Conservation from the inside-out: winning space and a place for wildlife in working landscapes

Authors: David Western[1], Peter Tyrrell[2,3], Peadar Brehony[4], Samantha Russell[3], Guy Western[2,3], John Kamanga[3]

1. African Conservation Centre, P.O. Box 15289, Nairobi 00509, Kenya
2. Wildlife Conservation Research Unit, Department of Zoology, University of Oxford, Oxford, United Kingdom
3. South Rift Association of Landowners, P.O. Box 15289, Nairobi 00509, Kenya
4. Department of Geography, University of Cambridge, Downing Place, Cambridge, United Kingdom

Corresponding: Peter Tyrrell, peterdavidtyrrell@gmail.com

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The art of land doctoring is being practiced with vigor, but the science of land health is yet to be born. Aldo Leopold: A Sand County Almanac.

We protected wildlife from hunters and wildlife protected us from drought. Coexistence is the essence of survival for us both. Maasai elder noting why traditional livestock practices conserve wildlife.

Abstract

1) Protected areas fall far short of securing the space needed to sustain biodiversity and ecosystem function at a global scale and in the face of climate change.
2) The prospects of conserving biodiversity in working landscapes help buffer the insularization effects of protected areas and holds great potential for biodiversity conservation on a landscape scale but depends on finding adequate space and a meaningful place in the lives of rural land users.
3) Using a case study in southern Kenya, we show that the conservation of large open landscapes, biodiversity and the coexistence between wildlife and livestock can be achieved indirectly by reinforcing pastoral practices that depend on open space, mobility, social networks and institutional arrangements governing common-pool resources.
4) Pastoral practices and wildlife both depend on large multiscale interactions within interlinked social and ecological systems, which are threatened by land fragmentation, alienation, and degradation.

5) We show that large open spaces can be maintained by using a conservation approach starting from within community aspirations that emphasize the links between livelihoods, productivity, efficiency, and resilience in pastoral economies and the secondary benefits of wildlife enterprises.
6) Scaling up from an ecosystem to multi-scale approach benefits pastoral communities by building resilience and new economic opportunities. In the process, the expanded scale conserves regional biodiversity and large free-ranging herbivore and carnivore populations underpinning ecosystem function and the nationally important tourism industry centered on the Kenya-Tanzania boundary.
7) The "inside-out" approach to the conservation of wildlife and biodiversity is place-based, draws on local knowledge and informal governance arrangements, and avoids the stigma of wildlife conservation driven by outside agencies.
8) The human-centered approach reinforces land health and spatial connectivity and encourages multi-level and distributed governance arrangements embedded in large regional and national jurisdictions

Keywords: Community based conservation; landscape conservation; working landscapes; pastoralism; livestock; wildlife; coexistence; ecology of scale; conservation governance; natural resource management.

THE EVOLUTION OF CONSERVATION

The scope of conservation has expanded continuously in the modern era, from natural resource management in the 18th century, to regulated hunting and protected area set-asides in the 19th century, and the conservation of species, biotic communities, ecosystems and biodiversity in the 20th century (Watson et al. 2014). The expanded scope reflects changing human sensibilities, views and uses of nature (Nash 1989; Thomas 1983) and, more recently, the aspirations of modern states and the international community (WWF 1980; Western & Pearl 1989; United Nations 1992; Sitarz 1993; Adams 2005; Watson et al. 2014; Western et al. 2015b). The philosophical and ethical foundations of conservation have in turn deepened from a largely utilitarian creed to encompass recreational, romantic, spiritual, educational, scientific, intrinsic and other values (Callicott 1990; Meine et al. 2006; Vucetich et al. 2015).

Changes in societal perceptions are echoed by the global perspective of the World Parks Congress (WPC) over the last half-century. The vision for national parks at the 1972 WPC projected the traditional view of areas set aside to protect natural wonders and wildlife for human recreation and enjoyment. The vision expanded to include parks for sustainable development at the 1982 WPC, and human wellbeing at the 2014 congress (McNeely 1993; WPC 2014). In the process six categories of internationally accredited protected areas have been recognized, ranging from Category I: strict nature reserves for scientific and wilderness protection, to Category V: land and seascapes where human uses have produced areas of distinctive esthetic, ecological and cultural value, and Category VI: areas managed mainly for the sustainable use of natural ecosystems (Dudley & Stolton 2008).

Although the WPC has raised the target for terrestrial coverage from 10 percent in the 1980s to 20 percent for 2020 (WPC 2014), the coverage falls far short of the area needed to sustain biodiversity for several reasons. First, historically, most protected areas were set aside for scenic, recreational and aesthetic reasons and for specific wildlife attractions, rather than for biodiversity or conserving ecosystem viability (Western & Gichohi 1993; Bennett et al. 2009; Fynn & Bonyongo 2011; Jenkins et al. 2013). Second, most protected areas were set aside in lands marginal for development, not to conserve biodiversity (Pressey & Bottrill 2008; Joppa & Pfaff 2009; Venter et al. 2017). Third, most protected areas are too small to avoid a loss of species due to insularization, habitat fragmentation and ecological disruption (Newmark 2008). Fourth, over one-third of protected areas are degrading due to human pressures (Jones et al. 2018). Finally, the prospects of retrofitting protected areas to maximize biodiversity coverage are limited, given existing land tenure and uses (Pressey et al. 2015). Calls for allocating half the earth to protected areas, primarily free of human activity (Wilson 2016; Dinerstein et al. 2017), face insurmountable political obstacles and fail to redress the systemic shortcomings of existing protected areas (Büscher & Brockington 2017). The alternative is to consider finding space in lands used for human uses compatible with conserving biodiversity and maintaining the ecological health of the land.

CONSERVATION IN THE HUMAN REALM

The prospects of conserving biodiversity within the human realm by sustaining the health of the land and its capacity for renewal has long been recognized as an evolutionary possibility and ecological necessity (Leopold 1949). Leopold, in calling for a land ethic, noted that the art of land doctoring is being practiced with vigor, but the science of land health is yet to be born. The land ethic is gaining recognition as being essential for halting global losses of biodiversity (Kremen & Merenlender 2018). The principles of the World Conservation Strategy (WWF 1980), Agenda 21 (Sitarz 1993), the Convention on Biological Diversity (United Nations 1992), and the Millennium Ecosystem Assessment (Assessment 2003) all underscore the importance of land health for sustainable development. Yet, land health also depends on cultural values and governance institutions (Ostrom 2009; Brockington et al. 2019).Many traditional societies, referred to as biocultures by Nicolay Vavilov (Nabhan et al. 2009), evolved husbandry practices and cultures that have sustained the health of the land for generations in the face of environmental perturbations and climate change.

