REPUBLIC OF KENYA

WILDLIFE RESEARCH & TRAINING INSTITUTE

Discover Beyond

1st Wildlife Scientific Conference 2023

"Use of Wildlife Science for enhanced Biodiversity Conservation and improved Livelihoods"

Proceedings

26th-28th September, 2023
Lake Naivasha Resort, Naivasha, Kenya

Coordination | Innovation | Partnerships

www.wrti.go.ke

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Contents

Contents

Conference Background Information

Introduction

Section 52(1K) of the Wildlife Conservation and Management Act, 2013 (WCMA, 2013) provides for the Wildlife Research and Training Institute (WRTI) to organize symposia, conferences, workshops and other meetings to promote exchange of views on issues relating to wildlife research and training. Further, the Institute's Strategic Plan 2022-27 emphasises the importance of holding local and international seminars, workshops, conferences and adventures to promote information dissemination and exchange. In addition, the National Wildlife Strategy 2030 emphasises biennial conferences in wildlife research as a priority activity to bring data and information to producers, managers and users to review, plan and coordinate with the goal of catalyzing innovation, developing new technologies and spurring investments to promote evidence-based wildlife conservation and management. Sessional paper No. 1 of 2020 on the National Wildlife Policy highlights the importance to the Government of promoting the use of the best available scientific information, knowledge and understanding in decision making and that the Government shall also develop mechanisms to ensure cross-sectoral linkages and consistent implementation of wildlife-related Multilateral Environmental Agreements (MEAs) and Sustainable Development Goals (SDGs). It is against this background that the Institute held the 1st Wildlife Scientific Conference in Naivasha, Kenya between the 26th and 28th September, 2023.

Rationale

Since Kenya's independence in 1963, the wildlife sector has experienced major challenges driven by anthropogenic and environmental factors with an average loss of over 50% of most species over the last 40 years. These include habitat degradation, fragmentation and loss; loss of connectivity; climate change; human-wildlife conflicts; diseases and loss of genetic viability; poaching for trophies and bushmeat; infrastructural development; and human encroachment into wildlife areas. These changes are driving significant wildlife population declines and damage to natural ecosystems. During the same period, the wildlife sector has experienced major changes in policy, legislation and institutional structures as well as in wildlife conservation and management in major ecosystems and landscapes.

To address the above challenges and enhance the socio-economic benefits of wildlife resources in line with the Bottom-up Economic Transformation Agenda (BETA), the Institute organized its inaugural wildlife scientific conference. The conference attracted 127 scientific papers from experts comprising 103 local and 24 international experts (UK, USA, Tanzania, Benin, South Africa, France, Netherlands, Spain and Germany). A total of 424 participants attended the conference. The presenters provided insights into a wide range of issues in the wildlife sector as highlighted in the themes and sub-themes below. In addition, the conference acted as a channel for disseminating information gathered internally and externally through wildlife research. The conference also provided a platform for sharing novel technologies for the wildlife sector and networking among wildlife researchers, conservationists, managers and policy makers.

It is envisaged that the conference findings will contribute to guiding and advancing policy development and decision making in the wildlife sector and therefore to enhancing sustainable benefits from the resource to the Kenyan people and as a global human heritage.

Conference Theme and Sub-Themes

In order to effectively address the challenges within the wildlife sector and optimize the economic benefits derived from wildlife resources for the Kenyan people, the conference was centred around the theme, **"Use of Wildlife Science for Enhanced Biodiversity Conservation and Improved Livelihoods"** which highlighted the nexus between science, policy, management and livelihoods. Additionally, it aligned seamlessly with the National Wildlife Research Agenda 2023-2027.

In line with the conference theme, the following ten (10) sub-themes were identified:

- SUB-THEME 1: Changes in wildlife population trends and dynamics
- SUB-THEME 2: Initiatives towards wildlife habitat restoration and connectivity
- SUB-THEME 3: Approaches to climate change mitigation and adaptability
- SUB-THEME 4: Emerging alternative wildlife utilization and enterprises
- SUB-THEME 5: Approaches to enhance human-wildlife coexistence in human dominated landscapes
- SUB-THEME 6: Addressing wildlife health challenges through One Health approach;
- SUB-THEME 7: Use of new technology in addressing wildlife conservation challenges
- SUB-THEME 8: Use of science for harmonized policy engagement
- SUB-THEME 9: Use of biotechnology and bio-prospecting for enhanced socio-economic benefits
- SUB-THEME 10: Use of natural capital accounting systems and payment for ecosystem services for socio-economic benefits.

Opening and Closing Messages

Address By

H.E. Hon. Dr. William Samoei Ruto, CGH,

The President of the Republic of Kenya and Commander of the Kenya Defense Forces.

Invited Guests,

Distinguished participants,

Ladies and gentlemen,

Good morning.

I am very pleased to preside over the opening ceremony of this 1st wildlife scientific conference organized by the Ministry of Tourism, Wildlife and Heritage through the Wildlife Research and Training Institute.

Firstly, may I congratulate the Institute, which I am informed was operationalized in July 2020 by delinking wildlife research and training functions, staff and assets from the Kenya Wildlife Service (KWS) for organizing this conference in its 3rd year of operating as an independent institution. This is a great milestone indeed.

The establishment of the Institute through the Wildlife Conservation and Management Act in 2013, and its subsequent operationalization, albeit 7 years later, was informed by the need to provide coordinated wildlife research and comprehensive data to inform scientific based solutions that inform policy decisions, management approaches, and create innovative wildlife-based products and services. It was further informed by the need to enhance capacity in wildlife conservation and management through training.

The above needs, and the Conference Theme of "Use of Wildlife Science for Enhanced Biodiversity Conservation and Improved Livelihoods" are in line with the Bottom-Up Economic Transformative Agenda (BETA) of inclusive economic growth; equitable distribution of income; enhanced social security; and increased foreign exchange earnings from the wildlife resource. These are important steps towards Kenya's drive to greater prosperity.

The conference, that is bringing together local, regional and international scientists, wildlife managers, policy and decision makers in the wildlife sectors, development and conservation partners, and other stakeholders, will provide insights into a wide range of issues and challenges in the wildlife sector including changes in wildlife population trends and dynamics; wildlife habitat restoration and connectivity; climate change mitigation and adaptability; human-wildlife coexistence; and natural capital accounting systems and payment for ecosystem services for socio-economic benefits among others. In addition, it will act as a channel for disseminating information gathered internally and externally through wildlife research.

I look forward to being appraised on the outcomes of the conference. I expect to be informed how the outcomes will contribute in guiding policy development and decision making to address the emerging needs and threats in wildlife conservation and management. I also expect that the conference will inform measures that the Government can implement in order to enhance optimizing benefits from the wildlife resource to the Kenyan people in line with the Government's Bottom-Up Economic Transformative Agenda. Wildlife, ladies and Gentlemen, is a key driver of the tourism industry which is the 2nd foreign exchange earner for the country.

Ladies and Gentlemen, I recognize the existing wildlife regulatory frameworks and policies that the Government has established in order to transform the wildlife sector, a key enabler in the achievement of the country's economic blueprint, the Vision 2030. Among these are the Constitution of Kenya 2010, the Wildlife Conservation and Management Act No. 47 of 2013; Sessional Paper no 1 of 2020, the National Wildlife Strategy 2030, and various Multi-lateral Environmental agreements (MEAs) that the Country is Party to.

Whereas these legal frameworks and policies have served the country well, we are experiencing unprecedented challenges in the wildlife sector. These include habitat loss and degradation; loss of ecosystem connectivity; climate change; human-wildlife conflicts; diseases and loss of genetic viability; poaching for trophies and bushmeat; infrastructural development; human encroachment into wildlife areas among others. These challenges have resulted in significant declines in wildlife populations across the country.

It will be important to re-examine our laws and policies and the extent to which they will serve us into the future. In this regard, I direct the Ministry of Tourism, Wildlife and Heritage to submit a report to me in the next two (2) months on a roadmap towards the review of the Wildlife Conservation and Management Act which was enacted in 2013 but has numerous gaps and overlaps. In addition, the Ministry should submit a report to my office in the same period on the relevance of the National Wildlife Strategy and the Wildlife Policy and whether their review is necessary. It is critical that the Government harmonizes the existing policies and legal frameworks for them to be responsive to the needs of the wildlife sector, and for improved service delivery to the Kenyan people.

Ladies and Gentlemen

The Country recently hosted the first African Climate Change Summit that delved into the many challenges this phenomenon is causing to Kenya, the region and Africa at large. Various interventions were recommended.

In line with the National Climate Change Adaptation and Mitigation Strategy, I urge the Ministry, in a participatory approach involving key stakeholders to finalize and implement the National Wildlife Climate Change Adaptation and Mitigation Strategy that I understand is in a draft format. Such a strategy is important in ensuring we take appropriate actions to safeguard our natural resources for posterity.

Ladies and Gentlemen

The Government's vision is to enhance wildlife conservation as part of a strong environmental foundation for achieving Kenya's sustainable development agenda. In line with the provisions in the Constitution, the Government also envisages engaging all Kenyans in recognizing the value of our wildlife and embracing their role in its conservation through appropriate collaborative initiatives.

The Government also recognizes the need for evidence based decision-making and emphasizes the importance of knowledge, information, and human capital for successful conservation. It also calls for decision support tools for adaptive management, and promotes data sharing, use, and integrated cross-sectoral and multi-scale planning for conservation and sustainable development.

To this end, the Institute is expected to enhance knowledge through research on the status of the country's wildlife and their potential to facilitate optimized benefits and provide quality and comprehensive wildlife data and information to inform policy formulation.

The Government therefore has a lot of expectations that the Institute shall coordinate and undertake relevant research that will guide the wildlife conservation sector. We expect to get innovative approaches to addressing the myriad of challenges including issues of wildlife corridors and ecosystem connectivity. We also expect that collaboratively with other relevant Government Ministries, the Institute shall contribute to tapping from the Blue Economy and Carbon financing in protected areas among others areas.

