurred due to privatized wildlife conservation. We then used ethnographic methods to analyze how these changes have interacted with biophysical conditions and herder agency to shape current livelihoods. We found that recent barriers to seasonal range access have occurred due to policies on private conservation ranches, conflicts between pastoralists in surrounding areas, and recent conservation interventions. While pastoralist households have adapted their livelihood strategies within these constraints on mobility, livelihoods have also been impacted by complex interactions with markets, changes in herding institutions, relations with conservation actors, ecological conditions of currently accessed sites, and biophysical factors related to livestock species. Bringing together political ecology and social-ecological systems literatures, we conclude that efforts to align institutions and ecological processes in favor of wildlife conservation overlook the current institutional and ecological basis of livelihoods and, in so doing, perpetuate a historically-rooted scalar mismatch between pastoralist livestock mobility and ecological variability.

1. Introduction

Customary pastoralism in East Africa involves flexible institutions for securing access to seasonally variable common pool water and pasture resources, and coordination across levels of social organization in times of environmental stress (Blewett, 1995; Mwangi and Ostrom, 2009). With the success of pastoralist livelihoods in drylands closely related to mobility (Fratkin, 2001), fragmentation of rangelands can lead to misalignment between the scale of variation in ecological processes and the scale of seasonal movement (du Toit, 2009). Such dynamics have been shown to lead to decreased efficacy of pastoralism as a subsistence practice and can have cascading impacts on social and ecological factors (BurnSilver et al., 2008; Fratkin, 2001; Galvin et al., 2008; Galvin, 2009; Hobbs et al., 2008; Reid et al., 2008; McPeak, 2003; Mwangi, 2007; Mwangi and Ostrom, 2009; Weber and Horst, 2011). Historical contingencies in Laikipia, Kenya, have led to sweeping changes where today large privately-titled wildlife conservation ranches, supplemented by ecotourism profits and international conservation NGO support, practice strategic, low-intensity grazing within areas that are largely unfenced (Georgiadis et al., 2007; Western et al., 2009) aside from several ranches that have large fences for elephants, and fences bordering agricultural areas (Evans and Adams, 2016). In this context of new incomes and government policies that prioritize wildlife conservation, management practices on privately-titled ranches have

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increasingly sought to align the scale of ecological variability and mobility required by wildlife while maintaining low-intensity commercial cattle ranching. In contrast, pastoralist herding ecology within and surrounding Mukogodo Division in the northeast of Laikipia has seen increasing fragmentation of dry-season mobility, leading to concentration of herding occurring within areas of lower, more variable rainfall (Herren, 1991; Letai and Lind, 2013).

We explored how historical institutional changes have shaped livelihood outcomes and interacted with a more recent suite of changes related to wildlife conservation. Specifically, we asked how institutional changes have impacted the alignment and interaction of herding livelihoods with ecological processes, and how herders have adapted their livelihoods in response. Our exploration of how recent policies have impacted the alignment of the institutional landscape and the ecological requirements builds upon a multi-scalar understanding of the political economic context of livelihoods (Scoones, 2009) with an explicit consideration of constraints (Barrett et al., 2005; Liao et al., 2015; Speranza et al., 2014) and assessment of the scalar fit of institutions to ecological context (Cash et al., 2006; Cumming et al., 2006; Folke et al., 2007). Insights were gained by incorporating both political ecology and social ecological systems (SES) analysis (Turner, 2014). To expand SES understandings of institutional fit we considered global patterns of political economic shifts and their interaction with context-dependent social and biophysical factors (Li, 2014; Mitchell, 2002; Robbins, 2007; Tsing, 2005). We explored how wildlife conservation, herding ecology, and historically-contingent institutions have interacted to shape livelihood outcomes, and how historically-rooted inequalities between conservation actors and pastoralists have formed the basis for the current uneven ability of these actors to shape institutional landscapes. This led to an improved understanding of the complex ways that ecological processes are aligned and institutional landscapes are produced, as well as how discourses about pastoralist livelihoods and ecological outcomes have emerged and shaped conservation approaches.

In what follows, we begin by briefly contrasting social-ecological systems and political ecology as they relate to the concept of scale-mismatch. We then provide a historical literature review of the sequence of changes that have occurred in pastoralist institutions and livestock husbandry in Laikipia. Following an overview of our methodology, we report findings on themes salient to landscape use including: access, herd composition, livestock husbandry practices, relations with neighboring private ranches, and herding ecology. We finish with a discussion of institutional fit, incorporating analytical tools from the perspectives of both social-ecological systems and political ecology.

2. Pastoralism, alternate human/environment perspectives, and institutional fit

Equilibrium ecological understandings formed part of the rationale underlying colonial and post-colonial rangeland studies, which often focused upon determining the maximum sustained use of rangelands by applying fixed stocking rates (Ellis and Swift, 1988; McCabe, 2004). However, in drylands, it has been increasingly recognized that non-equilibrium processes may be important to consider, if the spatio-temporal variability of rainfall is high enough to keep herbivore populations below equilibrium levels and decouple vegetation dynamics from their impacts (Ellis and Swift, 1988). This depends on contextual factors such as key-resource availability and the spatial scale of movements, but has ultimately led to a recognition that considering the pressure, timing, and duration of livestock herbivory, in relation to variation of rainfall and other context-specific factors, can allow for more nuanced understandings of the most relevant rangeland landscape processes (Vetter, 2005; von Wehrden et al., 2012). These insights have also led to an emphasis on the heightened need for flexible responses at different scales that are often salient features of both pastoralist social organization and livestock husbandry (Ash et al., 2002; Mwangi and Ostrom, 2009; Niamir-Fuller, 1999).

Drawing in large part from ecological concepts and complex systems theory, SES provides a basis for analysis of non-equilibrium dynamics in the interaction of social and ecological factors at different temporal and spatial scales (Berkes and Folke, 1998; Walker et al., 2004; Ostrom, 2009). As a body of scholarship focused on systematically understanding how livelihoods and ecological process are intertwined and can cause cascading, interrelated shifts (Kinzig et al., 2006), the SES approach has been utilized extensively in rangelands (Anderies et al., 2004; Bestelmeyer and Briske, 2012). However, scholars have critically examined how using concepts with origins in ecology to understand social organization can mask the influences of power and culture (Cote and Nightingale, 2012; Walker and Cooper, 2011; Brown, 2014; Hatt, 2013), and privilege compatible epistemologies (Olsson et al., 2015; O'Sullivan, 2004; Nightingale, 2016). These critiques have also detailed how SES analysis can neglect understandings of the influence of larger economic forces on local interactions, and idealize or oversimplify social relationships (Davidson, 2010; Duit et al., 2010; Cretney, 2014; Béné et al., 2012; Welsh, 2014; Walsh-Dilley et al., 2013).

Political ecology is another body of scholarship with particular relevance to non-equilibrial, multi-scalar, complex interactions in socio-ecological analyses, but using a methodological focus built upon a rich understanding of geographic and historical context (Scoones, 1999; Zimmerer, 1994). An interdisciplinary field of study, political ecology has an explicit concern with power, uneven geographies of conservation and development, and complex political economic interactions that impact livelihoods, land use, and environments (Blaikie, 1985; Blaikie and Brookfield, 1987). With a long history of applications in rangeland studies (e.g. Abel and Blaikie, 1989; Turner, 1993), political ecology has scrutinized narratives of land degradation advanced by dominant actors that have often overlooked non-equilibrium dynamics, as well as ecological process and livelihoods from land-users' perspectives (Fairhead and Leach, 1996; Little, 1994; Turner, 1993). Turner (2014) highlights how the overlap of SES and political ecology provides opportunity for novel, integrative research; systems concepts allow for incorporation of sophisticated understandings of dynamics that characterize ecosystem complexity, and nuanced analysis of social processes of power and governance at multiple scales can foster complex understandings of human interactions with ecosystem process. This can lead to a more robust understanding of how social and ecological factors inter-penetrate (e.g. Levins and Lewontin, 1985; Mitchell, 2002; Tsing, 2005). In what follows, we treat SES and political ecology as perspectives that each yield only partial understanding of the system (Turner, 2014), with a long history of tensions and incompatibilities that we do not attempt to resolve, but instead consider pluralistically (Nightingale, 2016; Olsson et al., 2015) in hopes of gaining novel insights from diverse lenses and the productive tensions between them that neither approach could achieve in isolation.

