Elephant Modernities: Thinking along blurry lines between humans, elephants and technologies

Abstracts

Cluster 1:	Digital Conservation and Elephants' Adaptions to Anthropogenic Landscapes

Vocal communication in elephants: from production to function and potential implications for conservation

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Elephants are known for their complex vocal communication, characterized by the rumble, a vocalization with fundamental frequencies in the infrasonic range that is used in a variety of contexts and as a long-distance contact call. Yet, what makes elephants vocal communication distinctive is their remarkable vocal plasticity, including context-dependent within-call type flexibility[1].

Sound visualization experiments, for example, revealed that elephants can control the vocal path from oral to nasal rumble production depending on context, apply velopharyngeal coupling and produce complex forms of biphonation including the simultaneous production of nasally and orally emitted call types[2,3]. In addition, sounds, including common call types and idiosyncratic ones, are also produced by modulating non-phonatory structures, allowing for a wider range of communicative frequencies[4,5].

Along with whales, dolphins, seals and bats, elephants belong to a diverse and dissimilar group of non-human mammals proven capable of vocal production learning[6-8], i.e., of structurally modifying signals as a result of auditory experience. The capacity for vocal learning and their sound creativity is fundamental to understanding the eloquence within the elephants' communication system. This might also help to understand the evolution of human language and of open-ended vocal systems, which build upon similar cognitive processes.

This presentation will offer a synopsis of two decades of research on the vocal communication of elephants. The research encompasses various aspects such as the production of sounds, the cognitive and internal factors that influence the acoustic structure of elephant vocal signals, and the adaptive function of these signals in both African savanna (*Loxodonta africana*) and Asian elephants (*Elephas maximus*). In addition, the presentation will present new findings and discuss the potential for employing artificial intelligence to decipher elephant communication and apply this knowledge to conservation efforts.

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Valuable Insights Gained Through the Noses of African Elephants (*Loxodonta africana*)

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African elephants (*Loxodonta africana*) possess one of the best senses of smell within the animal kingdom. They have highest number of associated olfactory receptor genes among any mammal tested to date. Their scent acumen, together with their cognitive abilities means that they are capable of distinguishing between friend or foe, assessing food quantities, relatednesss and breeding status of conspecifics through odour alone. By harnessing both their olfactory and cognitive abilities, African elephants can learn to perform scent detection and scent-matching tasks that can provide valuable insights into not only their own behaviour but also that of other species. Through two separate research projects, we demonstrate that African elephants serve as valuable biosensors. Not only do they outperform dogs in sensitivity with regards to TNT detection, but they have also demonstrated the scentlessness of an ambushing snake species, the puff adder (*Bitis arietans*) – a phenomenon previously thought impossible among vertebrates. Additional biosensor applications of this species could see elephants as valuable role players in olfactory-based research, or as a complement to current and developing scent detection technologies, such as early disease detection, while simultaneously providing valuable enrichment for already captive elephants throughout.

Landscape connectivity for African elephants in the world's largest transfrontier conservation area: A collaborative, multi-scalar assessment

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Landscape connectivity operates at a variety of scales, depending on the geography of the area in question and the focal species or ecological process under consideration. Most connectivity studies, however, are typically focused on a single scale, which in the case of resistance-based connectivity modelling, is often the entire landscape or protected area (PA) network. This large, single-scale focus may miss areas that are important for connectivity at smaller scales and that can be documented via observed animal movements without resorting to landscape-wide statistical modelling and extrapolation approaches. Here I present recent results that characterize landscape connectivity at three different scales (local/micro, inter-PA, and landscape-wide/macro) in the Kavango-Zambezi transfrontier conservation area (KAZA) in southern Africa, using observed animal movements rather than conventional resistance surface models to produce a connectivity conservation blueprint for African elephants (*Loxodonta africana*). This analysis is based on an extensive, high-resolution GPS tracking database comprising approximately 4 million GPS locations from nearly 300 tagged elephants and their associated herds. The results show that high-fidelity elephant use of micro-corridors is typically—though not exclusively—related to directed movements towards water, often amidst heavy anthropogenic presence. Movement pathways that connected KAZA's core protected areas were longer and variable, with some channelled into narrow areas of use and others more dispersed across larger sub-landscapes. At the largest scale, a network analysis incorporating all used landscape grid cells revealed several clusters of large-scale movement corridors that connected distant parts of KAZA. The three scales of analyses reveal disparate geographical priorities for connectivity conservation that collectively could help ensure the functional connectivity of KAZA for its largest inhabitants. Each scale will require its own set of inter-related conservation interventions, while further research into areas with sparse data collection, and other species of conservation concern, could reveal additional connectivity priorities at each scale.