I recognize that as a new institution that is still in its infancy you may not have all the relevant research and training infrastructure, sufficient funding and expertise. The Cabinet Secretary is directed to work with relevant Ministries and Departments in Government to ensure the Institute is well resourced to fulfil the important mandate that has been bestowed on it by the Kenyan people.

Ladies and gentlemen

Despite the challenges in the wildlife sector, several achievements have been recorded over the years. This includes stabilizing the elephant and the black rhino populations following unprecedented levels of poaching in the 1970s to 1990s. These species have recorded significant growth in the past years and mortalities from poaching reduced significantly. In addition, several initiatives have secured key wildlife dispersal areas and migratory corridors particularly through establishment of community conservancies while the wildlife dependent tourism industry continues to bring in the much-needed foreign exchange. However, we must remain vigilant to ensure the gains are sustained.

Ladies and gentlemen, I wish you very fruitful engagements in the next three days. For participants from outside the country, please spare time to enjoy the beautiful scenery, visit wildlife protected areas around Naivasha and take time to enjoy the hospitality of the Kenyan people.

Thank you

Message from

Hon. Peninah Malonza, EGH, OGW

Cabinet Secretary – Ministry of Wildlife, Tourism & Heritage

Ladies and gentlemen

The Government of Kenya, on behalf of its people and that of the global community, is committed to the conservation of its invaluable natural resources including its wildlife resources. This is demonstrated by national laws enacted for the preservation and protection of the resources and also the multi-lateral environmental agreements the country is party to. The loss of biodiversity is being driven by anthropogenic factors that include increasing human population and global climate change. In Africa, and in particular Kenya, these two factors have drastically impacted on wildlife resulting in declining populations as a result of more frequent and severe droughts and habitat loss and fragmentation. Declining wildlife populations are impacting on the economic livelihoods of the many communities that live with wildlife and the enterprises that provide employment to Kenya's young population. This has the potential to negatively impact the economic base of the country and therefore any prescriptions to reduce such impacts are most welcome.

Kenya has therefore established and mandated various institutions to make sure that its invaluable natural resources are conserved and protected for the benefit of the people. The Wildlife Research and Training Institute (WRTI) was established by law, the Wildlife Conservation and Management Act, 2013, but it was not until seven (7) years later that the Institute started being actualized. The purpose for establishment of WRTI was to drive the wildlife research and training agenda in the country. It is the country's focal point with the national, regional and international community and it is envisaged that WRTI will provide coordinated wildlife research and comprehensive data to inform scientific based solutions that inform policy decisions, management approaches, and create innovative wildlife-based products and services.

It is my hope that this 1st scientific wildlife forum of its kind in Kenya will provide important insights into solutions to address declining wildlife populations, increasing habitat loss and degradation, increasing intolerance of human-wildlife coexistence, emerging and re-emerging diseases, loss of genetic viability, and climate change among others.

On behalf of the Government and the people of Kenya, allow me to welcome you to our beautiful country.

Message from

Sylvia Museiya, CBS

Principal Secretary – State Department for Wildlife,
Ministry of Wildlife, Tourism & Heritage

Kenya is one of the countries with the most wildlife species diversity and richness in Africa. The wildlife is found in various diverse ecosystems including terrestrial (savannah, forest and inland wetlands) ecosystems and >500 km long coastal marine ecosystem. Some of these ecosystems constitute important cross-border ones such as the Tsavo-Mkomazi, Amboseli–West Kilimanjaro and the Maasai Mara–Serengeti shared between Kenya and Tanzania. Such trans-boundary ecosystems need constant engagement besides addressing the ever increasing threats to wildlife and their ecosystems.

The Government of Kenya recognizes the role of research in wildlife conservation and for that reason established the Wildlife Research and Training Institute (WRTI) to coordinate and undertake research that will address emerging challenges in the wildlife sector. Among significant challenges is the declining wildlife populations across different ecosystems. For instance, most ungulates have dropped by >50% of their population since independence due to habitat loss, human wildlife-conflicts, reduced resources occasioned by droughts, and poaching for trophies and bushmeat. Wildlife is a renewable resource. However, care should be taken so that the tipping point is not passed beyond which species recovery is impossible. The wildlife sector competes with other land-use practices such as crop production and mining but gains through complementarity with other sectors such as livestock production. Ensuring optimal gains for people's livelihoods requires a delicate balance between these sectors. As a result, informed decisions can only be arrived at from serious research and engagement. Even then, we note that undertaking research requires funds and therefore, the State Department for Wildlife is committed to providing the necessary support from within and without.

Allow me to take this opportunity to welcome you to Kenya's 1st Wildlife Scientific Conference hosted by WRTI. I wish you fruitful discussions that will result in better recommendations for the sustainable conservation of wildlife.

Message from

Dr. David Nkedianye

Chairman, Board of the Institute

Ladies and gentlemen

The Government of Kenya, on behalf of its people and that of the global community, is committed to the conservation of its invaluable natural resources including its wildlife resources. This is demonstrated by national laws enacted for the preservation and protection of the resources and also the multi-lateral environmental agreements the country is party to. The loss of biodiversity is being driven by anthropogenic factors that include increasing human population and global climate change. In Africa, and in particular Kenya, these two factors have drastically impacted on wildlife resulting in declining populations as a result of more frequent and severe droughts and habitat loss and fragmentation. Declining wildlife populations are impacting on the economic livelihoods of the many communities that live with wildlife and the enterprises that provide employment to Kenya's young population. This has the potential to negatively impact the economic base of the country and therefore any prescriptions to reduce such impacts are most welcome.

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On behalf of the Government and the people of Kenya, allow me to welcome you to our beautiful country.

Message from

Dr. Patrick Omondi, OGW

Director/CEO

WRTI is excited to host the 1st Wildlife Scientific Conference in Kenya and I feel honoured to welcome you to this event being held at the Lake Naivasha Resort, in Naivasha between 26th and 28th September, 2023. This occasion marks the beginning of a new chapter in Kenya and sets the platform for biennial similar events in future. The event draws participants from wildlife scholars/scientists, Government (MDAs) and non-government wildlife conservationists, and various development partners. The forum aims to disseminate research findings as well as exchange ideas to inform sustainable wildlife conservation in the country. As a result, this 1st Wildlife Scientific Conference's theme, "Use of Wildlife Science for Enhanced Biodiversity Conservation and Improved Livelihoods", was carefully chosen in order to address various conservation threats in Kenya as well as seek solutions that enhance sustained biodiversity conservation for the people of Kenya and the world by ensuring that communities draw benefits to improve their livelihoods. WRTI's mandate is premised on the fact that scientific data and information are critical and that, when timely generated and disseminated, results in evidence-based decision making by managers and policy formulation for the country. I believe that this conference shall provide the much-needed data and information for the conservation of biodiversity for the people of Kenya and the world.

WRTI was operationalized slightly over 3 years ago and I must state here that the Institute is still in its infancy and therefore organizing this 1st scientific conference has been an enormous task. I wish to thank the Ministry of Tourism, Wildlife and Heritage for its support to ensure that this was actualized. I wish also to extend my sincere gratitude to other partners who contributed financial, material and in-kind support to ensure that this conference was successfully planned. Special gratitude to all the participants, without whom we would not be holding this conference.

I look forward to a most fruitful scientific engagement, succinct recommendations and way forward to reverse the negative impacts on biodiversity conservation in Kenya.

Lastly and on behalf of the Institute, I welcome you to the WRTI 1st Wildlife Scientific Conference and wish you fruitful engagement and safe stay in Naivasha.

Message from

The Conference Planning Committee

The Conference Planning Committee welcomes you to this WRTI's 1st Wildlife Scientific Conference that brings together policy makers, managers and wildlife scientists from national and international levels. These are drawn from government ministries, conservation NGOs, County Governments, management authorities, regulatory authorities, research and training institutes, universities and the media.

Wildlife scientists will showcase their research findings to inform participants on current wildlife issues in Kenya and beyond. Further, they will present opportunities and possible solutions that will inform policy formulation and management for sustainable development.

During the conference, there will be keynote addresses, plenary and panel discussions, oral and poster presentations, exhibitions and side events. The conference presentations will address current wildlife conservation challenges and opportunities, propose solutions and especially issues on wildlife population decline, habitat loss and degradation, poaching, habitat connectivity, diseases and loss of genetic viability, infrastructure development, human-wildlife conflict and impacts of climate change.

The recommendations generated from this conference are expected to enhance wildlife conservation, improve socio-economic benefits for the local communities, and sustain and grow tourism earnings from wildlife resources in the country.

We appreciate your presence and support during this conference. We look forward to your invaluable contributions.

Thank you!

Closing remarks by

Dr. David Nkedienye

Chairman of WRTI Board of the Institute

This is a great opportunity for me to close this conference. We have been here for 3 days and I really want to congratulate you all. First and foremost, I want to thank His Excellency the President Hon. Dr. William Samoei Ruto for recognizing the importance of this conference and as WRTI CEO said, he was to come and open this conference but due to other commitments he sent the Prime Cabinet Secretary Hon. Musalia Mudavadi to officially open the conference on his behalf. This shows the seriousness the president takes on matters of wildlife research and conservation. I really want to thank the Prime Cabinet Secretary for opening the conference. I also want to thank the Cabinet Secretary, Ministry of Tourism, Wildlife and Heritage, Hon. Peninah Malonza as well as the Principal Secretary, State Department of Wildlife, Silvia Museiya who was here yesterday. We also thank Members of Parliament from the Parliamentary Committee on Tourism and Wildlife for attending the conference. I am sure they appreciated the work researchers in the wildlife sector are undertaking to support wildlife conservation and they will therefore be in the frontline to support increased funding of WRTI from the exchequer.