Analysis of institutional fit in SES perspectives (Epstein et al., 2015; Folke et al., 2007; Lebel et al., 2013) builds upon hierarchy theory and spatial ecology to inform policy, often by detecting when the scale of management does not align with the dynamics of an ecological process of interest in conservation planning (Cash et al., 2006; Cumming et al., 2006; Guerrero et al., 2013). This approach synthesizes ecological understandings of scale with new institutionalism, or study of the dynamic rules and norms that create expectations of how others will act, and thus impact the outcomes of interactions among individuals (Agrawal, 2010; Lesorogol, 2008; North, 1990; Ostrom, 1990). This can be extended to understand institutions as shaping the impacts of land use on biophysical processes (Leach et al., 1999; Kepe and Scoones, 1999; Scoones, 1999), enabling assessment of the alignment of rules and norms with ecological processes at specific spatial, temporal, and functional scales (Cumming et al., 2006; Allen and Holling, 2010; Epstein et al., 2015; Folke et al., 2007; Lebel et al., 2013).

A sub-section of SES literature on institutional fit builds upon complex political, historical, and economic contexts (Lebel et al., 2005), showing, for example how different actors emphasize scales that benefit

their own interests (Cash et al., 2006). However, apart from recent analysis of how the concerns of powerful actors influence the ways in which scale is framed by knowledge and narratives (Ahlborg and Nightingale, 2012), this literature has rarely engaged with the extensive politics of scale literature that explores how scale is "socially constructed, historically contingent, and politically contested" (reviewed in Neumann, 2009). Political ecological analyses, however, are attentive to how scale is "produced" given different methodologies and epistemologies (Sayre, 2005; Rangan and Kull, 2009), as well as how scalar concepts are historically contingent and strategically deployed by state and non-state actors (Sievanen et al., 2013). Numerous empirical studies have documented how concepts of scale may be privileged and reinforced in conservation settings (Butt, 2014; Fairhead and Leach, 1996; Goldman, 2003; Watts and Peet, 1996), ultimately clarifying how "systems" scale framings can obscure heterogeneity and favor dominant discourses (Turner, 2014; Tsing, 2012).

While institutional perspectives in SES analysis that focus on rules surrounding material use of resources (Olsson et al., 2015) are useful for understanding conspicuous dynamics of exclusion and conflict, there is also much that can be added to this perspective from critical understandings, as shown by authors that explore how participation and access are shaped by power differentials (Cleaver and de Koning, 2015; Sikor and Lund, 2009) as well as those that analyze how historical and discursive aspects of power and governance shape livelihoods (e.g. Agrawal, 2005; Carr, 2013; Fletcher, 2010). These understandings have a close relationship to analyses of the uneven geography of development and conservation outcomes (Bebbington, 2004; Igoe and Brockington, 2007), which often focus on the politics and underlying logics of recent trends in conservation that constitute "a (re)negotiation of the boundaries between the market, the state and civil society" (Castree, 2008). Such a framing can improve understandings of the recent "unlikely alliances" between pastoralists, private enterprises, and conservation actors observed in Kenyan rangelands (Little, 2014).

We posit that understanding the historical, material, and discursive influences on the ways that scale mismatches are produced can lead to nuanced understandings of the historically contingent and uneven ways that institutional landscapes form and align with ecological processes. In what follows, we examine the interplay of changes in institutions, land use, and livelihoods that occurred in a context of policies of the colonial and post-colonial Kenyan governments, and more recent governance changes that have come about due to interactions with non-state conservation actors. We first provide an overview of historical pastoralist institutions that served to secure access to dry-season and drought forage, followed by a brief historical overview of changes in institutions related to herding livelihoods and mobility. This history will then serve as a backdrop to analysis of more recent institutional changes involving complex interaction between norms of access, norms of reciprocity, new relations, and biophysical changes that have interacted with herder agency to shape livelihoods.

3. Changes in the institutional landscape of Laikipia

3.1. Historical changes in herding livelihoods in Mukogodo Division

Prior to the imposition of British rule, the overall regional economy in East Africa was integrated and dynamic, with exchanges and fluid movements between livelihoods of pastoralists, farmers, and hunter-gatherers (Spear, 1993; Waller, 2012). The rangelands of Laikipia were predominantly occupied by Maa-speaking pastoralists until, in 1904, the British forced the Purko-Kisongo Maasai, weakened by both warfare with the Laikipiak Maasai and a rinderpest epidemic, to sign a treaty that confined them to two "reserves" that were a fraction of their territory. A second treaty in 1911 established that the Maasai would all inhabit a single reserve, enabling the inclusion of the Laikipia Plateau as part of the "White Highlands," a vast area stretching from northwestern Kenya to Mt. Kenya that was claimed for European farming and commercial ranching (Herren, 1987; Hughes, 2006). In 1934 the Kenya Land Commission (also known as the Carter Commission) concluded that five hunter-gatherer groups, despite having disparate lineages, were all "Dorobo", a British term derived from the pejorative Maasai word *il-torrobo* used to refer to hunter-gatherers (Cronk, 2004). As a result, the "Dorobo Reserve" (Mukogodo Division from here on) was demarcated in 1936 on the most arid lands of the Laikipia Plateau, considered undesirable for European ranching (Herren, 1987). Today, the inhabitants of Mukogodo Division, descended from the five previously mentioned groups, having married with Maasai and Samburu pastoralists, are all Maa-speaking pastoralists, several groups of which also keep bees (Herren, 1987; Cronk, 2004).

A process of increasing confinement of seasonal grazing movements within Mukogodo Division occurred by the early 1950s, as some borders of the reserve were fenced and livestock disease quarantine areas were established (Herren, 1991; Letai and Lind, 2013). Internal pressures on land mounted as pastoralists forced from European controlled areas took refuge within Mukogodo Division (Herren, 1987). During the drought of 1964 livestock numbers became so low that all but the wealthiest households began selling animals to buy grains, and most diets became heavily maize-based (Herren, 1991). Reciprocal relationships of mutual assistance between patrilineal and affinal family members as well as age-set mates that include food or livestock exchange when one family is disadvantaged are considered to reflect pastoralist adaptations to uncertain and inherently risky dryland environments (Aktipis et al., 2011; Blewett, 1995; Bollig, 1998; McCabe, 1990; Potkanski, 1999). However, under increasing strains of drought and market interactions these began to break down at Mukogodo (Herren, 1991).

The East Africa Royal Commission (Dow Commission) of 1952 deemed the common property regime of the Maasai to be the root cause of land degradation in rangelands, and recommended that subdivision and private property rights should be the goals of policy (Mwangi and Ostrom, 2009). The Swynnerton Plan of 1955 mandated that: pastoralist reserves destock below a set carrying capacity, access to markets be assured, and a permanent water source be developed (Grandin, 1991). The Land Adjudication Act of 1968, though post-independence, implemented this mandate (Grandin, 1991), and was backed by numerous international development agencies, and advocated for group ranches, or subdivisions within pastoralist reserves, intended to ultimately convert subsistence livestock husbandry to commercial beef production (Grandin, 1991). Subdivisions were intended to create formalized tenure and encourage investments to increase carrying capacity of the land, prevent degradation, reduce stocking rates, and to provide collateral for loans (Grandin, 1991; Mwangi, 2007), based upon the logic that individual land tenure would bring these changes (Hardin, 1968; Campbell, 1993). However, group ranches were frequently not delineated with respect to seasonal water and grazing access; the boundaries often crossed seasonal migration lines, resulting in decreased ability to access reserve grazing (Coldham, 1982; Halderman, 1972; Rutten, 1992) and reduced flexibility of socially coordinated responses at different scales (Mwangi and Ostrom, 2009).

Following Kenya's independence in 1963, many of the large ranches that did not remain leased to Europeans were consolidated by land buying companies (Letai and Lind, 2013). Other parcels were demarcated for subdivision, but many were never settled and were instead used by title-holders only as collateral for loans (Letai and Lind, 2013). Herders at Mukogodo Division began to utilize these lands as well as other open-access government lands for grazing (Letai and Lind, 2013). Encounters with disease during droughts in 1981 and 1984 led to cattle losses of ~60% each event (Herren, 1991), and combined with collapse of markets and grain supplies, forced many into migratory labor, while the remaining population became increasingly stratified by livestock ownership and more incorporated into the market economy (Herren, 1991). Families, especially those of lower wealth, began to focus more heavily on small stock (sheep and goat) keeping, as they are more

drought-tolerant than cattle, have higher rates of reproduction, and are more easily sold (Herren, 1991). Wealthier herders were able to sell cattle periodically and reduce offtake rates of smallstock, while lower wealth herders relied primarily on smallstock sales, and were thus differentially impacted by market offtake (Herren, 1990). With the growing socioeconomic inequality accompanying these trends, the customary safety nets of mutual loans and exchange of animals became used only by the wealthiest families (Herren, 1991).