Conserving biodiversity in landscapes transformed by farming, ranching, and other human uses depends on wildlife having access to their land and in their lives on terms favorable to them. The options for doing so include land sharing, land saving and land sparing (Fischer et al. 2014). The mixed-use and implicit coexistence in land sharing move biodiversity conservation beyond the sharp distinction between natural and human-modified landscapes implicit in protected areas to a land sparing-sharing continuum based on the intensity of uses (Western & Pearl 1989, Phalan, 2018). The scale ranges from heavily transformed and intensively used lands such as monoculture farmlands with little biodiversity to extensive uses in less modified landscapes such as grass-fed ranching, agroecological farming, renewable forestry practices, recreational uses of wildlands rich in biodiversity and extensive mobile pastoralism (Kremen & Merenlender 2018). Land sparing-sharing models can contribute significantly to biodiversity conservation, though not necessarily from a livelihood and social perspective (Phalan, 2018).

The expansion of nature conservation from the protection of habitats and species to sustaining biodiversity launched by the World Conservation Strategy in 1980 calls for large-scale planning across a broad range of land uses, users, jurisdictions, and agencies (WWF 1980). Biodiversity conservation in the human realm, especially at the scale needed to conserve species in the face of projected climate and land use changes in the 21st century (Newbold 2018), must also fit in with other land uses and minimize or offset the socioeconomic losses incurred (Donaldson et al. 2017).

If scaling up biodiversity conservation has great potential, it also faces severe obstacles (Western & Pearl 1989; Curtin 2015). Community-based conservation, largely focused on ecosystem-level conservation, has shown some success in conserving wildlife and biodiversity in rural landscapes and in improving socio-economic development (Shahabuddin & Rao 2010; Naidoo et al. 2016; Oldekop et al. 2016). Scaling up biodiversity conservation to a large landscape level calls for yet wider networks and jurisdictions cutting across varied land uses, user interests and jurisdictional boundaries (Sayer et al. 2013; Scarlett & McKinney 2016; Arts et al. 2017).

Several such landscape approaches have emerged over last few decades, ranging from the Yellowstone to Yukon Conservation Initiative (Merrill 2005), Colorado River Initiative (Adler 2007), Malpai Borderlands Group (Curtin 2002), Kavango Zambezi Transfrontier Conservation Area (Cumming 2008), and the Kenya-Tanzania Borderlands Conservation Initiative[1]. In many cases, the scale needed to secure sufficient space for biodiversity to accommodate large-scale migrations of species traverses several national boundaries. Many of these initiatives have struggled to reach their landscape-scale goals due to a limitation in economic resources for biodiversity conservation.

The tools for encouraging landscape biodiversity conservation are primarily economic in nature and include (i) conservation leases and easements, (ii) payment for ecosystem services, (iii) cost offsets, and (iv) consumptive and non-consumptive uses of wildlife (Nelson et al. 2010; Naidoo et al. 2016; Bedelian & Ogutu 2017). New economic accounting methods for valuing natural capital and ecological services, such the Total Economic Value (Costanza et al. 1997) and the System of Environmental-Economic Accounts (Jasch 2003), emphasize the multiple benefits of conserving biodiversity. These tools complement the efforts of parks to expand the reach of nature conservation and alleviate human threats to biodiversity.

[1] https://www.accafrica.org/our_work/explore_programs/conserving-biodiversity-in-east-africa/kenya-tanzania-borderland-conservation-initiative/

Large herbivores and carnivores have proven especially hard to conserve outside protected areas given a history of overhunting, displacement, the large spaces and intact habitats they need to survive, and the dangers and competition they pose to people (Tilman et al. 2017). Smith et al. (2018) show that a strong down-sizing of species has characterized the human impact on ecosystem structure and function over at least the past 125,000 years and is likely to continue to do so far into the future.

Despite these obstacles, there is considerable scope for conserving large herbivores and carnivores in the pastoral areas of Africa and rangelands around the world, far more than in protected areas (Western & Pearl 1989). The East African savannas reflect the long coevolution of humans and wildlife that survived both the Pleistocene megafaunal extinctions and colonial-era decimation of wildlife in other places (Adams & McShane 1992). The reasons are due in part to the cultural and use values of wildlife (Western et al. 2019), the seasonal mobility of pastoralists, and the milk-based pastoralist economy. If classified by the IUCN criteria, the pastoral-dominated savannas would be recognized as the equivalent of Category V landscapes where human uses have produced areas of distinctive esthetic, ecological and cultural values, and Category VI areas managed mainly for the sustainable use of natural ecosystems.

In this article, we focus on wildlife and biodiversity conservation in the East African savannas but also draw broader inferences for the rangelands which cover 25% of the earth’s surface and working landscapes more generally. Successfully conserving wildlife in the savannas depends on how herding people manage their lands (Groom and Western 2013) and finding places for wildlife which fit within the livelihood needs and cultural values of communities (de Pinho & Ellis 2009). We argue that the space and mobility for sustaining large mammals can be secured indirectly through an approach we term conservation from the ‘inside-out’. By inside-out we mean drawing on husbandry and conservation practices used to maintain the productivity and resilience of pastoralism or other land uses that directly or indirectly maintain large free-ranging wildlife movements in the process. Though overlapping, inside-out conservation is distinguished from bottom-up approaches to wildlife conservation in using primary livelihood considerations to win space for wildlife indirectly rather than through direct incentive-based approaches.

Ultimately, the inside-out approach aligns biodiversity conservation to land health and sustainable husbandry practices, thus widening the scope for nature conservation to the majority of the earth’s surface without necessarily relying on large capital investments or tackling biodiversity as the primary focus. Here, we use a case study that looks at the adaptation of traditional pastoral practices in East Africa to the fast-changing global age, and by doing so offers prospects for sustaining land health, improving livelihoods and conserving biodiversity.