The WRTI CEO has already acknowledged our sponsors, researchers and the partners and I also join in thanking them for the assistance accorded to us. I want to acknowledge all the participants in this conference. I have noted in attendance are quite a number of masters and PhD students as well as our own students who are studying wildlife at diploma level. We need to nurture this and I think in future we want to see more young upcoming scientists so that wildlife research will be sustainable into the future. Although we want to hear the work of scientists who have been doing research for up to half a century, we can soon run into trouble if we do not have enough regeneration and so the issue of mentoring young scientists is very important. We want to see more young people doing research.

Moving forward, one of the weighty issues of concern which has come from this conference is the declining wildlife populations. Something which should make us nervous. At this rate, if things don't change, we are on a trajectory where 10-20 years down the road, we will be meeting here to report Grevy's zebras, giraffes and other species are no more. We all disperse and do other things. Can we imagine such things? What will stop us if some of us are reporting 65-68% drop in numbers? That should make us very worried. All of us should think of new ways of dealing with the problem.

As researchers, we are not only to do research and report our findings, but think outside the box. Some of us should think in unorthodox ways. I was with one of the presenters and he was joking about hunting and enterprises and all that. I dare say that this country, just like the region, we need to come up with new ways because what we are reporting is not enough. Young and old scientists who have been in this field for years need to come up with new ways of dealing with the downward trends of wildlife populations, otherwise the future generation will blame us a lot. They will say for 30-50 years we just reported the downward trend and nobody stood up to say this is the only way to help us or this is a new way to help. We need to come up with ideas although they may not be very popular. Let us come up with findings even if they are not popular. Let us step up on the unwritten ground, let us dare to dream and present findings even if unpopular. At the end of the day, we shall tell the policy makers that it is written on the wall. This is it. Here are the choices. If you take this route, here are the

possible route options and this is the possible future. If things go wrong, they will be quick to blame us. We have to follow up with policy briefs and summaries in simplified form and tell them that this is what we think should be done. That is why I want to challenge all of us as we depart, let us think outside the box. Let us be daring, let us move into unchartered ground and look at what needs to be done to stop the downward trend.

Meanwhile as we part, we will be contacting some of you. We will be collaborating with you. We also encourage you to reach out, let us move forward. The president has given directives on a number of things and the Cabinet Secretary will be calling on us to address a number of issues. At this point in time in this country, there is an on-going review of the Wildlife Conservation and Management Act 2013, and the findings presented here plus others will feed into that. WRTI will put its foot forward, work with partners and advise the government on what science is saying in terms of wildlife conservation.

Am happy you are all here. I urge you all. I encourage all of you wherever you go. We are so proud that you found time to come and participate in the 1st wildlife Conference. We look forward to more interactions. We will work hard to seal any loopholes. We will want to bring more students and scientists and we will pick out more areas such as plant and marine science which may not have been properly covered. I want to thank everybody and I do realize that most of you wanted to link up with old friends, colleagues, old professors, etc. This is a new start. We are slightly new at only 2 years old and as we move forward, we will be able to stimulate more discussions and exchange with researchers so that together we can scale on to higher grounds.

I wish you all journey mercies as you go home. We request you to drop your feedback through the short questionnaire sent to you through the email. In addition, if you have anything for us, please send us so that it can be incorporated in the conference proceedings for future reference and your participation will not be in vain. The proceedings of the conference will be shared with all participants in the next two months. Thank you so much for your participation and doing your best. With those remarks, I wish to declare this 1st WRTI scientific conference officially closed.

Key Outcome and resolutions of proceedings of the WRTI 1st Wildlife Scientific Conference, held on 26th – 28th September 2023, Lake Naivasha Resort, Naivasha

At the end of the scientific conference, conclusions and a number of resolutions were derived from the floor through a participatory process and the key takeaways for action including the following:

01 ACKNOWLEDGES **WRTI's** mandate to lead the development of a **National Wildlife Database** which emerged as a major gap in the current wildlife information collation and sharing platform. It was AGREED that stakeholders contribute to the **Integrated Wildlife Database** by availing their data and supporting the process and a **Data Sharing Protocol** to be developed to guide access and contribution to the database.

02 UNDERSCORES the need to **review** the current wildlife **policy**, **legal** and **regulatory** frameworks in order to evaluate if they adequately address emerging issues in the wildlife sector. Additionally, STRESSED the need to engage policy makers in wildlife management and research to profile emerging issues in the National development agenda and policy directives.

03 UNDERLINES the need for scientific findings to be in a **simple** and **coherent language** that **communicates** to **policy** and **decision makers** as well as **wildlife conservationists** and **managers** in order to effectively guide the implementation of National and County projects in wildlife conservation areas.

04 STRESSES the need to **strengthen multidisciplinary**, **multi-sectoral** and **multi-institutional** approaches to address **wildlife health** challenges by embracing a One Health approach, enhancing partnerships and collaborations and strengthening infrastructure capacities in disease surveillance and diagnosis by constructing and equipping veterinary lab facilities, and establishing robust molecular diagnostic platforms.

05 EMPHASISES the need for **adopting innovative technologies** in wildlife research in order to enhance regular provision of scientific data and information to support effective wildlife management and conservation.

06 WELCOMES the WRTI resolution on holding Wildlife Scientific Conference **biennially** with the **next conference scheduled for September 2025.**

07 WELCOMES the establishment of a **One-Stop-Shop** research permitting process to streamline and expedite the application process. AGREES that WRTI to work with the National Commission for Science, Technology and Innovation (NACOSTI) and other Government agencies to identify and address bottlenecks in the wildlife permitting process.

08 ACKNOWLEDGES the importance of wildlife biodiversity in providing people's livelihoods and contributing to economic growth and AGREES the need for researchers to involve local communities in research activities to ensure **acceptance** and **equitable sharing of benefits** in line with National and International Instruments (Constitution, WCMA, 2013, Nagoya Protocol, CBD instruments among others).

09 CALLS on the Ministry to **develop policies** and **legislations** that recognize wildlife as a form of land-use and to guide valuation and utilization of wildlife resources to enhance economic value to land owners and local communities.

10 EMPHASISES the importance of increasing **public awareness** on the importance of biodiversity conservation including productive engagements with communities to influence attitude and behaviour changes and deliberately target the youth for sustainability.

11 CALLS on WRTI to initiate multisectoral, multidisciplinary, multi-institutional, local, National and International **collaborations and partnerships** based on the multidisciplinary nature of wildlife resources and expansive ecosystems while taking into consideration trans-boundary ones.

12 CALLS on the government to increase research funding from the current **0.8% of the Gross Domestic Product (GDP) to 2% of the GDP per year** in conformity with part VII of the ST&I Act, 2013 and a commensurate percentage of the research fund be allocated to research in the wildlife sector, in order to address wildlife research needs, based on its contribution to the GDP.

13 URGES the Ministry to develop a regulatory framework on sustainable financing mechanisms for wildlife conservation such as **carbon and biodiversity credits in wildlife protected areas and community conservation areas and** WRTI to establish partnerships and collaborations and build the necessary expertise to exploit these funding opportunities.

14 CALLS on WRTI to develop the **National Red List for rare, threatened and endangered species** in order to guide the **review of Schedule Six of the WCMA 2013** with support from the national Kenya Species Specialist Group (KeSSG) that was launched under the auspices of the International Union for Conservation of Nature (IUCN) during the conference.

15 UNDERSCORES the need for the Government to undertake initiatives to reduce, stop or reverse the disturbing wildlife population declines and degradation of their ecosystems. Such initiatives can include **increasing the percentage of wildlife revenue re-invested** in wildlife conservation and management, ecosystem restoration inside and outside protected areas.

Acknowledgements

The WRTI 1st Wildlife Scientific Conference could not have been successful without the support of various partners, institutions and collaborators. The WRTI appreciates the Ministry of Tourism and Wildlife for their technical and enabling policy space. The Kenya Wildlife Service, a state agency under the same ministry provided technical support, information and availed personnel to be part of the planning and execution of the conference. The San Diego Zoo Wildlife Alliance, Save the Elephant, Nature Kenya, Born Free Foundation, Amboseli Trust for Elephants, Space for Giants, the WYSS Academy, the KCB Foundation, Base Titanium, Japan Society for Promotion of Science, Ewaso Lions and the Kenya Wildlife Trust provided financial and moral support.

We highly appreciate the presenters and all the participants of diverse nationalities who committed their time, resources, and provided data to make the conference a success. Special thanks to the Conference Organizing Committee who spent time and worked tirelessly throughout the planning and execution.

Institutions that supported the conference:

Keynote Addresses

List of Presentations During The WRTI 1st Wildlife Scientific Conference

01 Conservation Science And Practice For Harmonised Policy Engagement

Lucy Waruingi, Executive Director- African Conservation Centre

The speaker observed that conservation science acts as a critical bridge between the natural world and policymaking. It provides the necessary knowledge, analysis, and guidance to inform policies that are not only effective in preserving biodiversity and ecosystems but also harmonized across various stakeholders and regions. The three top barriers often highlighted in the literature as significant constraints on the use of scientific evidence in conservation policy include, 1) that conservation is not a political priority, 2) that there is poor engagement between scientists and decision-makers, and 3) that conservation problems are complex and uncertain. The speaker identified 10 areas in which conservation science can support harmonized policy engagement: Data and Evidence-Based Decision Making, Identifying Priorities, Assessing Impact, Measuring Success, Setting Conservation Goals, Engaging Stakeholders, International Collaboration, Advocacy and Communication, Policy Innovation, and Public Awareness and Support.