3.2. Historical changes in authority structure and relations with conservation actors

The Land Group Representatives Act of 1968 set out a novel system of internal governance for group ranches. The group ranch authority structure of elected committee members, who in turn enforce wider government rules such as those on range management, animal husbandry, and land use, created a novel hierarchical structure that contrasts with customary elder authority (Kibugi, 2008; Mwangi and Ostrom, 2009; Rutten, 1992). While boundaries were officially delineated in the mid-1970s and ultimately resulted in the current group ranch subdivisions within Mukogodo Division, these subdivisions and group ranch committees were not formally recognized in the affairs of pastoralists until the late 1990s or early 2000s (Kaye-Zwiebel, 2011).

Today, Mukogodo Division accounts for 7.45% of Laikipia County, and consists of 13 groups ranches with several small tracts of privately-titled land dispersed within it (Letai, 2011). To the south and west are mostly privately managed lands based on 99-year leases, with 48 of these privately-titled ranches comprising 40% of Laikipia County (Letai, 2011). Following their use primarily for beef production since the 1930s (Herren, 1987), a transition in land use of these privately-titled ranches came about following the collapse of the export market to the Middle East and the end of the Kenya Meat Commission in the 1980s (Heath, 2001). The main income generating activities on many of these former commercial cattle ranches today include ecotourism, ecological research, horticulture, and livestock breeding (Letai, 2011).

Following a series of tensions in the early 2000s, when pastoralists made claims to ancestral Maasai lands and occupied private ranches (Kantai, 2007), several community-based conservation (CBC) “trusts” were formed between group ranches, private ranches, and a consortium of NGOs (Kaye-Zwiebel, 2011). These CBC trusts were based upon United States Agency for International Development (USAID) models, and led to title deeds to group ranches being obtained, group ranch boundaries within Mukogodo Division being formally recognized, adoption of formal group ranch governance structure in accord with national law, and growing authority of conservation actors within the internal management of group ranch affairs (Zaye-Zwiebel, 2011; German et al., 2016). For several group ranches, the African Wildlife Foundation (AWF) played a pivotal role in securing the title deed from the Ministry of Lands, drafting group ranch constitutions, and zoning land uses into designated housing, grazing, and conservation (i.e. livestock exclusion) areas (NAREDA Consultants Ltd., 2004; Sumba et al., 2007). Known motivations for wildlife conservation actors and neighboring private ranches to have advocated CBC trusts include establishing areas of designated wildlife habitat including megafauna corridors, incentivizing shifts in pastoralist livelihoods through ecotourism, accrual of funds for medical, educational, and infrastructural development, and leveraging against future land claims or grazing access demands (Sumba et al., 2007; Letai and Lind, 2013).

Numerous aspects of CBC trusts have been examined in terms of direct livelihood impacts and their politics (see Fennessy, 2009; Muthiani et al., 2011; Ramser, 2007; Sumba et al., 2007; Kaye-Zwiebel, 2011; Lamers et al., 2014). However, it is less clear how livestock husbandry livelihoods have been impacted due to accompanying changes in governance and norms. While formalization of group ranches has resulted in decreased cross-boundary movements (Letai and Lind, 2013), at the same time private ranches have begun to provide group ranch residents with limited access to regular paid grazing on private lands (Kibet et al., 2016). Additionally, while income from conservation enterprises established on group ranch lands has provided meager livelihood benefits (Sumba et al., 2007), employment on private ranches as herders, security, tour guides, and research assistants has increased, and numerous changes in relations between Mukogodo residents and conservation actors have occurred (Kaye-Zweibel, 2011). Our study explores how this sequence of institutional changes has incentivized different practices, how herders have adapted their livelihoods to these changes, and how these changes have impacted the alignment and interaction of herding livelihoods with ecological processes.

4. Study site

Our study focuses on Koija group ranch, an approximately 7605 ha ranch collectively-titled to Maa-speaking pastoralists (Kaye-Zwiebel, 2011). The majority of the people who reside at Koija trace their lineage to the LeUaso hunter-gatherer group, with some stating historical ties to Maasai (including Laikipiak Maasai) and Samburu groups. Frequent references in casual conversation are made to ancestors who primarily hunted, gathered, and kept bees for a living. Today, while being primarily pastoralists, many people continue to keep bees. As in Maasai areas, households are frequently connected with other households in a joint herding, food sharing, and residential *nkang* (plural *nkangitie*), or grouping of several households (Grandin, 1991; Spencer, 1993). Koija residents live in *nkangitie* containing one or several households, today usually of patrilineal descent. Koija is located at an elevation of ~1700 m, with mean annual precipitation of ~450 mm per year. The coefficient of variation of rainfall is close to 40%; it experiences substantially higher variability and lower annual rainfall compared to the majority of Laikipia County (Franz et al., 2010). The landscape vegetation is highly heterogeneous with patches of alternating *Acacia* spp. mixed with grasses, shrubs, succulents, and distinct areas of vertisol soils dominated by perennial grasses.

In 2001, AWF and Loisaba Wilderness, a ~22,600-hectare ecotourism and cattle ranch, led those residing within the delineated boundaries of Koija to enter a CBC trust whereby they obtained a title deed which provided the basis for legally binding contracts between Koija and advocating organizations, and established the formalized group ranch governance structure. USAID provided a loan for construction of an ecolodge on Koija that was intended to produce employment and direct income to Koija, with Loisaba managing the lodge (Sumba et al., 2007). Koija’s portion of the profits from the lodge were deposited in an account managed by a board of trustees and allocated toward health, education bursaries, and infrastructure expenses, on the conditions that Koija would maintain a designated conservation area (Fig. 1, Muthiani et al., 2011) and agree to an AWF land use designation plan (Fig. 1, Sumba et al., 2007). While the lodge is no longer functional today, the group ranch governance structure remains in place with the formal boundaries of Koija and land use designations remaining recognized. Koija residents are employed on Loisaba, and Loisaba sometimes provides a limited amount of grazing intended for use by all Koija residents, where animals are selected from across Koija as part of a quota (see German et al., 2017 for discussion of quota).

5. Methodology

Beginning in 2013, we conducted eight focus group discussions with elder herders to determine salient ecological, institutional, and livelihood changes that have occurred over recent history (1980–2015). We then completed surveys, attempting to speak with an elder at every *nkang* (n = 225 out ~245 *nkangitie* total) who is involved with herding decisions (male or female, their ages estimated, with an average of ~48.2 yrs). Two brief follow-up surveys were done in 2014 and 2015, however because we were unable to arrange to speak with 18 families,

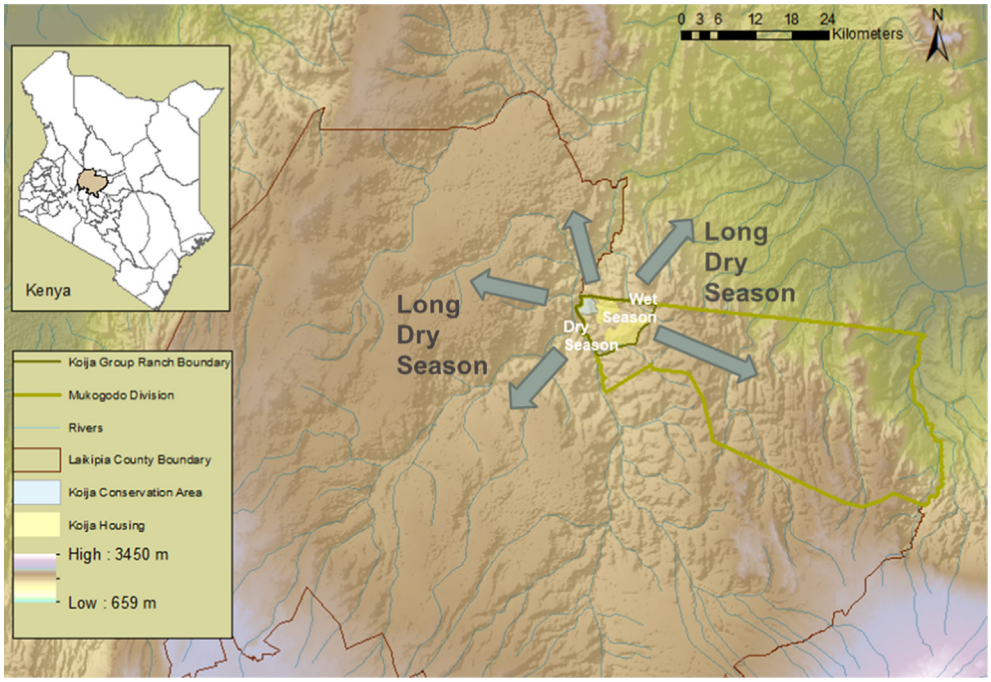

Fig. 1. Schematic of past seasonal grazing areas within and outside of Koija group ranch. Map by authors. Data sources: ASTER Digital Elevation Model, International Livestock Research Institute Streams Data.