PASTORAL AND WILDLIFE LANDSCAPES

Maasai pastoralists occupy much of the 100,000km^2 area that spans the Kenya-Tanzania borderlands and the Rift Valley (Fig.1). In this region, bimodal rainfall varies from 250 mm to 1700 mm across altitudes ranging from 600 meters on the floor of the Rift Valley to over 5000 meters on Kilimanjaro. The range of biomes cutting across the rainfall and altitudinal gradients make the Kenya-Tanzania borderlands one of the richest biodiversity regions in Africa and mammalian diversity centers on Earth (Jenkins et al. 2013). The region also has some 16 national parks and reserves stretching from Serengeti and Maasai Mara in the West to Tsavo and Mkomazi in the East (Fig. 1). The continuous patchwork of grasslands, bushlands, and woodlands reaching across this region also supports the greatest abundance of pastoral livestock and wildlife in Eastern Africa (Ogutu et al. 2016).

The Maasai peoples are made up of 13 politically semi-autonomous sections, each sharing the same clan and age-set groupings. The overlapping clans and age-sets move seasonally between wet and dry season grazing areas, largely in synchrony with wildlife migrations (Western & Nightingale 2005) by using reciprocal social ties that span the seasonal ranges and foster connections to adjoining Maasai sections (Spear & Waller 1993).

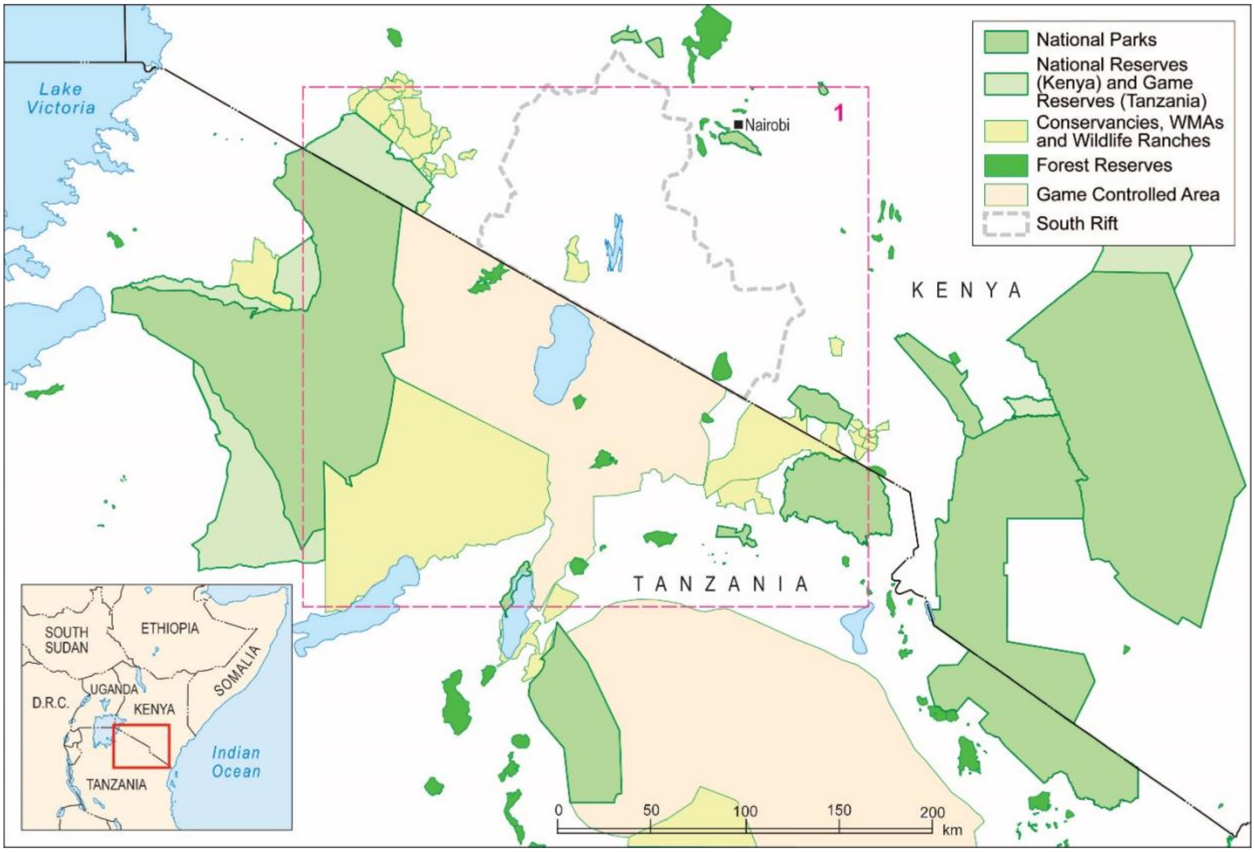

Figure 1: Map of the conservation and protected areas network in the Kenya – Tanzania borderland, highlighting the location of our case study within the region. Our case study looks at three scales: Shompole and Olkiramatian conservancies in the center of the map, the South Rift at the landscape level, and the regional level across the whole map. The red box indicates the extent of Figure 3. Data is from the World Database of Protected Areas (www.protectedplanet.org), South Rift Association of Landowners (www.soralo.org), Maasai Mara Wildlife Conservancies Association (www.maraconservancies.org) and BigLife Foundation (www.biglife.org).

The seasonally coordinated movements between wet and dry season ranges define the community of users and sustain their livestock herds except in extreme years when herders often move to distant refuges to evade droughts. Drought refuges are typically in the wetter regions of the landscape, such as highland pastures, wetlands, and areas receiving recent rains (Fynn et al. 2015). The drought movements expand the scale of use from the annual range of a few thousand square kilometers to tens of thousands, negotiated though their reciprocal arrangements (Western & Finch 1986).

The conservation of the grazing commons to ensure herd productivity and resilience is deeply rooted in Maasai governance and herding practices (Spear & Waller 1993). A family’s survival and wellbeing are bound to the welfare of its livestock and the availability of pasture and water. The Maasai nevertheless have no word for conservation. The link between rainfall, pasture production, herd productivity, family welfare, and the maintenance of commons resources is, instead, incorporated in the concept of *erematar*e. Akin to Vavilov’s biocultures and Leopold’s land ethic, *eramatare* is an ethos embedded in husbandry practices, cultural customs and the governance of Maasai society. *Eramatare* linkages stretch across the landscape through social networks, giving families access to the resources needed to sustain them through the seasons and in times of drought. *Eramatare* also extends to wildlife, which holds many values and uses among the Maasai, including for food, clothing, medicine, ornamentation, utensils, clan symbols and esthetic appeal (Western at al. 2019). Many species, including eland and buffalo, are regarded as “second cattle” and are used as a standby food source in times of drought (Western 1997).