02 Infrastructure & Conservation: The Nexus For Policy Development

Benson Okita-Ouma PhD, MBS, Director Wyss Academy for Nature

The speaker observed that Kenya's Vision 2030 development blueprint and the UN's 2030 SDGs place equal weight on development and environment. In practice, though, we continue to see infrastructure development suffocating nature in many places. The infrastructure-environment nexus addresses the challenge of meeting the demand for infrastructure services while maintaining or improving the quality of the environment. Infrastructure is a double-edged sword, associated with income gains and also often with environmental costs that are to a large extent, avoidable. There are several ways to reduce the costs and increase the environmental benefits of infrastructure projects, at both the project and national/sectoral levels, e.g., effectively designing and implementing projects that incorporate environmental, conservation or both considerations.

03 Ecosystem Monitoring With Community Engagement, 1967-2023

David Western and Victor Mose, Amboseli Conservation Program

The speakers observed that long term monitoring is important for sustainable biodiversity conservation. Changes in patterns of disturbance and interaction have led to important changes to the structure of the plant and herbivore communities and to homogenization and polarization of the ecosystem and an increase in vulnerability. The researchers identified the main causes of ecological decline in one of the closely monitored ecosystems (Amboseli) in Kenya including the following: Dry land farming, Wetland irrigated farming, Sedentarization, Segregation effects of land use, Habitat change, Loss of drought refuges, Loss of rangeland productivity and recovery, Rising drought frequency and intensity, and Poaching

04 Use Of Wildlife Science For Enhanced Biodiversity Conservation And Improved Livelihoods

J. Makanga, Regional Centre for Mapping and Regional Development

The speaker observed that conservation science acts as a critical bridge between the natural world and policymaking. It provides the necessary knowledge, analysis, and guidance to inform policies that are not only effective in preserving biodiversity and ecosystems but also harmonized across various stakeholders and regions. The three top barriers often highlighted in the literature as significant constraints on the use of scientific evidence in conservation policy include, 1) that conservation is not a political priority, 2) that there is poor engagement between scientists and decision-makers, and 3) that conservation problems are complex and uncertain. The speaker identified 10 areas in which conservation science can support harmonized policy engagement: Data and Evidence-Based Decision Making, Identifying Priorities, Assessing Impact, Measuring Success, Setting Conservation Goals, Engaging Stakeholders, International Collaboration, Advocacy and Communication, Policy Innovation, and Public Awareness and Support.

05 Regulation Of Wildlife Research In Kenya

Prof. Walter Oyawa, Director General, National Commission for Science, Technology and Innovation (NACOSTI)

The speaker observed that the constitution emphasizes the importance of science and technology in the knowledge based economic development of the country. The constitution further emphasizes the recognition of the indigenous inventions and technologies. Article 40(5) requires the state to support, promote and protect intellectual property. NACOSTI is anchored under the Science, Technology and Innovation (STI) Act 2013 which regulates Research system in the Country. Visions 2030 recognizes the key roles played by Science, Technology and Innovation (STI) in wealth creation and building human capital required for the transition to a knowledge driven economy. The government medium term plan (MTP) II proposed to intensify the application of STI to raise productivity and efficiency levels across the three pillars of national development. In KENYA, Science, Technology and Innovation (Research.) System comprises of i) Business and Industrial System- large companies ii) Education and Research System- professional education training iii) Political, Governance and Regulatory System.

He further emphasised that the Science, Technology, and Innovation Sector is regulated through the STI Act 2013 (Rev. 2014), which was enacted for three purposes; i) to facilitate the promotion, coordination and regulation of the progress of science, technology and innovation in the country; ii) to assign priority to the development of science, technology and innovation; iii) to entrench science, technology and innovation into the national production system and for connected purposes. The three (3) core agencies in the STI system in Kenya are i) The National Commission for Science, Technology and Innovation (NACOSTI), ii) the Kenya National Innovation Agency (KENIA) and iii) the National Research Fund. He stated that as a requirement to undertake research, any person undertaking or intending to undertake research in science and technology in the country, or who accesses, handles, or transfers any material or technology or moves it within, from or into the country, shall apply to the Commission for the grant of a licence in accordance with this Act. On offences, Any person who accesses, handles, transacts, transfers or moves any specified technology or any material necessary for scientific research within, into or from Kenya without a license issued under this Act; or contravenes the provisions of section 12, commits an offence and shall, in addition to any other penalty which may be provided for in the ST&I Act or any other written law, be liable on conviction to a fine not exceeding five million shillings or to imprisonment for a term not exceeding four years, or both.

In conclusions he observed that Covid 19 pandemic has reaffirmed the vital role of Science, Technology and Innovation as a Global Public Good, as well as in evolving solutions to mitigate the virus while at the same time cushioning the impact on households. Research regulation is therefore key to the advancement of national security, public safety, and inclusive sustainable development.

Sub-themes

01

Changes in Wildlife Population Trends and Dynamics

1.1 Keynote Speaker

Prof. Joseph O. Ogutu; Biostatistics, University of Hohenheim, Stuttgart, Germany

The speaker noted that prior to 1885, wildlife in Kenya was abundant and widely distributed. However, since then, populations have declined due to several factors including human population growth and settlements, habitat fragmentation and loss, livestock population growth and expansion, climate change and increasing variability, privatisation of land tenure, along with policy, governance, institutional, and market failures. Significant drivers of extreme wildlife declines and range contraction in Kenya before the 1977 hunting ban were licensed shooting by hunters, excessive shooting of problematic wildlife during control operations, and the elimination of species labelled as vermin (such as wild dogs, hyenas, jackals, and wild pigs) through shooting, poisoning, or trapping. Live capture and export also contributed to this decline. After the hunting ban was implemented, wildlife continued to decline for various reasons. These include land use and tenure policies promoting individualization of land tenure and land subdivision, expansion of human and livestock populations, habitat destruction and loss due to uncontrolled land use developments, poaching, the absence of a dedicated state institution for managing and conserving wildlife outside protected areas, and limited funding for wildlife and ecosystem conservation and management. The speaker further noted the following: Kenya is witnessing a dramatic human population surge (780%) from 5.4 million in 1948 to 47.5 million in 2019 and projected to reach 157 million by 2100 and faces a pivotal and pressing challenge: how to balance this growth with wildlife conservation. The rapid expansion of settlements and infrastructure, particularly in the 12% of the country with high agricultural potential and the 5% with medium potential, intensifies this challenge. The rest of the land, largely semi-arid or arid and situated in the rain shadow of the Ethiopian highlands, offers limited options for agriculture, pushing the population expansion into wildlife habitats. Concurrently, policy, governance, institutional, and market failures contribute significantly to Kenya's wildlife decline, estimated at 68% between 1977 and 2016. Like other African countries, Kenya is transitioning from an "empty world" to a "full world" scenario, where the existing wildlife management institutions and policies, largely shaped by colonial influences and inherited by post-colonial regimes, are proving inadequate. These centralized control and command, or open access regimes, favouring elites, exacerbate the tragedy of the commons, leading to a common tragedy. This is evident in the replacement of collectively managed wildlife by individually owned, hardy livestock species, which are unregulated and replace less hardy species. Furthermore, wildlife generates insufficient economic benefits outside parks and reserves and even within, most revenues are captured by elites, thereby undermining conservation incentives for local communities. Current conservancies in Kenya, while a step forward, fall short in terms of scale, long-term land tenure security, and financial sustainability, as highlighted by the devastating impacts of the Covid-19 pandemic. To address these multifaceted challenges, there is a pressing need to reform Kenya's wildlife ownership systems. These reforms should aim to maximize the value of wildlife to landholders and communities, eliminate arbitrary restrictions, policy vacillations and crippling bureaucratic hurdles, and ensure that the benefits of wildlife conservation are equitably distributed and reinvested in the communities that coexist with wildlife and in wildlife conservation and management. This calls for significant investment in wildlife research, training and monitoring and the evolution of institutions capable of managing wildlife, in human-dominated landscapes, in a "full world" context, thus aligning wildlife conservation and management efforts with the realities of rapid human population growth, expanding settlements and other land use developments in Kenya.

1.2 Presentations

1.2.1 Conservation Gains, Losses and the Future of Tana River Red Colobus and Tana River Mangabeys in the lower Tana River in Kenya: Analysis of Four Decades Population Trends.

[1]Kivai SM, [2]Mohammed O, [1]Peter FN, [1]Kabasa PM, [2]Abae R, [4]Gacheru P, [1]Otoli P, [3]Churo A, [1]Kivasu CM

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Abstract

The Tana River Red colobus (*Pilicolobus rufomitratus*) and the Tana River mangabey (*Cercocebus galeritus*) have prominently featured among the Top 25 World most endangered primates. The species are currently listed as critically endangered by the IUCN and nationally are captured in schedule six of the Kenya Wildlife Conservation and Management Act 2013. These monkeys continue to face imminent risk of extinction as a result of unprecedented degradation, fragmentation and loss of their habitats. Since the start of active conservation and protection of the species in early 1980, little progress has been made in their population recovery, but instead the numbers have continued to decline. Here we focused on data from recent and past census surveys, completed and ongoing conservation initiatives to analyze the population trends, conservation efforts, challenges, lessons learnt over the last four decades and draw appropriate recommendations to inform the future conservation efforts of species. Our findings suggest that both the Tana River red colobus and the Tana River mangabey population has declined by over 50% since 1980 and the effective reproductive population size is less than 1000 individuals. Over 70% of their primary habitat has been lost. Local community conservation politics and negative attitudes towards conservation have impeded conservation efforts for close to three decades. Increased conservation awareness and outreach in the last one decade have yielded positive results and local communities are now pro-conservation, which has resulted in the creation of local community conservancies enhancing the protection and conservation of the two primates. Community education, research focused on addressing the primary threats facing the two monkey species, development and implementation of the species' national action plans and coordinated partnership among conservation stakeholders in the lower Tana River remain critical for the future survival of these two endemic and critically endangered primates.