Dry season movements reflect challenges to female African savannah elephants in a human-impacted landscape.

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[1] Elephant connection, Zambia

Successful conservation of threatened species requires an understanding about how a species will be affected by future changes in human activities (land use, hunting) and environmental conditions (habitat, water, climate). We tracked the hourly movements of African elephants for two years via GPS satellite collars in southwestern Zambia and found that elephants moved seasonally between protected areas and human-inhabited areas. We found that female elephants showed site fidelity and did not undertake large-scale movements, leaving them potentially susceptible to disruptive events within their range. We found that in dry years, elephants moved away from the protected areas to range along 160 km of the human-inhabited Zambezi River, where they generally remained within 10 to 15 km of this permanent water source. Female elephants exhibited larger home range sizes when

in these human-inhabited areas, which may be due to seeking out dwindling food resources close to the river combined with frequent disturbance from human communities. Secure habitats for elephants adjacent to the Zambezi River, including undisturbed access points for drinking, will be vital to ensure the persistence of the elephant population in this area as they be-come more dependent on the Zambezi River in a drying climate.

Cluster 2:	Historical Entanglements: Elephants, Guns and the Ivory Trade

Entangled Histories of Elephant-Human Interactions in African Contexts: Archaeological and Palaeoecological Insights on the Origins of Elephant Modernity

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It is widely recognised that the loss, fragmentation, and degradation of habitats across the globe have contributed significantly to declines in biodiversity. Habitat fragmentation typically results in spatial restriction of species to smaller and more isolated areas, as well as loss in overall habitat heterogeneity. With the rupture of landscape connectivity come additional challenges, including reduction of gene flow within a species and a reduction in opportunities for adaptive responses as climatic conditions change and hence patterns of species mobility. Given the long history of human interaction with and exploitation of Africa's savannah and forest elephant populations, the latter are highly likely to have developed responses to anthropogenic landscape transformations over several centuries, even millennia, especially following the introduction of crop cultivation and livestock herding. Intensification of extractive practices from the seventeenth century onward in some parts of the continent in response to growing global demands for elephant ivory are also known to have transformed the distribution of forest and savannah elephant populations. As wildlife conservationists grapple with the multiple challenges facing the protection of these species and increasingly draw upon a range of direct interventions to achieve their goals, thereby creating the conditions in which elephant 'modernity' might have emerged, it is worth reflecting on the deeper histories of elephant-human interactions on the continent, on how we might identify these from archaeological, palaeoecological and historical records, and what we might learn from them that might help mitigate some of the challenges Africa's remaining elephant populations continue to face. This paper seeks to do this through a discussion of selective examples and strands of evidence from across Africa, with particular emphasis on savannah elephants inhabiting different areas of East Africa.

African Elephant Ivory on the Move

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Archaeologists, historians, and biologists are working together using a range of interdisciplinary methods to map the trade in elephant ivory trade across the African continent over the last 1,000 years. Using an object biography approach which combines archival, archaeological and scientific data sets, it is becoming easier to source ivory objects by starting with the biological history of the elephant from which the object was made, understanding the environment and life of the elephant whose teeth were eventually carved, traded, and valued in different contexts globally. This talk will use a series of case studies of mapping ivory objects to explore the potential of these combined methods to reveal human-elephant relationships over the last millennium.