HUMAN-DRIVEN CHANGES IN EAST AFRICA

Starting in the 1940s, concerns over the impact of population growth, land transformation and poaching of wildlife led to the creation of national parks and reserves presently covering 15% of Tanzania and 8% of Kenya. By the 1970s recognition that national parks are too small to avoid extinctions and insufficient to protect the wildlife migratory routes led to policies for engaging communities in wildlife conservation through tourism and hunting revenues (Western & Pearl 1989). In the ensuing decades the policy shift resulted in an expansion of wildlife conservation onto community lands by encouraging the creation of wildlife conservancies in Kenya and Wildlife Management Areas in Tanzania (KWCA 2016).

Despite the spread of community-based conservation in Africa's rangelands, its success hinges on the future of pastoral economies and cultures. Pastoralism, the dominant form of land use in the sub-arable savannas, accounts for over 90 percent of the large mammal biomass in Kenya (Ogutu et al. 2016). Despite the economic potential of tourism and sport hunting, wildlife revenues contribute to only a small portion of household income (Kristjanson & Trench 2009). The strong cultural identity and social bonds rooted in livestock also make it likely that pastoralism will remain the primary form of livelihood even where wildlife revenues are a significant portion of family incomes.

Pastoralism nevertheless faces many of the same threats as wildlife, namely the loss of space and mobility; land use changes and land degradation; a loss of livestock production; and decreasing resilience to droughts (Boone 2005; Hobbs et al. 2008). The loss of ecological adaptability to environmental perturbations is further compounded by a breakdown in the traditional governance institutions rooted in social reciprocity which regulate pasture use and minimize local risks of drought, disease and other hazards (Mwangi & Ostrom 2009). The breakdown stems from several factors arising from pre- and post-colonial government policies, including government-mandated regulations of the rangelands, the creation of wildlife parks and reserves, forced eviction of pastoral communities for agricultural development, sedentarisation and subdivision policies for rangelands, and the replacing and breakdown of traditional decision-making practices (Mwangi & Ostrom 2009). Because of these common threats, redressing the threats to pastoralism and pastoral lands indirectly alleviates the same threats to wildlife. Further, conserving the cultural and governance practices underpinning the mobility and resilience of pastoral herds also reduces human-wildlife conflict and the prospects for continued coexistence (Western 2019).

Here we look at an example of how two adjacent Maasai communities in Kenya's South Rift (Fig. 1) are drawing on both traditional and contemporary knowledge of husbandry and governance practices to sustain pastoralism and conserve wildlife. We then look at how the expansion of such ecosystem-level efforts can benefit from increased scales of governance and management to not only build livestock production and resilience but scale up to large landscapes to conserve biodiversity.

CONSERVATION FROM THE INSIDE-OUT

The benefits of multi-scale to pastoralists and wildlife Among pastoral communities free-ranging movements give livestock access to resources over large regions where forage and water sources are patchy and ephemeral. Mobility allows herders to track the richest pastures through the season and minimizes exposure to drought, disease, local pasture degradation and perturbations in semi-arid areas where rainfall is highly variable in time and space (Western 1982; Western & Finch 1986; Ash et al. 2004; Boone 2005; Wang et al. 2006; Hobbs et al. 2008). These ecological benefits of large-scale mobility in areas where resource availability is highly stochastic are reflected in the energy bonus of improved digestive efficiency, growth rates and milk yields for pastoral livestock and wildlife alike (Illius & O'Connor 2000; Owen-Smith 2004; Wang et al. 2006). In the case of pastoralists, the scale of use is tied to the scale of social networks allowing free and safe movement (Western 2019). Large social networks have in turn been shown to increase the benefit to individuals through a "return to scale" across a range of societies from hunter-gatherers to agrarian and urban economies (Hamilton et al. 2007; West 2017).

The ecological benefits of mobility in offsetting stochastic resource availability apply widely regardless of habitat and landscape variability. The benefits become far more beneficial, however, in landscapes varying in elevation, climate, soils, hydrology, habitat and plant nutrition. In such varied landscapes, the functional heterogeneity at scale adds the productivity, diversity, and resilience of large herbivores (Owen-Smith 2002, 2005; Fynn et al. 2016).

In the case of the African savannas, wildlife survival, abundance, and resilience to seasonal flux and drought are also scale-dependent, and like livestock, they depend on the ecological benefits accruing across large functionally heterogeneous landscapes (Western & Gichohi 1993; Fryxell et al. 2005; Owen-Smith 2005). Species such as elephants, lions, wild dogs, giraffe and migratory wildebeest, zebra and gazelle in the Kenya-Tanzania borderlands cover thousands of square kilometers in the course of seasonal movements (Fryxell et al. 2005; Mose et al. 2013; Dolrenry et al. 2014; Osipova et al. 2018). In that species richness, habitat diversity and ecosystem integrity all increase with landscape heterogeneity (Peterson et al. 1998; Fig. 3), conserving metapopulations of landscape species—species using a large geographic area which includes a wide variety of other species —conserves biological diversity and integrity in the process. Large open landscapes also avoid the compression effects of large mammals on biodiversity (Western & Maitumo 2004) and rangeland health (Hobbs et al. 2008; Western et al. 2015a) through seasonal movements and population dispersal (Mose & Western 2015).

Scale and mobility in increasing functional heterogeneity also facilitate coexistence between livestock and wildlife by increasing foraging options, minimizing competition (Fynn et al., 2016, Tyrrell et al. 2017) and expanding the scope for the spatial and temporal separation of wildlife and livestock. Temporal separation in turn reduces pathogen transmission, crop-raiding and livestock depredation (Valls-Fox et al. 2018; Western 2019).