and four *nkangitie* relocated to areas outside of Koija, follow-up surveys were not completed at these *nkangitie*. Surveys included short responses on livestock wealth, income, seasonal herding locations, and open-ended questions about livestock husbandry practices and CBC trusts. Participant observation of livestock husbandry practices, informal interviews, and twenty in-depth key informant interviews with senior elders focused on herding ecology and changes in livestock husbandry were also completed. All interviews and surveys were translated from Maa to English, and key-informant interviews were transcribed and analyzed using NVIVO software (Version 11). With 3 elders as key informants, we compiled a history of former multi-family *nkangitie* locations, and verified locations of these sites and their sizes based upon current locations of glades (lawn-like grassy areas that form on former homestead sites, see Young et al., 1995 for a detailed description) as well as through informal conversations. Livestock numbers were verified using a systematic count of the entire group ranch in 2016, and compared to counts done by the Koija grazing committee (2015) and by AWF (2002). In calculating tropical livestock units (TLU) we followed Zaal and Dietz (1999), with an equivalence of 10 small stock, 1.42 head of cattle, or 1 camel to 1 TLU. Average adult male equivalents (AAME) were calculated following (Nestel, 1986). We compared livestock holdings distributions by calculating a GINI (Gini, 1912) coefficient in excel for comparison of 201 *nkangitie* between 2002 and 2016.

6. Results

The results are organized according to the following themes: (1) general changes in internal herding rules and norms, recent changes in external access, and changes in herd composition; (2) changes in cooperative livestock husbandry, and changes associated with employment relations with conservation actors; and (3) ecological changes and their interaction with herding practices.

6.1. General changes in internal herding rules and norms, recent changes in external access, and changes in herd composition

Life histories from focus group discussions indicated that the areas of seasonal restriction and use within Koija remained consistent throughout elders' lives, except during periods of extreme drought conditions. Restrictions are placed on all animals using watering points and grazing areas near the Ewaso Ng'iro river when forage in hilltop glades and water sources near homesteads is adequate. This practice itself is a hybrid system of seasonal restriction based upon rules influenced by government-imposed "chiefs", who beginning in the colonial era altered customary institutions of authority and land use (Hughes, 2006), often through deliberation with councils of elders. This system has been in place as long as all elders could remember, and today this decision-making is also formalized through the elected grazing committee and includes continued formal restriction of a wildlife conservation area and management plans designed by conservation organizations to increase rangeland productivity. During dry periods in the past, restrictions would be lifted, and when reserve grazing was exhausted elders would coordinate travel outside the group ranch, typically with the *ilmurran* (unmarried males highly trained in cattle herding) leading large herds of cattle of mixed-ownership to areas that had experienced sufficient rainfalls (Fig. 1). While restriction of seasonal grazing areas within Koija was last in place in mid-2013 due to insufficient perennial grass regeneration (discussed below), the conservation area remains formally restricted except during extreme drought. Goats rarely leave Koija, but as sheep and cattle require grass, they are usually required to move during drought. Out of 225 *nkangitie* included in our analysis, 67 reported that they do not currently leave Koija to access forage resources.

Key informants and focus group participants indicated that livelihoods and growth of herds were primarily limited by drought and disease, with an emphasis on access to forage resources outside of the group ranch during drought. While it was indicated that families are less mobile today due to children being enrolled in school, dietary changes, and homes being more permanent, forage access outside of Koija was also indicated to have decreased sharply over the past 30 years (Fig. 2). Ninety *nkangitie* indicated that they had accessed neighboring private ranches located to the west until the early 1980s (Figs. 2 and 3) when these ranches began excluding pastoralist access. While ranches offer a limited paid dry-season grazing quota today, other violations are strictly enforced, leading to confiscation of livestock until a fine is paid, or jailtime. Most herders stated in interviews

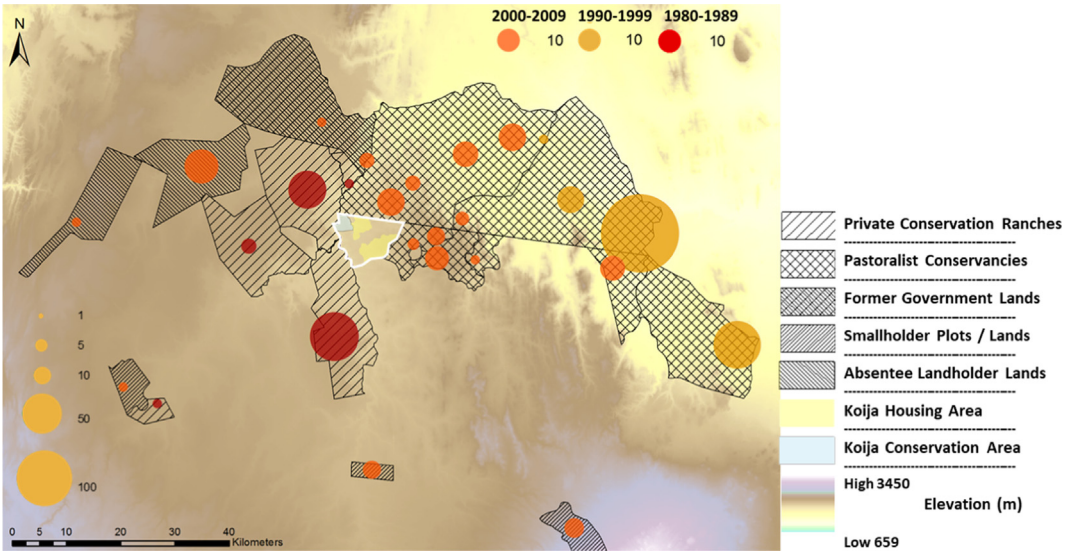

Fig. 2. Locations of areas formerly accessed outside of Koija. Size of dot indicates number of *nkangitie* that reported a loss of access to these sites during the time period referenced, color indicates time period that last access occurred. These were located according to place names. Koija is outlined in white. Map by authors. Elevation data source: ASTER Digital Elevation Model.

that previously there was a recognition of informal seasonal access, and place names indicate longstanding past access by pastoralists.

A second wave of exclusion from other seasonal grazing access areas occurred during the early 1990s when conflicts to the north and east of Mukogodo Division between Somali and Samburu groups, in present-day Isiolo county, limited access to these areas (Figs. 2 and 3). In the late 1990s, additional conflicts in these areas further decreased access. In the early 2000s, as previously mentioned, a wave of formalization of tenure (title deed acquisition followed by formalization, CBC trust formation, and exclusion) swept throughout Mukogodo Division, decreasing most access to *enkutoto* (sub-sections) to the east that trace lineages to Digirri and Mumonyot *ilosho* (sections) rather than LeUaso, but were said to be frequently and freely moved between during wet and dry seasons (Figs. 2 and 3). At the same time, areas to the immediate north were in the process of forming conservancies, and began to exclude Koija residents, while other areas to the north and northwest were embroiled in conflict between Samburu and Pokot pastoralists (Figs. 2 and 3, see Greiner, 2012 for discussion of this conflict). These changes include former government holding grounds, titled to National Youth Services and Livestock Marketing Division that served as de facto