Keywords: Conservation, Mangabey, Population trends, Tana River, Red colobus,

1.2.2 Development of a Science-Based Integrated Metapopulation Management Plan for the Kenyan Black Rhinoceros *(Diceros bicornis michaeli)*

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Abstract

The conservation of threatened species in the face of increasing human population pressure and habitat fragmentation, necessitates active metapopulation management. Translocations play a crucial role in enhancing gene flow among populations. In the eastern subspecies of the black rhinoceros (*Diceros bicornis michaeli*) in Kenya, translocations are vital for maintaining population growth, genetic diversity, and offsetting the effects of small population size. However, the success rates of translocations and their impact on reproductive output and physiological well-being remain unclear.

This study aims to develop a science-based metapopulation plan to promote growth and recovery of the Black rhinoceros. The research evaluates factors mediating translocation success, including mortality rates, reproductive rates, and physiological measures in source and recipient populations. It further investigates the impact of stress and distress on translocated individuals by examining multiple biomarkers from different physiological systems. The research utilizes existing rhino monitoring data in Kenya to analyze the relationship between translocation outcomes and various covariates across the black rhinoceros metapopulation. The study also explores the relationship between population density, ecological carrying capacity, and reproductive performance. By addressing factors such as stress, genetic restoration, and reproductive potential, the study will provide evidence-based guidelines for translocation practices, optimal population growth rates, and the maintenance of genetic diversity for the Kenyan black rhinoceros and other threatened species.

Keywords: Black rhinoceros, reproduction, stress, translocation

1.2.3 A long-term study: Lion trends and dynamics in northern Kenya

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Abstract

Lion, *Panthera leo*, numbers have declined by approximately 43% over the past 20 years across Africa. In Kenya, there are ~2,489 lions in both protected and unprotected areas. Habitat loss and conflict with humans have largely contributed to their decline. Anthropogenic factors have an impact on the demography of lion populations, whether they exist inside or outside protected areas. If suitable habitat does not exist within the human-occupied landscape, then there would be reduced immigration of new males, longer pride tenures within protected areas and the potential risk of inbreeding. Conflict mitigation measures and community-led programmes are important in reducing human-lion conflict and promoting coexistence. The demography of the lion population in the Samburu-Isiolo ecosystem has been studied since 2002 to provide data on the area's basic lion population structure. Due to the small size of the protected areas within the study area, it was expected that lions would frequently move outside the reserves into the surrounding human-occupied landscapes and, therefore, their ranging behaviour was also assessed through the use of collars and direct sightings. Conflict is recorded when it occurs to learn about hotspots and trends. This study provides the first population insights into lions within the Samburu-Isiolo ecosystem; considering both the protected areas and the surrounding human-occupied landscape. Results show an increasing lion population, with increased tolerance amongst communities. Key habitats for lions were identified through the landscape. Knowledge of the demographic status of lions is essential in understanding how populations change, especially within the anthropogenic landscape, as exposure to anthropogenic threats, especially human caused mortality on boundaries of protected areas can lead to changes in lion demography. It is important to understand how lion population demography may respond to human caused mortality especially in small protected areas, and how community tolerance can affect their trends and dynamics.

Keywords: conflict, lion, population, Samburu, trend

1.2.4 Africa's wilderness under threat – the case of wild dogs *(Lycaon Pictus)* in Kenya's Kajiado County

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Abstract

Africa's wildlife species have been subjected to high level threats affecting their numbers. Poaching, climate change, habitat loss and degradation are some of the threats that have negatively impacted Africa's iconic wild species like elephants (*Loxodonta*), rhinos (*Rhinocerotidae*), lions (*Panthera leo*), cheetahs (*Acinonyx jubatus*) and wild dogs (*Lycaon pictus*). This study focuses on African wild dog, the threats to it and interaction with humans and livestock in the non-protected areas of Kajiado County. The research was conducted in Keekonyokie ward of Kajiado west constituency where there have been numerous sightings of wild dogs. A sample size of 30 respondents was selected from four areas of the expansive Keekonyokie ward comprising Leshuta, Loodariak, Oltepesi and Ilmasin. Questionnaires were administered to the respondents and the results analyzed using the SPSS software. The findings revealed that there were significant numbers of wild dogs based on numerous sightings and pack sizes. The study also revealed that not all respondents were aware of the African wild dog's 'Endangered' status and 76.7% were not in favor of conserving the species due to frequent attacks on their livestock. The study recommends awareness campaigns highlighting the role of the species in maintaining ecosystem health, tourism and education and conservation measures be undertaken by stakeholders like Kenya Wildlife Service (KWS) and other non-state actors to prevent the decline of wild dogs.

Keywords: Threats, wild dogs, habitats, endangered.

1.2.5 Anthropogenic disturbance induces opposing population trends in spotted hyenas and African lions

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Abstract

Large carnivore populations are declining worldwide due to direct and indirect conflicts with humans. Protected areas are critical for conserving large carnivores, but increasing human-wildlife conflict, tourism, and human population growth near these sanctuaries may have negative effects on the carnivores within sanctuary borders. Our goals were to investigate how anthropogenic disturbance along the edge of the Masai Mara National Reserve, Kenya, influences the demography and space-use of two large carnivore species that engage in intense interspecific competition. Here we document, in one disturbed region of the Reserve, a rapid increase in the population size of one large predator, the spotted hyena (*Crocuta crocuta*), but a striking concurrent decline in numbers of another, the African lion (*Panthera leo*). Anthropogenic disturbances negatively affected lion populations, and decreasing lion numbers appear to have a positive effect on hyena populations, indicated here by an increase in juvenile survivorship. We also saw an increase in the number of livestock consumed by hyenas. Our results suggest human population growth and indirect effects of human activity along Reserve boundaries may be causing a trophic cascade inside the Reserve itself. These results indicate both top-down and bottom-up processes are causing a shift in the carnivore community, and a major disruption of guild structure, inside the boundaries of one of the most spectacular protected areas in Africa.

Keywords: Anthropogenic disturbance, Demography, Hyenas, Lions, Masai Mara

1.2.6 Avian diversity in different forest regimes in and around North Nandi Forest, Kenya

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Abstract

Forest fragmentation and degradation leads to formation of modified habitats whose ability to support existing avifaunal diversity is still largely unknown. The main aim of the study was to assess avian species diversity in four forest regimes on the Eastern side of the North Nandi Forest; indigenous forest, disturbed forest, plantation forest and farmland. Birds were surveyed using point counts, timed species counts; distance line transects and mist nets. Shannon-Weiner diversity index H' for the bird community ranged from 3.060 for plantation forest to 4.053 for the disturbed forest. Bird species richness was significantly different in the four forest regimes surveyed (x^2=26.747, df=3, P<0.0001). There was also a significant difference in bird abundance across the four study areas (F=15.141, df=3, 1121, P<0.0001). PCA analysis revealed that two variables; diameter at breast height and ground cover, with eigenvalues >1 were strongly correlated with habitat structure in all the four areas and explained 73.2% of the total variance. Linear regression analysis revealed a significant difference between bird species richness and tree diameter at breast height (F=99.760 r^2=0.73, df=1, 1268, P<0.0001) and tree height (F=97.134 r^2=0.71, df=1, 1268, P<0.0001). Bird abundance also revealed a significant difference with diameter at breast height (F=77.654 r^2=0.58, df=1, 1268, P<0.0001) and tree height (F=68.163 r^2=0.51, df=1, 1268, P<0.0001). Overall, the results indicate that disturbed forest and indigenous forest support a high bird species richness than plantation forest and farmlands. However, high bird abundance was observed in farmlands and plantation forest as opposed to indigenous forest and disturbed forest as they provide dispersal routes over a short distance and are important for creating corridors between primary forests.

Keywords: Diversity, Richness, Abundance, Forest regimes

1.2.7 Birds in the matrix: the role of agriculture in avian conservation in the Taita Hills, Kenya

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Abstract

Agricultural conversion of tropical forests is a major driver of biodiversity loss. Slowing rates of deforestation is a conservation priority, but it is also useful to consider how species diversity is retained across the agricultural matrix. Here we assess how bird diversity varies in relation to land use in the Taita Hills, Kenya. We used point counts to survey birds along a land-use gradient that included primary forest, secondary vegetation, agroforest, timber plantation and cropland. We found that the agricultural matrix supports an abundant and diverse bird community with high levels of species turnover, but that forest specialists are confined predominantly to primary forest, with the matrix dominated by forest visitors. Ordination analyses showed that representation of forest specialists decreases with distance from the primary forest. With the exception of forest generalists, bird abundance and diversity are the lowest in timber plantations. Contrary to expectation, we found feeding guilds at similar abundances in all the land-use types. We conclude that while the agricultural matrix, and agroforest in particular, makes a strong contribution to observed bird diversity at the landscape scale, intact primary forest is essential for **maintaining this diversity, especially among species of conservation concern.**

Keywords: Birds, diversity, agriculture, forest, gradient

1.2.8 25 Years of Long-Term Elephant Monitoring in Samburu

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Abstract

Where possible, individual based monitoring of wildlife populations can provide detailed information on population ecology, demography and behavior. African elephants can be individually identified and recognized where they are visible from vehicles, making them a good species for individual based monitoring. We identified over 1000 individuals in the Samburu and Buffalo Springs National Reserves in northern Kenya and have been following them for the past 25 years. Here we summarize the population trends we have recorded over that time. About half the population uses the reserves regularly (seen in the reserve at least four months per year), while the other half are more sporadic visitors to the park. Focusing on the regular visitors, we summarize the trends in births, deaths, immigration and emigration over 25 years. This gives us detailed information on years when the population increased and decreased. Overall reproductive driven growth among the best known individuals has led to a near doubling in size over the 25 years of monitoring, despite substantial declines coinciding with the period of high poaching between 2009-2014. The population is currently increasing.