Finally, scale and mobility increase the structural and functional heterogeneity of landscapes through disturbance effects created by the differential grazing and browsing impacts (Fuhlendorf et al. 2016; Fynn et al. 2016) important to conserving the richness and integrity of ecosystems. Examples of patch dynamics caused by the seasonal movements of livestock and wildlife to optimize foraging include the interaction of elephants and livestock in creating a shifting mosaic of habitats (Asner et al. 2016), the intensity, timing and scale of fires influencing biodiversity and forage quality (Fynn et al. 2016; Morrison et al. 2018) and abandoned settlements in creating nutrient hotspots and habitat succession (Muchiru et al. 2009; Vuorio et al. 2014). The expanded scope for coexistence linked to scale also favors ecotourism, hunting, and recreation activities that diversify pastoral economies and sustains ecological services such as carbon sequestration, nutrient cycling, and water supplies at local, national and global scales (Yahdjian et al. 2015).

Expanding the scale of landscape management from an inside-out approach is driven by the vested interests of pastoralists and agro-pastoralists in sustaining their livelihood productivity and resilience and, incidentally, avoids the negative impacts of fragmentation of rangelands (Hobbs et al., 2008; Western and Groom 2013). Conservation approached from the self-interests of herders and their social networks shift the focus from top-down outside-driven programs to culturally embedded and community-based approaches to conservation (Fig. 2).

Social-ecological system theory (SES) and landscape governance theory recognize that successful management of common property resources depends on managing the commons through social networks and ruled-based institutions with coherence at the appropriate social and ecological scales, the capacity for adaptive management through devolved management rights, and marketable landscapes (Fig 2.; Ostrom 2007; Cumming et al. 2013; Reid et al. 2014).

Our case study demonstrates that fundamental principles of SES theory and landscape governance theory are integral to but fading in traditional Maasai communities. The traditional grazing practices and land use practices, social networks and governance arrangements are changing but remain central in sustaining natural resource management from an ecosystem to landscape and regional level.

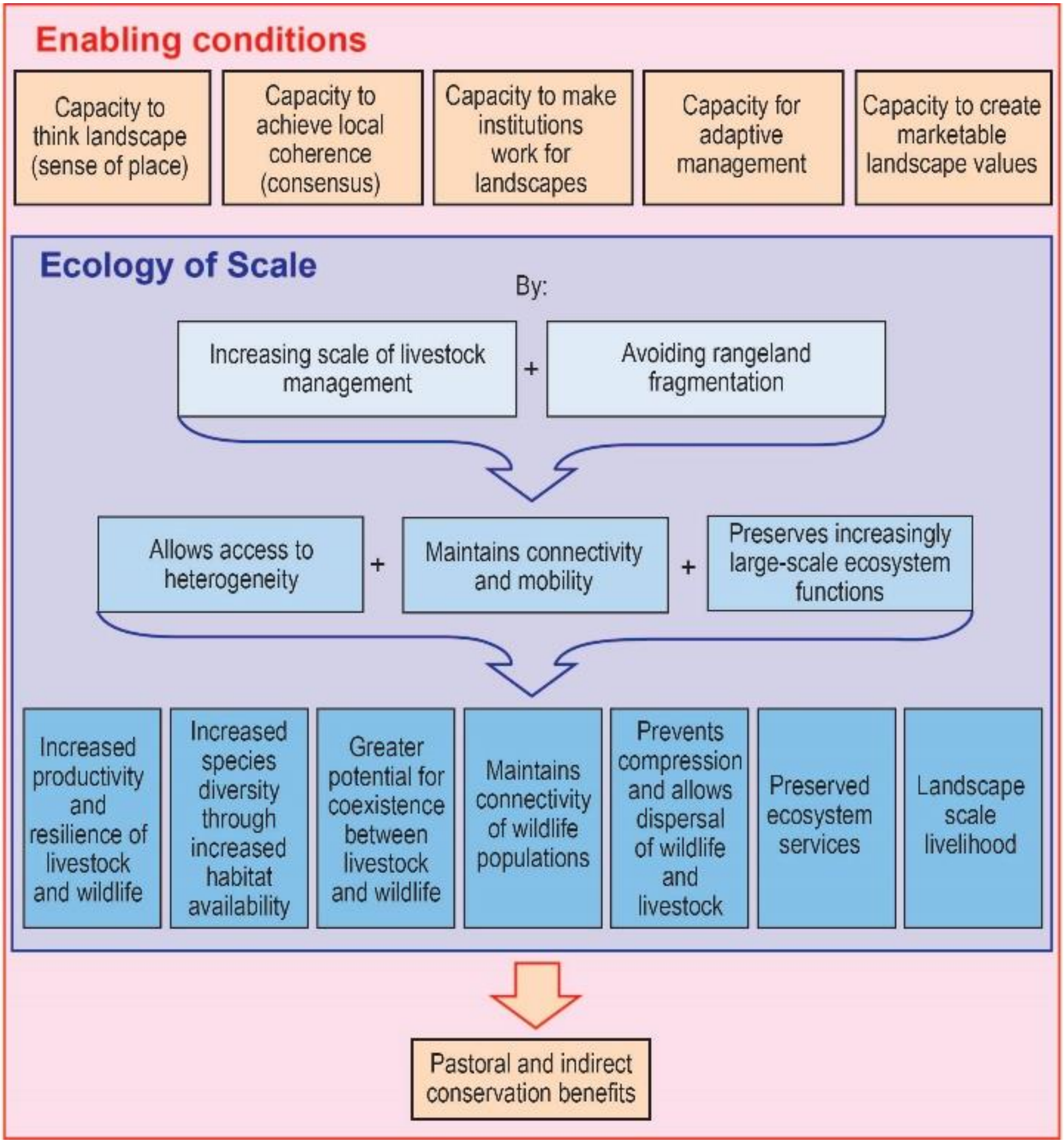

Figure 2- A diagrammatic representation of conservation from the inside-out for rangeland and pastoral systems. Successful resource governance of the pastoral rangelands depends on enabling conditions (Arts et al., 2017) linked to the ecology of scale and social networks (Cumming et al., 2014). Scale benefits pastoralists through increased mobility, herd production, resilience and the maintenance of land health and,

in the process, conserves biodiversity and ecosystem services. The benefits and implications of the ecology of scale can act across multiple scales (ecosystem, landscape, region).