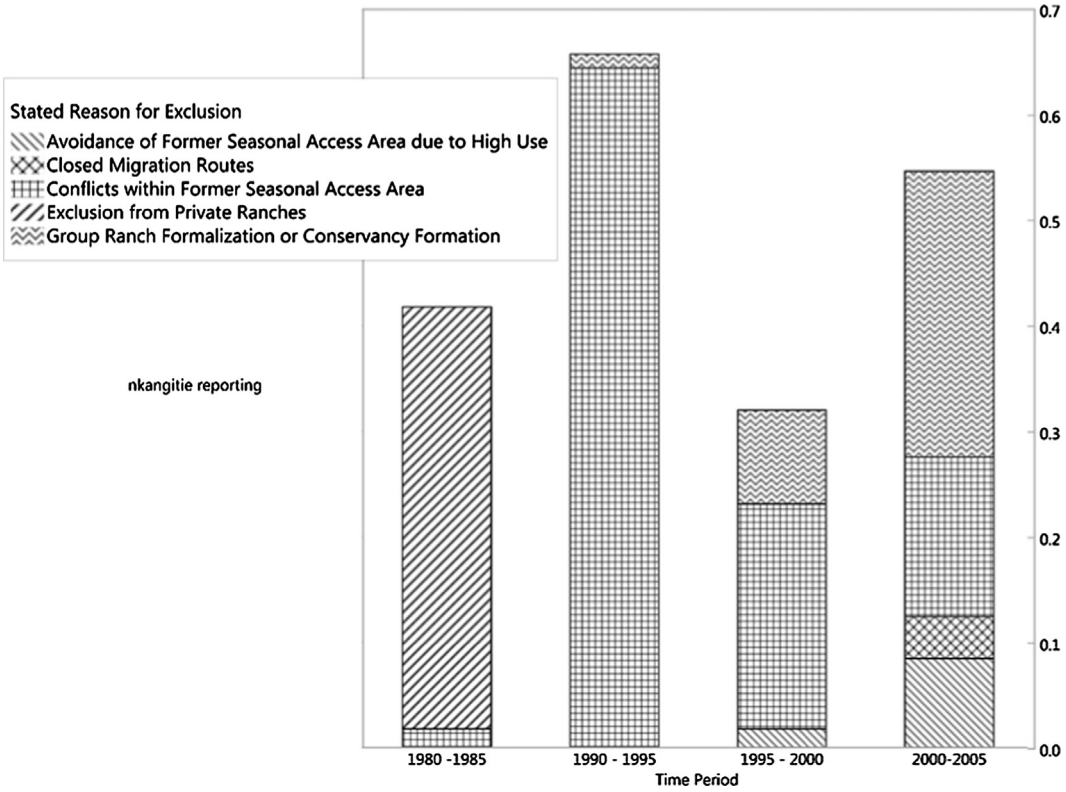

Fig. 3. Reasons and timing of loss of grazing access outside of Koija (decimal fraction of *nkangitie* where a place and reason were mentioned by elders, n = 225).

open access in the past following disuse as a holding ground, but were then said to have become occupied by Samburu herders in the late 1980s. Conservation trust formation in these areas is currently in process.

Today, livestock leaving Koija are taken to a small number of places. Out of those that do leave Koija, it is typically left to each *nkang* to arrange for this access. Paid grazing on neighboring private ranches began in the early 2000s and is said to offer benefits to those that have cattle by guaranteeing their survival and health in times of drought, and by providing herding labor. In 2013, at a time that was not considered drought, but when forage was considered inadequate for cattle on Koija, paid grazing was made available on private ranches. At that time, out of 1294 head of cattle, less than 480 of these cattle were said to have gained access through paid grazing, while at least 814 gained access through personal relationships or through employment. The other 219, or 6.20% of Koija's cattle, were present in very low densities at nine areas with a historical precedent of pastoralist use. The remaining 57.43% (2027) of Koija's cattle relied on either the marginal grazing resources within Koija, or illicit grazing on private lands. At the same time 3994, or 36.32% of Koija's sheep, were in three areas outside of Koija where there is a historical precedent of pastoralist use, while 5.04% (554) were located in very low densities at 16 different sites, and the other 58.64% (6448) sheep located within Koija.

To gain an understanding of how these changes in access over time have impacted herd composition, we estimated past livestock density using an average of the numbers of livestock that each elder who was a member of a nuclear family said were within their shared *nkang* at that time. The word *entare* (goats and sheep together) was used for this portion of the survey, as individuals could typically not recall the exact numbers of separate species. This showed that from 1980 to 2016, there has been a ~35% decrease in cattle since the 1980s, and an approximately tenfold increase in sheep and goats (Fig. 4). While TLUs overall have increased over the past 30 years (Fig. 4), the average amount of livestock per person indicates herding livelihoods are increasingly strained, with the average in 1980 for this region was estimated at about 3.07 TLUs per person, and an average value of 2.04 TLUs per person in 2016. The sharp decreases in cattle were consistently explained as being due to drought, disease, and a lack of access to forage during drought. In addition to the historical impact of drought and lack of forage on cattle detailed by Herren (1991), recent droughts were stated to have driven subsequent decreases in cattle (1997, 1999–2001, 2009). In explaining historical increases in small stock, goats have been increasingly favored due to fast reproduction, drought resistance, ease of slaughter, ease of sale, and the high reliance of families on a grain-based diet, in general agreement with previous studies (e.g. Herren, 1991; Hauck, 2013). However, the role of small stock as a source of cash necessary to support cattle keeping was also emphasized. At the same time, due to elements of cosmological relationships, identity, quality of milk, and status, many interviewees expressed their preferences for keeping cattle, despite sensitivity to drought and difficulty of sales during drought, while some alternately indicated that conditions are leading them to only keep camels (camels increased from 0 in 1980 to 299 in 2016) and goats today. The overall increase in TLUs over time therefore reflects the changing composition of herds, as well as increasing intensification of use of the constrained area that is available, and also relates to the increased reliance upon sales and maize-based diets, where the required TLU-to-person ratio has likely become decoupled. Finally, from 2002 to 2016 (Fig. 4), the numbers of sheep, goats and cattle have all increased. While this increase is likely mostly due to recovery of herds following a severe drought in 2000, 66.22% (4673) of the increase in small stock was accounted for by sheep. This increase in sheep is likely related to changes in external forage access, with 52.34% of sheep located year-round on sites located outside of Koija (we discuss how external forage conditions relate to increases in sheep in Section 6.3).

6.2. Changes in cooperative livestock husbandry, and changes associated with employment relations with conservation actors

At the same time herd composition changed, there were also changes in the structure of *nkangitie* and cooperative herding practices, where multiple patrilineal families have recently decreased the practice of living together and keeping livestock in one large *nkang*. It was stated in both focus group discussions and key informant interviews that the practice of families migrating together has also greatly decreased recently, and today it usually occurs only between close relatives, friends, and immediate neighbors, while in the past occurred collectively. Labor sharing was said to have decreased on a day to day basis, while 25 families currently hire herders from other families at Koija. Reasons stated for declining labor sharing were children attending school, lack of trust in others' herding practices, and expectations that people without children in school should pay other children to help.

Cultural shifts were often stated as an explanation of changes in cooperative herding, with increasing precedence of individual families'

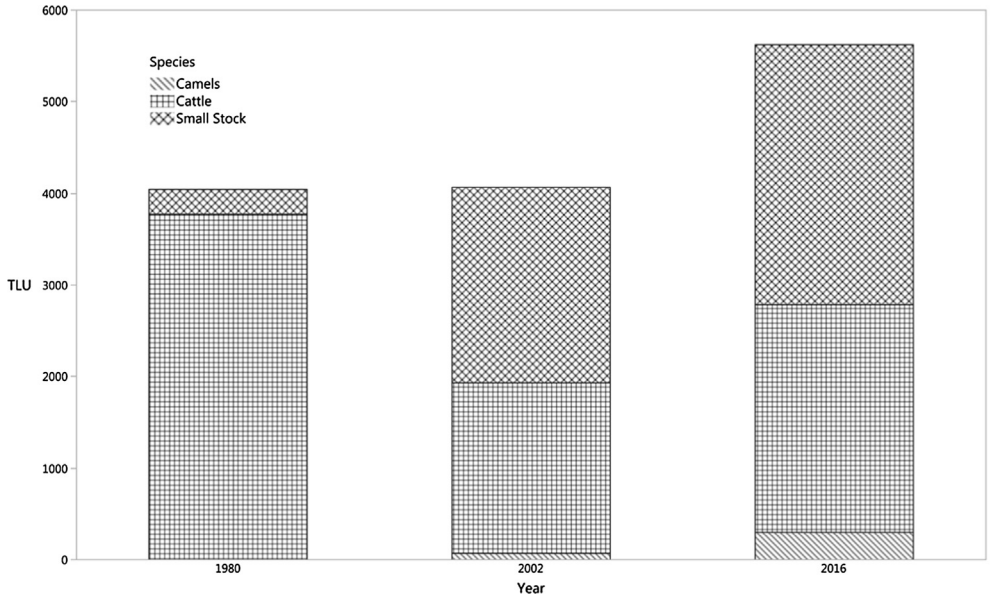

Fig. 4. Historical changes in livestock (TLU per species) estimated from surveys and livestock counts.