1.2.9 Long-term population and demographic trends among the Amboseli elephants of Kenya

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Norah Njiraini, Field Researcher and Training Coordinator, Amboseli Elephant Research Project

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Abstract

The Amboseli region of Kenya contains a small, well-protected elephant population (*Loxodonta africana*) where life histories based on individual recognition have been tracked since 1972. This population increased gradually from ~600 to over 1800. Using regular resightings of individuals, we have tracked life histories of ~3900 elephants (1936 males, 1971 females). Our ongoing population monitoring uses monthly re-sighting of individuals, with 100% annual re-sightings for females in ~65 families (0-12 sightings per month, median = 3.25), and 87% annual re-sightings for 405 independent adult males (median = 8.8 sightings per year). We present population trends over 50 years, illustrating the effects of droughts (n = 20) where grass growth and food biomass was limited. Droughts are associated with high mortality among the youngest and oldest age classes, suppressed conception probabilities and a reduction in the likelihood of male musth.

Demographic data derived from regular sightings consist of births to known females, with an accuracy of ±1 month for 79.6% of births among 1901 animals alive at the end of 2022; deaths, either observed when carcasses were located, or inferred through the disappearance of a female or calf when the rest of the family was subsequently seen. Carcass identity, age and sex were based on known ear attributes, body size and genitalia. Some males (n = 20) were known to have dispersed from the population after ~15 years of age, and a few known males (n ~30) have been re-sighted after periods of 5 to 8 years away. Typically, these re-sightings occurred when the males were in the sexually active state of musth. The short and long-term consequences of marked population perturbations need to be considered in general population models for elephants that are subject to environmental uncertainty, competition with livestock and other wildlife, or human-induced mortality.

Keywords: Climate change; elephant demography; elephant survivorship; population dynamics

1.2.10 Modelling Distribution of Kirk's Dik-Dik *(Madoqua kirkii)* in the Greater Tsavo Ecosystem

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Abstract

Kirk's Dik-diks are habitat-restricted small antelopes ranging in Eastern and South Western African arid savanna shrub and woodlands. They are monogamous; pair-bonding for life and the male maintains a territory. They are the main prey of Leopards, raptors in Tsavo National Parks and hosts for various ectoparasites (Kinswood *et al*, 1997). Recent bushmeat poaching statistics of several faunal species in the Tsavo Conservation Area indicate modes in Kirk's Dik-dik incidences. Bushmeat poaching often occurs in wildlife protected and dispersal areas. The foregoing facts prompted us to estimate the population size and model the spatial distribution of Kirk's Dik-diks in the Greater Tsavo Ecosystem to inform protection and rehabilitation. Dik-dik and habitat data were collected from Tsavo National Parks and Ranches in 2022 using the Line-transect method. Data sets of temperature, precipitation, slope, land cover, distances of sighting points from predators, zebras, road network, KWS management points, shoats, settlements, river and water points were acquired from secondary sources. Rdistance and Maximum Entropy modeling for environmental predictors were applied to estimate Dik-dik densities and predict Dik-dik spatial distribution, respectively. Dik-dik density was estimated at 3-5 animals/km^2 lower than in 1970s and 1990s (Hofmann, 1973 and Kingswood *et al*, 1996). Taita Taveta Ranches had the highest Dik-dik encounter rate and suitable area, followed by Tsavo West NP and Tsavo East NP. Land cover made the highest (43.2%) contribution to the model prediction; water points made the second highest; followed by precipitation; carnivores and KWS management points. Response figures indicate the species prefers savannah shrublands and woodlands to grassland and forest; <10 km radius from water points, annual precipitation and <20 km from KWS management points. Taita Taveta Ranches, Tsavo West NP Mzima-Murka sectors, Tsavo East National Park Ithumba-Athi sectors and Northern Chyulu Hills NP had high to medium suitability conditions. Very low to low suitability was predicted in South Kitui NR, Galana-Kulalu Ranch, South-Eastern Tsavo East, Chyulu Hills forest and Rombo-Mbirikani-Kuku ranches.

Low encounter rates in Chyulu Hills and Southern Tsavo East attributable to forest and grassland cover which are unfavourable to Kirk's Dik-dik. Low encounter rate in Kulalu is a result of low habitat suitability due to human settlements, mass tree cutting, agriculture, livestock incursions and bushmeat poaching. The vice versa prevails in Taita Taveta Ranches, Tsavo West NP and Tsavo East NP. Our results suggest that enrichment planting of savannah open grassland in Tsavo East NP and degraded forest lands in Cyulu Hills should be informed by best practices. Further, strategic ranger bases should be developed in South Kitui NR and wildlife security patrols intensified in the North Eastern Tsavo East NP Ecosystem. Lastly, remnant Dik-diks should be translocated from the Kulalu ranch section to the protected areas and illegal land acquisition stopped.

1.2.11 Leopard *(Panthera pardus pardus)* density and putative co-occurrence with Spotted Hyaena *(Crocuta crocuta)* in the Maasai Mara Ecosystem, Kenya

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Abstract

The African large predator guild (ALPG) is the last intact large predator guild, and interactions between its members influence ecosystem function. It contains leopard (*Panthera pardus pardus*), lion (*Panthera leo*), cheetah (*Acinonyx jubatus*) and spotted hyaena (*Crocuta crocuta*). Of these, the leopard is the least studied in the Maasai Mara Ecosystem (MME), and one of the least dominant members. We used camera trapping to estimate leopard density and investigate the presence of lion and hyaena as potential predictors of leopard occurrence, controlling for preferred prey relative abundance/richness, and habitat. We deployed 68 camera traps at 34 stations (mean spacing 2.5km) for 63 consecutive days during the wet season in the Mara Triangle area of the MME in 2019. We recorded habitat as open or closed within 25 m of stations, and quantified competitor and preferred prey presence from camera images. We estimated leopard density using closed population spatially explicit capture recapture (SECR) analysis, and predictors of leopard occurrence using generalized linear mixed modelling (GLMM). We recorded 725 leopard images and estimated density at 1.90±0.56 individuals 100 km^{2} $^{-1}$, which is relatively low compared to other areas and only slightly higher than estimates of cheetah (an inferior competitor) in the MME from a previous study. The best model predicting leopard occurrence contained hyaena presence, and showed a positive association, indicating co-occurrence. Hyaenas are numerous in the MME, and commonly klepto-parasitize leopard kills, i.e., hyaenas likely follow leopards. Our preliminary results indicate that hyaena populations may limit leopard populations in the MME. However, low variance prevented modelling of detection when considering covariates of leopard occurrence, and therefore occupancy analysis of a larger dataset is required to confirm findings. Further work should also explicitly test hypotheses relating to the mechanism of hyaena-leopard co-occurrence and replicate the study across the MME, seasonally and annually.

Keywords: camera-trapping; co-occurrence; density; leopard; spotted hyena

1.2.12 Ecological factors influencing large herbivore distribution (LHD) in Ruma National Park of Homa Bay County, Kenya

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Abstract

Understanding ecological factors influencing large grazing herbivores distribution (LHD) in terrestrial ecosystems is a fundamental goal of ecology. Studies have shown that ecological factors variably influence LHD in savannah ecosystems. A study on ecological factors influencing large herbivore distribution (LHD) in Ruma National Park was carried out to reveal distribution patterns to enhance resource planning. It was found out that the mean grass biomass in Ruma National Park varied between 163 g/m^2 and 1940 g/m^2 where the relationship (R^2=0.83, P=0.0001), indicated that 83% of the variation in the LHD was accounted for by grass biomass. Positive association (R^2=0.66, P=0.0001), strongly demonstrated that 66% of the variation in the LHD was explained by Grass Species Richness (GSR) with *Themeda triandra* being the most abundant grass species. The mean monthly rainfall (R^2=0.51, P=0.001) explained 51% of the variation in the LHD. Multiple regression (R^2=0.33, P=0.001) showed that water sources and altitude explained 33% of the variation in the LHD with variation in water sources (t=3.02) being higher than in altitude (t=1.4). High rainfall had low LHD in the Park's plains due to flooding. In conclusion, the main ecological factors that best predict LHD are grass biomass and species richness. Therefore, there is a need to conserve ecological factors such as grass biomass and species richness in the Ruma National Park to safeguard ecological diversity.

Keywords: Biomass, GSR, Altitude, Water sources and Rainfall

1.2.13 Interaction of the African leopards *(Panthera pardus pardus)* and olive baboons *(Papio anubis)* In Laikipia, Kenya.

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Abstract

Studying interactions between leopard (*Panthera pardus pardus*) and baboon (*Papio anubis*) present challenges due to the elusive nature of leopards and the rarity of primate predation events, often occurring at night. To investigate leopard-baboon dynamics, we utilized camera traps, distance sampling, and baboon sleeping site surveys. The study estimated a leopard population density of 11.4 (95% CI 8 – 17) leopards per 100 km^2, with a total population size of 25 (95% CI 17 – 37) leopards. Baboon density was estimated at 3 (95% CI 1.8 – 4.6) individuals per km^2, with a population size of 655 (95% CI 409 – 1049) at Loisaba. Baboons preferred sleeping sites in trees with a mean height of 16.8 ± 3.2 m and 87% overlapping canopy, as well as cliffs with a height of 19.7 ± 4.9 m and 96% ledges. Monitoring baboon sleeping sites using camera traps for 1053 days revealed a relatively low detection probability for leopards (0.04) compared to baboons (0.46). Although leopards posed predation risk at night, they did not significantly deter baboons from using sleeping sites. However, predation events were localized across different baboon sleeping sites. Regarding spatiotemporal partitioning, leopards were primarily nocturnal (49%), crepuscular (28%), and diurnal (23%), while baboons were mainly diurnal (84%) and crepuscular (16%). Leopards showed low temporal overlap (Δ=0.32 (0.26-0.37)) with baboons but had a 55% spatial overlap. The research provides insights into the elusive activity patterns of leopards, particularly their peak hours, aiding future studies in the greater Laikipia conservation area. Additionally, estimating leopard population density contributes to Kenya's national goal of understanding leopard populations better. In conclusion, despite challenges posed by the secretive nature of leopards and infrequent primate predation events, our study enhances understanding of predator-prey dynamics, offering valuable contributions to wildlife conservation efforts in the region.