Ecosystem scale

The pastoral lands of Kajiado and Narok counties in Kenya cover 40,000 km² along the border with Tanzania. The traditional common grazing grounds were divided into group ranches under the Group Ranch Representatives Act (CAP 287) in the 1960s and 1970s. Two of the group ranches in the southern Rift Valley of Kajiado County, Shompole and Olkiramatian, cover 1500 km² (Fig. 1) stretching from the forested Nguruman Escarpment to the semi-arid grasslands and bushland flats of the Rift Valley floor. The pre-colonial occupants of the Shompole-Olkiramatian ecosystem are predominantly members of the Lodokilani section of Maasai. The section includes a small group of settled farmers along the base of Ngurman Escarpment and a transhumant population of approximately 20,000 pastoralists who move seasonally.

Shompole and Olkiramatian communities have maintained their traditional collective herding practices to avoid the subdivision and fragmentation of their common grazing grounds arising from the subdivision and privatization of group ranches (Mwangi & Ostrom 2009; Russell et al. 2018). The two group ranches have, however, adapted traditional husbandry practices and livelihoods in response to the emerging opportunities in the market economy and to conform to national land, governance and development policies. The adaptations include diversifying the traditional livestock economy through commercial livestock production, farming, wildlife and tourism enterprises, and pursuing new opportunities through education, social services and rural development (pers. comm. John Kamanga).

Both Shompole and Olkiramatian incorporate national legal requirements in group ranch governance statutes by appointing government chiefs alongside traditionally selected age set leaders responsible for overseeing the use of common-pool resources. Among other functions, the group ranch committees regulate the movement of livestock and seasonal pastures (Tyrrell et al. 2017; Russell et al. 2018; Western 2019) and arbitrate herding arrangements within and between clans and with adjoining group ranches and Maasai sections (ibid.). The traditional late-season pastures double up as wildlife conservancies attracting tourism enterprises, including lodges, cultural visits and nature walks (pers. comm. John Kamanga). The group ranch committees also oversee livestock markets and guide development activities through land planning and zoning to ensure complementarity in land and resource use.

The regulation of livestock movements among community members ensures optimum use of pastures, the conservation of late-season grass reserves and minimum conflict with wildlife over pastures and water (Tyrrell et al., 2017). The governance practices afford community members access to grazing grounds, a variety of habitats for sustaining herd productivity and the mobility required to capitalize on patchy rains, avoid both disease outbreaks and competition with wildlife (Russell et al., 2018). The ability of herders to live alongside wildlife and benefit through tourism enterprises and traditional values (Roque de Pinho, 2009) depends on their rich knowledge of wild herbivores and carnivores and their skills in averting conflict (Western, 2019).

The role of traditional deployment of community scouts termed *ele'enore* is to gather the information the community needs to weigh its grazing options and reach collective decisions on herd deployment, watering regimes and the avoidance of serious conflicts with wildlife (Western 2019). Olkiramatian, drawing on the *ele'enore* tradition, set up a Lale'enok Resource Centre which trains and deploys resources assessors to gather a wide variety of ecological, social and market data relevant to collective herd management, land planning, resource management and market access. The resource assessors use automated data collection platforms to enter and analyze information for rapid dissemination and decision-making (Mose, Western 2015, and Tyrrell 2017).

The mix of traditional and contemporary knowledge, herding practices and governance arrangements maintains the seasonal scale of livestock movements on Shompole and Olkiramatian, ensuring that wildlife and livestock can benefit from seasonal migrations and adaptability to droughts (Russell et al., 2018; Tyrrell et al., 2017). In contrast to the sharp wildlife declines in pastoral areas which have been subdivided (Groom & Western 2013; Ogutu et al. 2016; Said et al. 2016), wildlife populations on Shompole and Olkiramatian have been more resilient. Elephant numbers have increased sharply, wild dog sightings have increased, cheetahs are resident, and the lion population has spread into the surrounding ranches (Ahlering et al., 2013; Schuette et al., 2013; Tyrrell et al., 2017). The area remains an important bird area with several threatened species (BirdLife 2019, Amutete 2004)[2].

Landscape-scale

The success of the Olkiramatian and Shompole conservation efforts encouraged the African Conservation Centre (ACC) to create a landowner network connecting Amboseli National Park and Maasai Mara National Reserve across the Rift Valley, aimed at forging a new tourist link and conserving the biodiversity-rich landscape (Fig. 1 & Fig. 3). ACC partnered with the Olkiramatian and Shompole leaders in 2007 to establish the South Rift Association of Landowners (SORALO) incorporating the 16 current and former group ranches spanning the 15,000 km² landscape. The common goals of the SORALO members include land security, raising and diversifying livelihoods, sustaining natural resource use and land health, developing ecotourism enterprises and conserving the open rangelands and rich wildlife assemblage.

The governance of SORALO's membership builds on the existing social networks and reciprocal grazing arrangements connecting adjacent Maasai clans and sections. SORALO is registered as a land trust and like Shompole and Olkiramatian, incorporates traditional and contemporary governance institutions and practices. The SORALO board includes representatives of regional group ranch clusters and draws on strong community inputs and the political influence it has with county and national agencies.

[2] (BirdLife International (2019) Important Bird Areas factsheet: South Nguruman. Downloaded from http://www.birdlife.org on 09/09/2019 and http://www.conservationleadershipprogramme.org/media/2014/11/000703_Kenya_FR_BirdsSouthNguruman.pdf)

The geographic reach and group ranch network SORALO covers scales up Shompole and Olkiramatian ecosystem-level governance to take advantage of the expanded benefits accruing from a landscape scale, including access to drought refuges, the conservation of watersheds and ecosystem services they depend on beyond their boundaries, the protection of wildlife corridors, joint wildlife scouting operations, ecotourism planning and access to country, national government and NGO services.