values over shared norms, and a decrease in shared norms and closeness between people compared to the past ("people loved one another"). In informal discussions, herders also attributed changes in labor sharing to the material basis of small-stock, mentioning the difficulty of managing large herds and the difference in accumulation of manure within livestock enclosures, where the different composition of goat and sheep dung necessitates it must be regularly removed and piled outside. Comparing *nkangitie* with multiple herds, 26 out of 40 *nkangitie* herded their small stock together, while 14 *nkangitie* did not. The *nkangitie* that herded small stock collectively had significantly smaller mean total herd sizes than the *nkangitie* in which each nuclear family herded their small stock separately (145.85 and 238.79 average entare, respectively, $t_{26.41} = -1.72$, $p = 0.048$), which in informal interviews was said to reflect the difficulty of managing very large herds of *entare*. This contrasted with *nkangitie* with multiple families owning cattle, who nearly always (37/39) herded their cattle together, regardless of herd size.

To understand how changes in livestock husbandry and increasingly individualized practices among families relate to one another, key informants provided oral histories that indicated which families lived together in *nkangitie* in 1984. Based upon analysis of former *nkangitie*, we determined there would have been 16 very large *nkangitie* within Koija at that time. Using population density estimates (Herren, 1989), we calculated there were approximately 1316 people living on Koija in the mid-1980s compared to our current estimate of 2761. This confirmed that there would have been a much higher average number of people living within each *nkangitie* with an average of 82.25 within each in the mid-1980s and an average of 11.36 living in each of the 243 *nkangitie* today.

Finally, considering the distribution of livestock holdings and inequality at Koija in 2016: 70 out of 225 *nkangitie* had less than 0.70 TLUs/AAME (the equivalent of less than one cow per person), 155 *nkangitie* had no cattle, and just 37 *nkangitie* had above 4 TLUs per AAME. Comparison of the GINI coefficient showed that between 2002 and 2016 there has been an increase in inequality in livestock holdings except camels (Table 1), with sheep and goat holdings contributing the highest and second highest, respectively, to the overall increase in inequality of TLUs.

In response to questions about differences in livelihood outcomes, respondents emphasized elements of luck, family history, and individual dedication as important factors, but also emphasized the benefits of employment in determining individual *nkang* livestock husbandry success. Employment allows families direct access to cash to allocate toward livestock costs (e.g. medicine, paid grazing, buying animals), as well as to cover household costs such as school and medical expenses, thereby reducing the offtake strain on herds. Employment on private ranches also leads to grazing access for employees, which constitutes the bulk of secure, non-illicit pastoralist access to these private lands. Thirty-five *nkangitie* reported having members with current full-time jobs on conservation ranches, and four reported having a member with other full-time employment. Fifteen others reported small amounts of part-time current employment on conservation ranches, and sixty-six reported having past temporary employment on a conservation ranch or at Koija's ecolodge. Thirty-six reported current or past employment within Koija as infrastructure guards, herders, teachers, and dispensary employees, but these jobs typically pay half or less the rates formerly paid on conservation ranches. Considering increases in livestock between 2002 and 2016, *nkangitie* with current full-time employment had significantly greater increases in cattle (paired *t*-test, $t_{53.63} = 1.75$, $p = 0.043$) and sheep ($t_{66.71} = 2.02$, $p = 0.024$) compared to *nkangitie* without full-time employment; however, this relationship was not significant for total TLUs or goats ($t_{57.03} = 1.641$, $p = 0.948$, $t_{61.01} = 1.08$, $p = 0.857$, respectively). Additional factors mentioned in interviews and surveys indicated how employment may be impacting reciprocity, as Koija residents that work as guards on private ranches gain direct cash from bribes from those accessing illicit grazing and some employees are rewarded for informing on group ranch members who participate in illicit grazing and hunting.

Table 1
Comparison of inequality amongst *nkangitie* (GINI coefficient values) between 2002 and 2016 (subset of 221 *nkangitie)*.

	2002	2016
Cattle	0.573	0.613
Goats	0.423	0.506
Sheep	0.559	0.669
Camels	0.895	0.863
TLUs	0.537	0.606

6.3. Ecological changes and their interaction with herding practices

This section summarizes the ecological factors that interviewees indicated have interacted with and shaped herding practices as they are today. Elders in focus group discussions and interviews indicated dramatic changes in vegetation, including widespread increases in two now-dominant tree species, *Acacia mellifera (ilmunichoi)* and *Acacia reficiens (nchurai)*. Nearly uniformly, *Acacia mellifera* was mentioned as important for supporting goat production, while *A. reficiens* was said to be of little livelihood value, and both were said to cause decreases in grass in their understories. Many other now dominant understory species were regularly mentioned as having increased over the last 30 years and to have low forage value. Two canopy species, *Euphorbia tirucalli (pushiruti)* and *Euphorbia bussei (lpopongi),* as well as associated species important for bee and goat keeping, and the overall availability of grasses were also indicated to have decreased. The most common explanation given for changes in abundance of grasses was lack of rainfall. Declining milk yields of all livestock species were widely observed across *nkangitie*. Some interviewees stated that this suite of changes are causing Koija to be suitable for goats and camels alone, as their browsing resources remain available except during extreme drought.

Interviewees indicated ecological factors interrelated to changes in access outside of Koija were also impacting herding practices. Informal interviews in particular indicated that sheep increases are likely related to recent access changes and the grass within the few non-private areas accessible outside Koija, where higher amounts of *Pennisetum mezianum* grow on vertisol soils. As cattle can only eat *P. mezianum* following adequate rains, and due to inadequate amounts of reliable water sources, these areas are not regularly utilized for cattle, while the cattle at Koija are said to be better supported by grasses found on luvisol soils.

In addressing questions of forage scarcity and seasonal ecological dynamics, some interviewees first replied that "people are many now", but upon further discussion often said this referred to the increase and distribution of *nkangitie*, and difficulty of finding areas where the forage had not already been consumed. Sustaining cattle was said to have become difficult most of the year within Koija, due to decreases in rainfall, but also due to the constant presence and high density of all livestock species leading to poor grass regeneration, coupled with lack of outside access: "we are like in a warthog hole (*ngumuto olbitir*), because we don't have those places that we used to go". Goats in particular remain on Koija year-round. Herders are often forced to bring externally-grazed sheep and cattle back to Koija immediately following rains because dry season forage in non-private areas is depleted and paid grazing access ceases, leaving no alternative other than illicit grazing. The state of poor vegetation regeneration was also said to be exacerbated by herders from northern areas moving into Koija immediately following rains to illicitly access neighboring private ranches. Recent attempts to restrict this presence at the behest of conservation organizations were also reported to have led to tensions between Koija residents and herders from Samburu coming to graze in Koija's conservancy as well as to access privately-titled ranches (see Pellis et al., 2018 for one analysis of recent conflicts). While interviewees frequently stated that one of the main benefits of group ranch formalization is the

ability to exclude outsiders (especially from Samburu), it was also sometimes mentioned that there had been a breakdown of reciprocal relationships, and herders from Koija can no longer expect to access areas to the north as a result. Additionally, some expressed opposition to wildlife conservation areas that excluded livestock, emphasizing that the grass within these areas as well as on neighboring conservation ranches was actually becoming negatively impacted due to not being grazed. This was also closely related to a frequent view (30.28% of surveys), that a main motivator behind trusts was security of private ranch property boundaries.

7. Discussion

The range of mobility required for pastoralists in Mukogodo Division to adjust seasonally to the high variability of rainfall and vegetation has become fragmented over time. Drawing from an SES perspective (e.g. Mwangi and Ostrom, 2009), we found this occurred first through the reorganization of the institutional landscape to favor commercial cattle production by settlers, emphasizing private land tenure on ranches, and over time leading to the near total exclusion of pastoralists from these areas. Ongoing constraints to mobility, while related to conflict among other pastoralist groups in surrounding areas, have also been exacerbated by the central reliance on the institutional structure of group ranches utilized in CBC trusts. This has led to a rigid understanding of boundaries between pastoralist lands that constitutes the key element of what we interpret as scalar-mismatch between land use institutions and ecological process (i.e. Cumming et al., 2006; Sayre, 2017).