Keywords: Leopards; Baboons; Camera traps; Predation; Conservation

1.2.14 Dynamics of herbivore distribution and habitat selection in the greater Serengeti Ecosystem, Tanzania

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Abstract

Understanding the spatio-temporal distribution and habitat selection of herbivores is an important goal of their ecology and management in protected landscapes. This study was therefore conducted in the Greater Serengeti Ecosystem, in Northern Tanzania

to determine the dynamics of the distribution and habitat selection of seven medium to large herbivore species (impala *Aepycerus melampus*, Grant's gazelle *Nanger granti* wildebeest *Connochaetes taurinus mearnsi*, zebra *Equus quagga*, buffalo *Syncerus caffer*, giraffe *Giraffa camelopardalus*, and elephant *Loxodonta africana*). Aerial survey data on herbivores and remote-sensing-based habitat quality maps covering two study periods (1995 and 2015) were used to assess habitat selection and use. Herbivores were aggregated according to their feeding guilds: browsers (Grant's gazelles and giraffe), grazers (wildebeest, zebra and buffalo), and mixed feeders (impala and elephant), and habitats characterized into low, medium, and high quality classes, derived from habitat quality maps generated from an Integrated Valuation of Environmental Services and Tradeoffs (InVEST) model. We utilized kernel density to map species distribution range. Bonferroni confidence interval and Chi-square goodness-of-fit test were used to assess habitat selection and use. We observed a significantly clustered distribution pattern for all the herbivores at the ecosystem level across space and time. We recorded high mean species observations in the Serengeti National Park (NP), followed by Game Reserves (GRs) and least in Wildlife Management Areas (WMAs). The herbivore mean sightings were higher for 2015 than for 1995. Herbivore distribution ranges contracted for browsers and expanded for grazers and mixed feeders in 2015 compared to 1995. Our results suggest that herbivores significantly avoided low-quality habitats but favored high-quality habitats across space and time. Information on species' distribution, habitat selection and use are useful in determining high priority areas for effective conservation. We suggest continuing protection efforts and reducing habitat degradation in the ecosystem.

Keywords: Protected area categories, ecosystem, habitat quality, InVEST model, Census data, spatio-temporal distribution, herbivores, Greater Serengeti Ecosystem

1.2.15 A general age- and sex-structured model of wildlife population dynamics illustrated by the Mara-Serengeti Topi population

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Abstract

Biodiversity of large wild mammals is declining at alarming rates worldwide. It is therefore imperative to develop effective population conservation and recovery strategies. Population dynamics models can provide insights into processes driving declines of particular populations of a species and their relative importance. But there are insufficient tools, namely population dynamics models for these herbivores, for characterizing their decline and for guiding conservation and management actions. Therefore, we have developed a model which can serve as a tool to fill that void. Specifically, we develop an integrated Bayesian state-space population dynamics model for wildlife populations and illustrate it using a topi population inhabiting the Masai Mara Ecosystem in Kenya. The model integrates ground demographic survey with aerial survey monitoring data. It incorporates population age- and sex-structure and life-history traits and strategies and relates birth rates, age-specific survival rates and sex ratios with meteorological covariates, prior population density, environmental seasonality and predation risk. It runs on a monthly time step, enabling accurate characterization of reproductive seasonality, phenology, synchrony and prolificacy of births, juvenile and adult recruitments. Model performance is evaluated using balanced bootstrap sampling and by comparing model predictions with empirical aerial population size estimates. The hierarchical Bayesian model is implemented using MCMC methods for parameter estimation, prediction and inference and reproduces several well-known features of the Mara topi population, including striking and persistent population decline, seasonality of births, juvenile and adult recruitments. It is general and can be readily adapted for other wildlife species and extended to incorporate several additional useful features.

1.2.16 Distribution and abundance of migrant birds and endangered mammals within Naivasha Wildlife Sanctuary, Kenya

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Abstract

The survey was carried out in Naivasha Wildlife Sanctuary located at S0.7754°, E36.3715° which comprised the game farm, sanctuary and annex covering a total area of 1,550 hectares. Survey blocks were delineated based on vegetation types and habitats. Birds were sampled using the time-species count method whereas capture-mark-release method was employed to study small mammals using sherman and tomahawk traps. Large mammals were sampled using direct and indirect sightings along transects. A total of 324 birds of different species were recorded out of which 6 were migrant species thus justifying the area as an Important Bird Area providing roosting grounds for both afro-tropical and Palearctic migrant birds. They include African Paradise Flycatcher (*Terpsiphone viridis*, AM), Barn Swallow *(Hirundo rustica*, PM), Black Kite (*Milvus migrans*, AM, PM), Common Swift (*Apus apus*), PM, Red-chested Cuckoo (*Cuculus solitaries*, AM), White Stork (*Ciconia ciconia*, PM). The study also recorded 3 endemic species including Rufous-naped Lark (*Mirafra Africana*), Speckled Mousebird (*Colius striatus*) and Yellow-breasted Apalis (*Apalis flavida*). Two birds of prey, Black Kite and Augur Buzzard, were recorded but with low relative abundance.

Maasai Giraffe (*Giraffa tippelskirchi*) and spotted hyena (*Crocuta crocuta*) were recorded as large endangered mammal species. A total of 7 species of small mammals were sampled that included *Lemniscomys striatus, Thallomys loringi, Graphiurus murinus, Mus rattus, Praomys spp* and *Mastomys spp* and the *Ictonyx striatus* (African polecat). There were also direct and indirect sightings of Dikdik *Madoqua spp.*, Scrub hare *Lepus saxatilis*, Rock hyrax *Procavia capensis* and mongoose burrows. The study area has a rich diversity of birds and mammals despite being relatively disturbed and is comparable with other ecosystems that are relatively intact. There is therefore a need to ensure effective conservation measures within the sanctuary aimed at maintaining natural ecosystems with minimal disturbance.

Keywords: Afrotropical Migrants, Capture Mark Release and Palearctic Migrants.

1.2.17 Past outcomes and future directions for African elephant translocations

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Abstract

Conservation translocations are a common management practice across species, accounting for numerous successes across diverse taxa. For the African savannah elephant (*Loxodonta africana*), translocations are undertaken to repopulate parks, reduce populations, address human-wildlife conflict, and release rehabilitated individuals. Elephant translocations are a costly and risky undertaking, requiring skilled teams, available release sites, and sufficient funding to carry out. Translocations require animals dependent on existing social bonds and landscape knowledge to start afresh, which may compromise their ability to adapt in a new environment. Where animals engaged in conflict are the targets of translocation, there is also risk for involved human communities, and the potential to 'shift' the problem elsewhere. Given the cost of elephant translocations to management agencies, communities, and elephants, it is critical to understand the efficacy of this approach for this endangered and keystone species. Here, we present a review of the peer-reviewed and grey literature to assess the state of knowledge on African elephant translocations. We aimed to determine what is known and what isn't regarding the success of this practice. Our search produced 49 relevant sources, which we scanned for translocation context, location, method and duration of post-release monitoring, type of investigation, and known outcomes. We summarize trends in the literature, distil findings into a set of recommendations for management, and identify research directions that would support translocation decision-making.

Keywords: Human-elephant conflict, reintroduction, population restocking, post-release monitoring, release success

1.2.18 Pathways to human-giraffe conflict and co-existence in Eastern Kenya

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Abstract

Giraffe populations are declining significantly across much of Africa due to habitat loss, poaching, civil strife, and human-giraffe conflict. Notwithstanding these factors, while giraffes play an important ecosystem role in the African savanna and the socio-economic well-being of African communities, less attention has been paid to human dimensions of giraffe conservation. To help fill this gap, we collected information on human-giraffe conflict (HGC) in eastern Kenya. We explored general attitudes, risk perceptions, and the drivers of giraffe sightings. We used a quantitative questionnaire as an interview script to conduct face-to-face interviews with n = 400 respondents in Garissa County, primarily around the Bour Algy Giraffe Sanctuary. On average, respondents generally possessed positive attitudes towards giraffe and, on average, respondents did not see giraffes as a risk: to personal or children's safety, of disease transfer, to cattle productivity, or the integrity of the land. Risk perception even decreased if a respondent had encountered a giraffe. Interestingly, giraffes were perceived not to cause damage to land or other property by 59% of participants thus highlighting that it may be possible to promote co-existence in the region. Further, competition for water, lack of awareness on the plight of giraffes, habitat encroachment and poverty were raised as the four main conflict drivers. Respondents supported the use of fire, torches, and having dogs as a way to deter giraffes. Because of the proximity of giraffes to farms and homesteads, economic activities such as agriculture and cultural tourism, women-led acacia trees nursery enterprises, invasive prosopis control and utilization along with opening up water corridors may motivate communities and minimize HGC. This work provides a basis for action by the community and policy makers to promote giraffe-farmer co-existence in eastern Kenya.

1.2.19 Status, conservation threats and restoration of the Tarangire-Manyara (Kwakuchinja) wildlife corridor in Tanzania

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Abstract

The Tarangire-Manyara (Kwakuchinja) wildlife corridor is an important habitat for facilitating wildlife movement between Tarangire and Manyara National Parks in Tanzania. However, the corridor is facing a number of socio-economic, ecological and environmental issues. This study was conducted to determine the status and viability of the corridor. A combination of data collection methods namely Focus Group Discussions, participatory mapping, camera traps, elephant collaring and ground transects were used to collect information. Results indicated that a total of 32 wildlife species were recorded in the Kwakuchinja wildlife corridor using both direct and indirect methods. The most frequently recorded wildlife species were elephant (42.9%), giraffe (19%) and zebra (10.2%). Of the species recorded, four are categorized in the IUCN Red List of threatened species, namely the African buffalo (Near Threatened); Elephant, Giraffe and Lion (Vulnerable). Movement data of 13 collared elephants showed that the corridor is still viable for habitat connectivity. Participatory assessment and boundary verification of the corridor indicated that the area currently being used for wildlife movement has been reduced to 274.45 km^2 (maximum width of 4.2 km and a length of 188.14 km). Land use-land cover map of the corridor showed that

agriculture, bare land, and shrubland are increasing while woodland, grassland and water are decreasing. Ground truthing indicated that the corridor is threatened by increased human activities especially agriculture, human settlement and livestock grazing. It was concluded that Kwakuchinja wildlife corridor is still viable though highly vulnerable; therefore, efforts are required to restore, demarcate and protect the corridor to sustain connectivity of the two National parks.