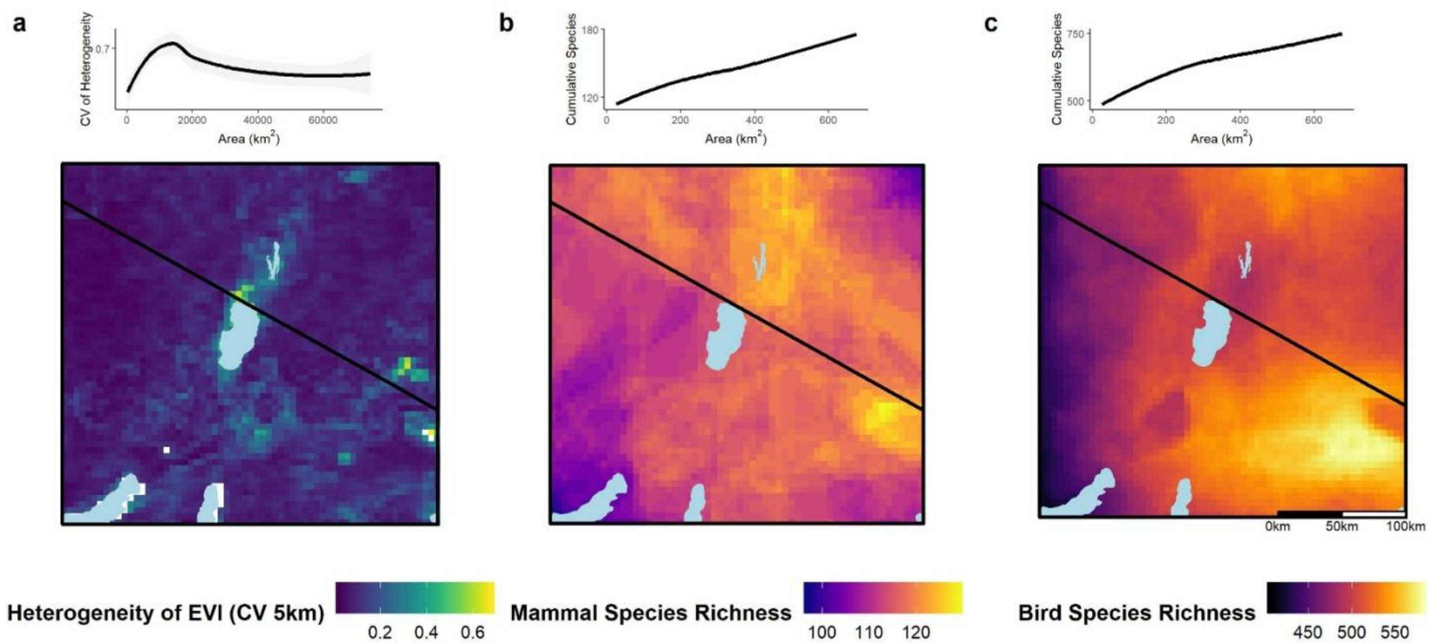

Figure 3. 5 X 5 km grids maps of the Kenya-Tanzania borderlands (border - black line) and major lakes (light blue) showing: a) Habitat heterogeneity based on the coefficient of variation of Enhanced Vegetation Index (EVI) from Tuanmu and Jetz (2015). The accompanying graph shows heterogeneity increasing steeply with area coverage from a central pixel to a peak at 15,000km$_2$. The accompanying graphs to maps b) and c) show respectively species richness in mammals using the Digital Distribution Maps of Red

List Species (IUCN, 2016) and birds based on Bird Life Digital Distribution Maps (BirdLife, 2016) both increasing steadily from a central pixel.

Regional-scale

The Kenya-Tanzania borderlands are globally important as a vertebrate biodiversity hotspot and regionally as a center of plant diversity accounting for a quarter of all the plants recorded in Kenya and Tanzania (Ministry of Environment Natural Resources and Regional Development Authorities 2015; Fig. 3). The borderlands also support large populations of endangered and threatened species, including one of the largest free-ranging elephant populations, richest carnivore assemblages in Africa, and among the largest remaining large herbivores migrations worldwide (Harris et al. 2009; Jenkins et al. 2013). Coupled with sixteen protected areas and a $1.5 billion annual tourism industry, the borderlands have attracted international attention as one of the earth's last great natural wonders.

Despite the attention and large well-equipped government ranger forces, wildlife has declined sharply in national parks both sides of the border in the last few decades (Western et al. 2009; Craigie et al. 2010). The declines stem from the same threats confronting the future of free-ranging pastoralists at an ecosystem and group ranch level; land conversion, subdivision, settlement and growing pressures on the open rangelands. Species dependent on large-scale migrations to access seasonal forage and sustain large populations are especially vulnerable to land compression and fragmentation. Both the Tarangire and Nairobi National Park herbivore populations are threatened by a lack of collaboration and incentives at the regional scale (Western & Gichohi 1993; Newmark 2008).

In the case of elephants, the main cause of the decline in the 1970s and 1980s arose from a ten-fold rise in ivory prices on the world market creating a surge in poaching and compression of remaining herds into the relative safety of national parks (Stiles 2004; Mose & Western 2015). The compression reduced woody habitats and biodiversity in national parks and most severely in small parks like Amboseli. Here, the extreme compression and habitat loss (Western and Maitumo 2004) spurred efforts in 2006 to reestablish the elephant's range to reduce the pressure on the park and recolonize the elephant's former wide-ranging movements. The first step involved training and deploying community scouts and promoting conservancies and tourism enterprises in Shompole and Olkiramatian where resident herds were driven out by poachers in the 1980s.

Following the natural repopulation of Shompole and Olkiramatian, ACC and SORALO expanded the elephant recovery program to connect the isolated Mara and Amboseli population with the aim of creating a metapopulation across the Rift Valley. The recovery involved monitoring elephant movements and deploying community scouts along dispersal routes. The program, premised on the inside-out model of conservation, evolved into the Borderlands Conservation Initiative (BCI) in 2012.

The initial goal of BCI was to halt elephant poaching by using SORALO-like community linkages to create space for the fragmented park populations and recreate a viable metapopulation in the pastoral lands spanning the Kenya-Tanzania borderlands. BCI used the endangerment and charismatic appeal of elephants to create a coalition of local NGOs, conservation organizations, researchers, and government agencies to support the pastoral community initiatives. The BCI collaboration soon expanded from the initial focus on elephants to conserving lions, other large carnivores, giraffe and other threatened and charismatic species to obviate the impacts of land restrictions on large scale movements and the fragmentation of metapopulations critical to their genetic and ecological viability. Recent evidence from the Serengeti-Mara ecosystem shows that even the largest of national parks are threatened by surrounding human pressures (Veldhuis et al. 2019) and are in need of mitigating conservation measures aimed at sustaining free-ranging movements.