Restrictions in external grazing access as well as changing norms of reciprocity at multiple scales have over time gradually shaped the current system of highly individualized external access, occurring primarily through: grazing quotas, employment on private ranches, the few areas that all residents have a right to access informally, and Koija residents' uncomfortable but necessary reliance on illicit external forage access. CBC trusts, while supporting tenure formalization, and thereby conferring the ability to exclude outsiders from grazing areas (though this in practice happens rarely, and is an ongoing source of tension), have also locked-in group-ranch boundaries that are incompatible with the flexible institutional basis of external access required in pastoral systems (see Turner, 1999; Fernández-Giménez, 2002 for similar examples), and a large portion of the population finds themselves in an individual state of precarity for external grazing access today.

It has been previously documented how drought, decreased dry season mobility, and an increased need for livestock sales to buy grains have all led to an increased reliance on small stock, along with decreased reciprocity and heightened inequality within Mukogodo Division (Herren, 1991). In considering the alignment of institutions and ecological processes as a whole over recent years at Koija, this trend has continued, interacting with filters on cattle access to external grazing areas as well as social, ecological, and market factors at the local scale, leading to a positive feedback where herders are increasingly emphasizing small stock to meet basic subsistence needs and/or support cattle. While shifts to reliance on small stock can represent a temporary recovery strategy following loss of cattle herds (Cossins and Upton, 1988), at Koija it likely more closely reflects an adaptation to the multiple ongoing changes in access, social norms, markets, climate, and plant abundance, mirroring adaptations documented elsewhere (Liao et al., 2016; Opiyo et al., 2015; Österle, 2008; Silanikove, 2000). Adaptations have enabled subsistence in spite of external access constraints, but long-term implications at the local scale within Koija are of heightened concern not just due to lack of mobility, but to novel constant pressure on grass regeneration. Further, Koija residents and recent studies recognize that rainfall has become more variable within Mukogodo Division (Franz et al., 2010; Huho et al., 2009), increasing the need to consider potentially non-linear and decoupled vegetation-herbivore dynamics (e.g. von Wehrden et al., 2012). While livestock have increased in overall biomass density, this pressure provides only a partial explanation of the increasing challenges to livelihoods at Koija, where residents indicated a complex interaction between lack of rainfall, disease, fragmentation of homesteads, constraints on mobility, market pressures, changes in herd composition, and pressure on forage regrowth that all appear to be reinforcing a stable state of high reliance on small-stock for many.

Given the multiple goals of enhancing wildlife conservation efforts, securing borders of private ranches, and enhancing pastoralist livelihoods in Laikipia (Sumba et al., 2007), a salient feature of CBC trusts has been a desire to foster sustainable landscapes by aligning scale and landscape process, to balance wildlife conservation concerns and livestock-based livelihoods (Sundaresan and Riginos, 2010; Kinnaird and O'Brien, 2012; Georgiadis et al., 2007). Proponents of landscape interventions are extremely conscious of the closely-related issues of landscape sustainability and livelihoods, as well as the need to garner support for conservation projects from group ranch members (Sundaresan and Riginos, 2010; Kibet et al., 2016). However, the rationale underlying CBC trusts, despite deeply appreciating ecological dynamics and the need for wildlife mobility, in actively modifying pastoralist herding institutions, not only neglects customary institutions, but neglects the historical constraints placed on livelihoods due to market, mobility, and social changes.

To explain this entrenchment of scale mismatch and the contradictory outcomes observed in CBC trusts, we next take a political ecology approach to analyzing local dynamics and their parallels with global patterns in conservation practice. Some of the observed trends have direct parallels to the literature on neoliberal natures (Castree, 2008), however we make reference to this literature only when it directly applies, to emphasize the contingencies of outcomes and avoid the homogenizing tendencies of this interpretive lens (Bakker, 2009, 2010), as well as emphasize other dimensions of governance not explained by neoliberalism (Fletcher, 2010). Firstly, a key dimension to conservation in Laikipia is that it has assumed its current shape largely through a decentralization process known as delegation (Ribot, 2002) in which non-governmental actors assume many functions typically assumed by the state, referred to in the scholarship on neoliberalism as a “flanking mechanism in civil society” (Castree, 2008: 142; see also Little, 2014). Partnerships between NGOs and managers of private ranches are supported by access to international capital and networks of influence, enabling them to play central roles in shaping governance, often having greater prominence than the state (though supported by it), while also providing infrastructure, health, education, and other services (DePuy, 2011; Kaye-Zwiebel, 2011).

Secondly, delegation of the role of the state to NGOs in Laikipia has been accompanied by a novel partitioning (see Igoe and Brockington, 2007) of the Laikipia landscape in line with the privatization and marketization elements of neoliberalisation (Castree, 2008). The institutional shifts advocated by conservation NGOs and private ranch managers enabled clear demarcations of ownership under collective title, the designation of strategically-placed wildlife conservation areas as part of corridors that were also intended to be market-based income generators for pastoralists, and a commodified approach to granting limited grazing access to private ranches. They have also defined forage scarcity at the local level within group ranch confines, while emphasizing exclusion of outsiders and transformation of management practices to internalize the goals of conservation (see Fletcher, 2010 for a consideration of how this relates to wider governance trends intended to have a disciplinary impact on land use practices). This reshaping of institutions is intended to harness economic benefits for pastoralists, with support from international development and conservation organizations, but on the other hand parallels governance reforms that have led to the simplification of social and ecological processes (Scott, 1998; Zimmerer, 2000) and territorialization of contested lands (Vandergeest and Peluso, 1995; Corson, 2011; Peluso and Lund, 2011; Sievanen et al., 2013). This effectively creates buffer zones on the edges of

privately-titled ranches, in which private ranches have gained novel influence/authority, similar to those on the margins of protected areas in other pastoralist areas of Kenya (Butt, 2014). This resonates with work by others showing how projects of territorialization are often intimately bound up in attempts to establish legitimacy and authority (Sikor and Lund, 2009; Peluso and Lund, 2011).

Thirdly, institutional changes that have occurred were encouraged under the assumption that CBC trusts would, through linking conservation livelihoods markets to global factors, generate new income streams and indirectly incentivize livelihood shifts away from pastoralism across pastoralist group ranches. This intervention of non-state actors to restructure livelihoods (see Castree, 2008; Fletcher, 2012; Holmes and Cavanagh, 2016; Igoe and Brockington, 2007 for discussion of global trends), can be seen as a less direct form of governance that introduces incentives for those acting in their own individual economic interest to transform their behaviors (Fletcher, 2010). Rapid growth in conservation and ecotourism has expanded employment in the past two decades in the region and led to an optimistic anticipation of continued growth. However, while CBC trusts have resulted in increased access to formal education, health care, and infrastructure there is little indication that these projects provide a viable long-term alternative to pastoralism, the dominant livelihood in the region (Little, 2014). Furthermore, the relatively small subset of households with employment at Koija appear to be using the benefits of employment to navigate constraints to pastoralism and increase their herds, in line with others' findings in the region (McPeak and Little, 2005). Reconfiguration of livelihoods is intertwined with relations between actors, as individuals appear to be forming alliances with neighboring private ranches that benefit their extended households at the potential expense or exclusion of others rather than seeking collective interests in CBC trusts. These patterns are thus closely related to increasing inequality and control of access, paralleling wider stratified trends of outcomes in conservation and development projects (Ribot and Peluso, 2003; Lemos and Agrawal, 2006). They are also linked to ongoing shifts in reciprocity and increasing individualization of risk and responsibility (Fletcher, 2010), as well as power relations between Koija and private conservation ranches – with employment that benefits a lucky few intertwined with support for conservation projects.

While these global trends and the neoliberalisation lens provide explanatory power regarding the shape of conservation and development projects at Koija, they provide only partial explanations of recent phenomena and tend to mask contingencies and outcomes unrelated to neoliberal policies observed. The importance of pre-existing local changes in institutions of reciprocity, for example, cannot be ignored. Previously documented decreases in labor sharing, animal gifting, herd risk pooling, sharing of herding labor, and overall changes in reciprocity within the constraints of limited access and sedentarization (Herren, 1991), have likely influenced individualization of the benefits of CBC trusts. The ultimate drivers of the individualization of *nkangitie* are also likely related to a number of factors not considered in our study, such as attitudes fostered by public education in the region, the dominant economic ideals of wider Kenyan society, decreasing elder authority (Lesorogol, 2008), and changes in structures of authority and norms due to introduction of group ranch governance (German et al., 2016; Kibugi, 2008). These interactions can also be seen in the tensions between individualization and collectivization of grazing quotas, exclosures, and farming within Koija (German et al., 2017), and outcomes within Mukogodo are deeply entrenched in pre-existing unevenness in influence among actors in Laikipia, and the Kenyan state's role in the commoditization of land and policies of exclusion (Behnke, 2018). Thus, historical contingencies and social differentiation have likely interacted in complex ways with global patterns of shifting relations between markets, NGOs, and the state (Bakker, 2009, 2010; Fairhead et al., 2012) to shape individualization.