Elephant Infrastructures in the Southern Cape Colony, c. 1750-1950

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The research highlights the ways in which colonial expansion – in particular, settler colonial expansion – impacted, and was impacted by, elephants in the Cape Colony over two centuries. It discusses the well-documented slaughter of elephants in the quest for ivory, as well as the move towards the regulation and preservation of elephants from the nineteenth century. Its focus, however, is on the effects of the measures taken by both elephant and human to avoid colonial encounters, subjugation and death. The paper presented here is a part of a broader project which aims to produce a multispecies history of the area between the Outeniqua and Tsitsikamma Mountains and the Indian Ocean in the Southern Cape of South Africa. It is an area in which colonial claims and presence occurred comparatively early, but where settlement and 'civilising' were hampered by terrain; its deep gorges and rivers, dense forests, rocky coastline and steep mountains. Using this area as a case study, the paper discusses how elephant pathways throughout the Southern Cape were operationalised by colonial powers, allowing them to 'settle' and exercise authority over the area. Colonial engineers used these routes to navigate the construction of roads and, hence, wagon access, which made large-scale settlement possible. Elephant pathways here are understood as infrastructure which was utilised by human and other-than-human animals alike. The paper discusses this elephant infrastructure and its particulars, and how elephants created a network which altered and influenced the way in which multiple species navigated and engaged the forest system from the pre-colonial into the colonial period, and the present. The changes that colonisation brought to elephants' lifeworlds, I argue, also brought a new determinative logic to their infrastructures; a logic which ultimately made the extension of settler colonial authority in the region possible. In this case study we find insights into, not only how elephants adapted to modernity, but, how some of the elephants' adaptations influenced the way in which settler colonialism unfolded in what-is-now South Africa.

The "broader project" I refer to began as a history of the Outeniqua/Tsitsikamma region approached as a collection of human and other-than-human animal flows and engagements in and out of the forests that shaped the forests and its inhabitants, and looks at these multispecies flows to highlight the relations between human and forest, forest and elephant, and elephant and human. It turns out this was quite complicated so it has since expanded to include various methodological questions.

Abstract: Firearms, Hunting, and Elephant Populations in the Lower Zambezi Valley, c.1780-1880

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From the late eighteenth century onwards, firearms became increasing utilised as hunting tools by African communities within the *prazos da coroa* of the lower Zambezi valley. Though the incorporation of guns in this region was gradual, and their use operated alongside traditional hunting practices, by the middle of the nineteenth century firearms had become one of the primary instruments used by certain local communities to hunt elephants and other large game, both for subsistence and to satisfy ivory markets across the Indian Ocean and beyond. These hunting activities were tied to a commercial system in which firearms, ivory, cloth, and enslaved people were exchanged. The increasing use of firearms in hunting over the early nineteenth century contributed to shifting socio-cultural dynamics within many *prazo* estates, yet there is also anecdotal evidence that reliance on guns had notable impacts upon elephant population around the lower Zambezi River. Research on nineteenth-century human-elephant interactions in Zambezia remains limited, in part due to a paucity of source material for that region, yet a methodology that combines oral tradition, Portuguese ivory export records, and anecdotal accounts of elephant distributions may allow us to reconstruct potential elephant depopulations and their links to changing hunting technology, practices, and social contexts.

Exploring elephants in hunting narratives from South Sudan, c. 1840s-1940s

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European accounts of elephant-hunting in 19th-20th century Africa have been used by historians mainly to explore the construction of the idealised male imperial hero (MacKenzie, 1988). As 'by far the most formidable of all animals' (Baker, 1866), the elephant was the perfect foil to the noble white hunter. Historical geographers Lorimer and Whatmore have sought to deepen such analysis by 'attending to both human and nonhuman embodied experience' in hunting encounters. But their conclusions remain focused on European hunting ethics and codes of sportsmanship which they argue rationalised away the affective experience and removed 'the passionate body from the fray' (Lorimer & Whatmore, 2009: 669, 685).

This paper returns to the question posed by Lorimer and Whatmore (2009:676): 'How do we witness and evoke the embodied experience of elephants, especially past elephants?'. The paper will suggest that we <u>can</u> explore the embodied experience of past elephants and people through textual (and some oral) accounts of hunting in South Sudan, and that these sources are never simply human-authored: the animals leave their own 'writing' through the tracks, sounds, smells and movements that we can trace in the texts (Benson, 2011). The paper will explore how elephants were responding to the huge

increase in hunting stimulated by the ivory trade after 1840, and to the new technology of guns. In turn, it will also consider how elephant bodies and behaviour shaped human technologies and hunting methods. The paper will argue that closer attention to descriptions of elephants under fire demonstrates that the 'passionate body' was never removed from the fray and instead elicited interspecies empathies that could also disrupt the racialised construction of the noble hunter.