Inside-out conservation as a way forward

Conservation in working landscapes connected from small land management entities to large multiscale landscapes holds untapped potential for alleviating the insularization and other human impacts on protected areas as well as conserving biodiversity in rural landscapes. Global warming is adding urgency to conserving species beyond protected areas as their ranges shift in response to climate change (Thomas et al. 2004). The threats call for new approaches to conserving biodiversity in the rural landscape. Solutions range from creating buffer zones for protected areas, protected areas that include working landscapes, conservation easements, leases, and direct land purchases. Conservation opportunities in the agrarian landscape include creating space through land-sparing intensified agriculture; conservation subsidies to farmers to protect wetlands, rivers and woodlands, and financial offsets for converting inimical uses to conservation-compatible uses.

Conservation emanating from within communities based on sustaining livelihoods which are dependent on large open landscapes widens the scope for nature conservation in the rural lands which cover 75% of the earth's terrestrial surface. Contrary to both top-down and bottom-up approaches which are focused primarily on conserving wildlife as the priority, an inside-out approach builds on existing practices that maintain open landscapes and wildlife by patching together networks of livelihoods and interests with compatible objectives. Unlike debates around land sparing and land sharing, this approach is centered on people rather than wildlife (Phalan 2018) and allows for a range of land use options along the sharing to sparing continuum. As our case study shows, the productivity and resilience of pastoral communities are linked to the ecological and functional benefits of scale, heterogeneity and land health, which if sustained, makes space for large free-ranging wildlife populations and biodiversity. While the inside-out approach is applicable to rangelands, it has relevance to other large complex systems that benefit from increasing the scale of management to larger landscapes, such as marine fisheries (Curtin, 2017).

Finding such space also depends on finding a place for biodiversity within a community's aspirations and economic options. To succeed, biodiversity conservation in rural lands must expand to a landscape scale and cut across national, jurisdictional, institutional and cultural boundaries, and create network connections between them (Scarlett & McKinney 2016). The feasibility of using an inside-out approach to conserve large open spaces becomes more feasible when linked to existing theories connecting landscapes among multiple jurisdictions using a polycentric and devolved approach to governance (Ostrom 2007), landscape theory based on sustainable practices (Arts et al. 2017; Curtin, 2017), and a sound ecological understanding using functional heterogeneity theory (Fynn et al. 2016; Fuhlendorf et al, 2017).

Of particular use is the SES framework (Ostrom 2007, 2009; McGinnis & Ostrom 2014), which allows for the analysis of relationships among multiple levels of complex social-ecological systems at different spatial and temporal scales. It also helps us understand how specific parts of the systems are related and interact. Applying the SES framework to natural resource management reveals several important elements affect the likelihood of users' self-organizing to sustainably manage a resource, including: (i) the existence of institutions that work at the correct social and ecological scales; (ii) governance that is multi-scale and multi-level, (iii) communities who have clear devolved autonomy over resource management; (iv) communities who see an importance of the resource, and see a benefit (through economic and non-economic values) from their natural resources; (iv) strong social norms of collaborative governance and management (Ostrom 2007, 2009; Cumming et al. 2013; Reid et al. 2014).

Our case study shows that these conditions are achievable for the management of pasture (and subsequently wildlife), and when they are conceptually twinned with a capacity for effective landscape governance (see Arts et al. 2017 for landscape governance as a capacity; Fig 1) and locally appropriate ecological principles, the results are mutual benefits to people, livestock and wildlife.

Biodiversity and livelihoods dependent on land health converge in the rangelands more than in most other biomes. The convergence stems from two formerly disparate objectives. First, the ambit of protected areas for conserving biodiversity has widened from the strict protectionism of IUCN Category I parks to include Category VI areas accommodating a range of compatible human values and uses. Second, land users, including pastoralists, private commercial ranchers, fishing, hunting, and forestry communities are finding common ground in conserving healthy, open landscape for their inclusive values. These include not only primary livelihoods but also other uses and values as nature sensibilities expand and international commitments to sustainable development deepen. These include a sense of place, a healthy environment and the range of ecological services it provides (Sayer et al. 2013; Arts et al. 2017).

The inside-out approach to winning space and a place for wildlife and biodiversity is place-based and draws on local knowledge and informal governance arrangements. It avoids the bottom-up wildlife-centric approaches driven from the outside that alienates communities working the land for a living. Instead, conservation approached from the inside outward promotes a human-centered approach that reinforces land health and spatial connectivity. It also encourages a shift from colonial and post-colonial central government command-and-control policies that have hampered wildlife and natural resource management towards devolved rights and ownership emerging with political and economic liberalization trends around the world.

Expanding conservation benefits from the inside-out is especially pertinent to conserving large herbivores and carnivores which need large open landscapes, pose considerable threats and costs to rural communities, and are the most vulnerable of all species to farming, ranching, and resource extraction (Tilman et al. 2017). Given that the downsizing of large herbivores and carnivores will have the biggest impact on ecosystem structure and function in coming decades, finding places for such landscape species will avert trophic cascade effects and the ecological impoverishment arising from the loss of keystone species (Dirzo et al. 2014; Smith et al. 2018).

Unlike much of East Africa's privately protected areas, conservancies and Wildlife Management Areas which 'buy' tolerance through tourism, trophy hunting or other land leases, the inside-out approach to conserving large open landscapes and wildlife expands self-interests and shared community livelihoods, social networks, and cultural values. In the case of the Maasai, *eramatare* linkages at the individual levels between family and herds, and at the community level for land access and land health through common pool governance arrangements, these connections promote both traditional intrinsic and instrumental values for wildlife. The linkages also reduce conflict and increase the prospects for coexistence with wildlife. Nevertheless, governments, NGOs and other conservation agencies have a large supporting role to play in offsetting the opportunity costs of wildlife and mitigating conflict as subsistence economies erode with population growth and market economies.

Collaboration at large scales and across human-dominated landscapes faces enormous challenges and at best will only complement and not supplant the need for protected areas and other conservation tools. Yet, as Leopold recognized, the extension of ethical values to include the health of the land is an evolutionary possibility and ecological necessity. By drawing on lessons from cultural institutions, principles, and practices which have maintained the commons for generations, combined with ecological, political and social sciences, we see the possibility of landscape doctoring evolving into the science of land health.

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Authors' contributions

DW, SR, and PT developed the original concept for this manuscript. DW lead the writing. PT and PB produced the figures and analyzed the data and assisted DW with the drafting of the manuscript alongside SR, SR, GW, and JK. All authors revised the manuscript critically for important intellectual content, approved the version to be published, and agree to be accountable for the aspects of the work that they conducted.

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