Finally, to understand the interaction of previous institutional shifts and the connection to global conservation and development trends, exploring the production of scale is essential, in particular considering the historical and ongoing differential ability of actors to "produce" the scale of concern in policy discussions (Sayre, 2005; Rangan and Kull, 2009; Sayre, 2017). The scale usually emphasized in these discussions in Laikipia reflects concern with the ecological scale required for megafaunal movements, focusing inquiry into landscape ecological processes on threatened wildlife populations, and emphasizing pastoralists as threats to wildlife and tourism (see also Butt, 2014). This at the same time leads to a lack of consideration of the ecological scale needed for pastoralists to respond to variation in rainfall to sustain cattle, and a definition of scarcity at the local scale alone for pastoralists, within group ranches, rather than considering the wider ecological landscape that livestock as well as wildlife were integral to historically. CBC trusts have created zones that are primarily designated for either wildlife or pastoralist use, and while grazing in wildlife areas is permitted during drought, the rationale behind these restrictions appears to lack a nuanced understanding of competition between domestic herbivores and wildlife (e.g. see Butt and Turner, 2012). Though the known influence of domestic herbivores in maintaining grassland states that are beneficial to wildlife is sometimes acknowledged (e.g. see Western and Gichohi, 1993; Young et al., 1995), these changes constrain mobility in ways that largely removes decision-making about the use of these lands from pastoralists, and parallel projects that impose a binary separation of pastoralism and wildlife that does not align with pastoralist ecological knowledge, institutions, or historical ecologies (Goldman, 2009).

By producing the scale of concern, an ahistorical narrative that posits pastoralists as a threat to wildlife is created. As seen in the NGO grey literature, there is a central conviction that recent shifts in vegetation and the marginal state of pastoralist livelihoods are due primarily to issues of land management, livestock stocking rates, and population growth (Alexovich et al., 2012; Fennessy, 2009; Lent et al., 2002; NAREDA Consultants Ltd., 2004; Sumba et al., 2007). While the stocking rates on many group ranches are indeed high by livestock officer standards (Kaye-Zwiebel, 2011), our findings indicate that the assumption that this is the central explanatory factor of livelihood pressures tends to overshadow the equally important simultaneous changes in mobility, herd composition, rainfall, ecological context, and the complex interpenetration of socio-economic factors that underpin changes in landscape processes and livelihoods from herders' perspectives. The perspective of managers of private ranches has undoubtedly been informed by experiences on lands with low historical livestock densities, greater and less variable rainfall, and recent contestation of their property rights. However, these views are contrasted by those of pastoralists, who have been historically concentrated on small areas of drier land, with increasingly limited access to former grazing lands, adjacent to neighboring ranches where they perceive an abundance of underutilized resources. Thus, emphasis on internal management practices and ways of restoring or enhancing rangeland productivity within group ranch confines echoes the shortcomings of the group ranch model (Rutten, 1992) as well as colonial management interventions to restore rangelands that historically failed because they lacked consideration of external grazing access (Anderson, 2002). They also are directly rooted in a lack of consideration of pastoralist knowledge and the institutional basis of their husbandry practices, as previously noted in discourses about pastoralists in Laikipia (DePuy, 2011; Yurco, 2011). By focusing on sustaining mobility for wildlife, while at the same time primarily advocating destocking, livelihood transformations, and landscape "security", conservation actors have perhaps unintentionally aligned themselves with policies that bear much in common with equilibrium-rooted ecological discourses about pastoralism (Anderson, 2002; Blaikie and Abel, 1989; McCabe, 2004; Turner, 1993; Waller, 2012) and that create an "anti-politics" (Ferguson, 1990) at work in the assumed benefits of CBC trusts – masking elements of new forms of land control and influence over populations.

The resulting narratives that speak to ecological impacts and the ecological limits to livelihoods, but define the problem as one of

pastoralists as irresponsible land stewards, ahistorically "produce" the scale of concern in such a way that obscures ultimate causes and leads to an assumption that interventions to alter livelihoods are needed (see McCabe, 2004; Moritz, 2008). This in turn also reinforces a top-down focus on formalized tenure, security of borders, and exclusion of others, rather than a pluralistic, genuinely collaborative approach (e.g. see Goldman, 2011; Goldman and Milliary, 2014) to conservancies that might, for example, include discussions of the need for flexibility of institutions at multiple scales across the region, including seasonal grazing access rights recommended by others (e.g. Mwangi, 2009; Lengoiboni et al., 2010).

8. Conclusions

In asking how institutional change has impacted the alignment between ecological processes and livelihoods in Laikipia, we used an integrative approach that drew from disparate literatures on institutional fit (Cumming et al., 2006) and the influence of wider political and economic processes on local land uses (Blaikie and Brookfield, 1987; Abel and Blaikie, 1989; Turner, 1993). We identified ways that pastoralist livelihoods are contingent upon institutional constraints, the adaptive agency of herders, biophysical factors, and wider global patterns of conservation interventions. The current patterns of land use and livelihoods at Koija are difficult to understand without considering the history of dispossession, loss of access, intervention in pastoralist land use practices, and both economic and ecological discourses that have all contributed to a neglect of the requirements of pastoralist livelihoods. Conservation in Laikipia follows global patterns of non-state actors increasingly assuming a role in shaping governance and attempting to shape land use practices. However, it also has grown out of historical contingencies of large privately-titled ranches playing a central role in reorganizing the use of landscapes and unevenness in the ability to influence outcomes and ecological discourses about pastoralist herding. Rather than giving due consideration to pastoralists' agency, knowledge, livelihoods, and institutions, and enhancing flexibility and resilience of pastoralist livelihoods in CBC trusts, there is a pattern of reinforcing feedbacks that present barriers to truly collaborative approaches sensitive to local livelihoods.

Hierarchical SES approaches focused on ecological levels and scale enable an improved understanding of feedbacks and the alignment between ecological and social processes, but are less attuned to factors such as power imbalances and difficult-to-quantify livelihood concerns that can be nuanced using ethnographic accounts focusing on different narratives and knowledges (e.g. Leach et al., 2010; Ahlborg and Nightingale, 2012). While previous analyses of scale mismatch have incorporated consideration of overtly contested politics and conflicts between different interests (Cash et al., 2006), we showed how attempts to harmonize social and ecological processes in the name of wildlife conservation at the landscape scale have also worked together with a project to partition the landscape to reinforce land claims and security of privately-held ranches. These institutional changes, which are bound to a series of assumptions portraying pastoralists as irresponsible land stewards that need to be taught how to manage their livestock, ironically reinforce a series of previous institutional changes that have led to constraints on pastoralists' ability to negotiate reserve grazing access and thus, a misalignment of livestock mobility and ecological variability. Our ethnographic data and personal observations alike indicate that this misalignment is concentrating livestock locally, constituting a positive feedback on the grazing system that is leading to negative impacts on both vegetation regeneration and livelihoods, while pastoralists at the same time report that many areas designated for wildlife conservation are underutilized for grazing from their perspective. Using a critical mode of inquiry alongside SES analysis, we found that explicit analysis of historical, material, and discursive practices produced novel insight as to how scale mismatches are constructed and reinforced by social processes. Drawing from critical studies of governance (Ferguson, 1990; Peluso, 1993; West, 2006) and relational aspects of conservation and development (Goldman, 2011; Kull, 2004; Nadasdy, 2005; Neumann, 2002) supplemented our understanding of how uneven, historically contingent processes have shaped the alignment of institutional and ecological scales in Laikipia. While a specific vision of landscape conservation prevails in Laikipia today, it is our hope that this analysis might help inform more robust alternative landscape conservation approaches that focus on pluralistic processes and outcomes where the well-being and livelihoods of land users, along with wildlife habitat connectivity, are realized as interdependent goals.

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