Cluster 3	Coexistence and Conservation: Examples from Namibia

Human-Elephant Interaction in a Northeastern Namibian Coexistence Landscape: Practices, Imaginaries, Knowledges

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This contribution deals with human-elephant interaction in a northeastern Namibian coexistence landscape. This space is shaped by various conservation efforts, the rapid increase of wildlife numbers (notably of elephant numbers) and the built up of ecotourism on the one hand and a major expansion and restructuring of agricultural practices on the other hand. The paper will focus on how human-elephant relations develop in such a dynamic context in which the demography of all species has changed dramatically and rural economies have been grossly transformed by local as well as national drivers in recent years. Human-elephant conflict is much debated locally but also progressively at the national level as there is little doubt that elephant damage to gardens is profound. Human-elephant interaction, however, is much more than just conflict but also entails forms of co-adaption and argument on the human side about the sociability, sensing and memory of elephants. Intense observation of elephants and theorizing such empirical accounts of another species come together in a local ethno-elephantology, that combines local knowledge and science-based knowledge. This results in a co-evolving coexistence landscape that is certainly not harmonious but full of conflicting claims to resources and varying practices of securing livelihoods. The contribution will particularly zoom in on wildlife corridors that run through communal areas connecting national parks in Botswana, Namibia, Zambia and Angola. Here humans and elephants interact often on a daily basis and the mutual experience of the often times conflicting needs and wants of another species become most pressing.

African Human-Elephant Co-existence: Using Technological Advances to Promote Human-Elephant Co-existence in the Human-Dominated Landscapes of Northwestern Namibia

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The elephant population which was once widely distributed throughout Namibia, and now restricted to the northern parts of the country are stable and growing. The population is currently estimated at 25,000 elephants. Of this growing and stable elephant population, a small population of elephants adapted to the prevailing arid conditions are found in northwestern Namibia. This population make up about 4% of the total elephant population and is sparsely distributed over a large area where they

come into conflict with local livestock farmers. The northwestern elephant population faces a number of conservation challenges including conflict with local farmers over scarcely distributed water resources. The Nature Conservation authorities together with local communities and partners adopted innovative conservation approaches to conserve and protect the northwestern elephant.

Harvesting Elephants along Wildlife Corridors in KAZA: The limits of localised management

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Elephants play a central role in community based natural resource management (CBNRM) in Namibia as they attract both tourists and trophy hunters. The harvesting of wildlife in Namibian community conservancies is managed by the allocation of quotas, a process informed by annual game counts as well as the need to deal with 'problem' animals and to facilitate certain traditional practices. CBNRM in the Zambezi province also forms part of a broader development strategy in which hunting within conservancies adjacent to protected areas is understood as providing a useful buffer between farmers and areas of high biodiversity. Analysis of conservancy audits shows that elephant quotas respond to reported elephant damage the previous year, but that elephant harvesting is primarily related to geographic location on elephant corridors within the Kavango Zambezi Trans-frontier Conservation Area (KAZA). The harvesting of elephants as they move across KAZA helps incentivize community conservancies to tolerate these important wildlife corridors. Yet these elephants are also a wider (international) resource and hunting quotas should thus ideally be determined through broader consultation within KAZA. The framing of quota allocations as responsive to localised ecological and developmental needs fails to acknowledge the international ecology of this migratory species.

Towards a Scientification of Elephant Management: Insights from Namibia's Zambezi Region

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African elephant populations have faced a dramatic decline since the 17th century, driven by extensive poaching for ivory and habitat destruction due to human expansion. By the late 20th century, this crisis had turned elephants into symbols of global conservation concern, spurring demands for reliable data on population numbers, elephant ranges, and poaching incidents. The worries about rapidly declining elephant populations culminated in the 'ivory trade ban' which was adopted in 1989 at the Conference of the Parties in Lausanne. However, the ban was strongly opposed by southern African countries, including Namibia, which argued that their stable elephant populations could be best conserved through sustainable utilization. In response, these countries intensified elephant research, forged international alliances, and used newly available technologies as mediators to produce more accurate and transparent data to support their stance. On the example of the Caprivi Monitoring Project (1992-1995) this presentation examines these developments in Namibia's Zambezi Region, tracing how international governance frameworks, technological advancements and national conservation priorities converged to drive a 'scientification' of elephant management.