Keywords: corridor, Kwakuchinja, Tarangire-Manyara, viability assessment

1.2.20 The extent and impacts of invasive species on wildlife habitat productivity: A case of Lake Nakuru National Park, Kenya.

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Abstract

Invasive species affect biodiversity uniqueness by changing their ecological structure and functioning, reduce habitats, species diversity and richness. They are characterized by special adaptations to persist, mature and spread. The Lake Nakuru National Park (LNNP) is a closed ecosystem, a Ramsar site and globally known for flamingoes. The park has high densities of herbivores including the Cape buffalo (*Syncerus caffer*), Rothschild's giraffe (*Giraffa camelopardalis*), Burchell's zebra (*Equus quagga burchelli*), Black rhino (*Diceros bicornis*) and White rhino (*Ceratotherium simum*) that depend on vegetation largely comprising of grasslands, closed shrublands and acacia forests. The park has been colonized by invasive species such as *Solanum incanum, Ocimum suave, Sida schimperiana, Lippia javanica, Urtica massaica, Achyranthes aspera, Lantana trifolia and Tarchonanthus camphoratus*. As a result, the quality and quantity of grasslands sustaining the high herbivore population have been greatly impacted and the impact exacerbated by perennial and prolonged droughts. The Park has, as a result, regularly been affected by wildlife diseases which can be addressed if wildlife food quality and quantity are improved.

This study uses remote sensing techniques to provide critical information on invasive species to park managers by identifying and mapping the extent of invasive species in the park. Thus, a rapid assessment of the invasive species was carried out for 5 days at a minimum mapping unit of 10 x10 m to conform to Sentinel 2 imagery spatial resolution. A total of 51 training points of invasive species and 9 control points (other vegetation) were taken. Initial analysis detected seven invasive species including *Solanum incanum, Tarchonanthus camphoratus, Senna didymobotrya, Ocimum suave, Hypoestes forskaolii, Achyranthes aspera* and *Urtica massaica*. Six invasive species except (*Tarchonanthus spp)* are extensively established within the previously grassland-dominated areas predominantly inhabited by large grazers such as buffalo and zebra. Several maps were produced showing the extent of the invasive species in the park.

Keywords: Invasive Species, Lake Nakuru, Remote Sensing

1.2.21 The impact of cattle foraging on habitat by Kenyan plains zebras *(Equus quagga)* and Grevy's zebras *(E. grevyi)*.

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Abstract

Grazing by cattle can dramatically impact landscapes by reducing biomass. Yet as long as the soil remains moist, cattle grazing can also often stimulate new growth of nutritious and digestible vegetation. How wildlife, especially the two zebra species (*Equus quagga* and *Equus grevyi*) that inhabit the semi-arid regions of Kenya, choose where to forage on a grassland mosaic of grazed and abandoned swards, is poorly understood. By driving fixed loops bisecting varying sward types, we recorded where cattle and zebras grazed and vegetation characteristics of the swards. Overall, the two species of zebras responded to active and abandoned grazing sites very differently. Initially over 90% of the zebras used the area where cattle had ceased grazing with plains zebras grazing on the apex where vegetation was taller than along the hillslopes where both hippos and Grevy's zebras grazed. Once the cattle moved into the experimental area, Grevy's zebras associated closely with tightly bunched cattle herds where the grass remained short and green. Plains zebras, however, mostly remained on the abandoned grazing areas where biomass was accumulating. Although some moved to the experimental area, they only remained on the edge of a pastoralist herd that moved quickly and ranged widely, thus leaving the vegetation and not significantly different from the recovering swards in the abandoned cattle grazing areas. Zebras clearly adjust their habitat choices depending on the quantity and quality of a landscape. But their sensitivities and needs vary. That the endangered Grevy's zebra seeks out grazing lawns, suggests that sharing landscapes intensively grazed by livestock may not be the major problem limiting their recovery that conventional wisdom suggests.

Keywords: Cattle, Grazing, Grevy's zebras, Plains zebras,

1.2.22 The influence of elephants foraging on tree species regeneration and abundance in Arabuko-Sokoke forest, Kenya

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Abstract

Elephants play a significant role in structuring forest and savannah ecosystems. They influence plant regeneration patterns through their role in seed dispersal and germination and increasing habitat heterogeneity. Most research on the influence of elephants on tree regeneration patterns have focused on savannah habitats and lowland to mid altitude forests. This study investigated the role played by elephants in the regeneration and abundance of coastal forests' tree species, specifically, the influence of elephant foraging activities on seed predation, germination rates and seedling growth rates with a focus on *Balanites maughamii* and *Manilkara sulcata*. It also examined the density and distribution of these tree species along elephant trails and non-elephant forest trails. The results from seed predation experiments revealed a higher predation rate (25%) near parent trees compared to 15% away from parent trees as predicted by the Janzen-Connell hypothesis. The seed germination experiment showed that seeds that passed through the gut had higher germination success of 74% and lower germination latency of 47 days as compared to a germination success of 11% and germination latency of 96 days for seeds that did not go through the elephant gut. There was no notable difference in seedling germination rates and latency between seeds that went through the elephant gut and planted in elephant dung as manure and those seeds that were planted without elephants' dung, suggesting limited effect of manure. The growth rate of *Balanites* seedlings from seeds planted with elephant dung manure had a growth rate of 0.33 cm per day compared to 0.42 cm per day for the control but this difference was not statistically significant. Results also revealed a higher density of elephant dispersed trees along elephant trails compared to random trails. Results revealed that elephant foraging behavior had a positive influence on tree species regeneration in the Arabuko-Sokoke Forest.

Keywords: Elephants- *Loxodonta Africana*, Torch wood *(Balanites maughamii)*, Dubard *(Manilkara sulcata)*

1.2.23 The role of environmental, structural and anthropogenic variables on underpass use by African savanna elephants *(Loxodonta africana)* in the Tsavo Conservation Area

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Abstract

Species moving over long distances, such as the African savannah elephant (*Loxodonta africana*), are especially vulnerable to habitat loss and fragmentation. This is particularly true in the Kidepo Valley region of northern Uganda - bordering South Sudan and Kenya. This remote and rarely surveyed region is home to a small population of elephants, which is thought to be increasingly isolated due to expanding human activities. However, how far this population roams is unclear - with some literature and folklore suggesting the existence of ancient corridors among the three countries. In order to preserve landscape-scale connectivity with other protected and unprotected areas, it is thus crucial to understand the extent and drivers of the Kidepo elephant movements. To this end, eleven Kidepo elephants were collared and tracked at hourly intervals for a year, allowing us to investigate movement patterns and home range sizes. Surprisingly, we found that connectivity indeed still exists among all three countries, and that the home ranges of these elephants far exceed estimates from historical records. Moreover, movement analyses also indicated that several individuals from our sample size preferred spending time outside formally protected areas - in rangelands typically occupied by rural communities. Our findings will be essential for conservation planning and policy-making in the region, especially with regards to securing connectivity across transfrontier conservation areas, and to manage human-elephant conflict on community land.

Keywords: home range, population range, transboundary movement, African savannah elephants, Kidepo Valley

1.2.24 Understanding the foraging behavior and dispersal patterns of red Colobus monkey (*Piliocolobus rufomitratus*, Peters 1879) populations in natural and agro-ecosystems forests in Tana River Primate National Reserve, Tana River County, Kenya

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Abstract

Faced with habitat loss and forest fragmentation challenges, the Tana River Red Colobus (*Piliocolobus rufomitratus*), is at the verge of extinction. The Tana Red Colobus occupies 34 out of the 77 riverine forest patches of the Lower Tana River, within a stretch of about 60 km^2 of the Tana River Primate National Reserve (TRPNR). The reserve was established in 1976 for the conservation of the IUCN Red listed and second most threatened colobine in Africa. For years conservation and restoration efforts were implemented in favour of the species populations in the protected natural habitats, with complete ignorance of a decade of information on the species populations in the non-protected agroecosystems situated in the North and South of the TRPNR. This study attempts to evaluate the implications of the ignored agroecosystems by assessing possible incentives for the species co-existence with human populations; the range limits for red colobus to colonize distant forest patches, and understand the foraging behavior and strategies of the Tana River red colobus . The findings of the study indicate possible shifts in foraging behavior of the species, with implications for the possibility of range and habitat expansion. This may also suggest critical management strategies to limit and eliminate potential human wildlife conflict scenarios.

Keywords: Red Colobus (*Piliocolobus rufomitratus*), Tana River Primate National Reserve, Agroecosystems, Habitat loss, Forest fragmentation

1.2.25 Young male elephants – dispersal and exploration in Amboseli

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Abstract

Young male elephants undertake both social and locational dispersal when transitioning from their natal family into independent adult life. Most research on male ranging focuses on males already in adulthood, where strategies centre on growth, competition, and reproductive opportunities, or on pressures at the human-elephant interface such as crop foraging or fence breaking. However, the shift from family to adult strategy is a prolonged process, and the social and ecological choices made during this phase open up new ranging areas and provide bridges between populations. In Amboseli we have documented independence for 611 males born in Amboseli families since the start of the study in 1972. These males have exhibited a variety of dispersal behaviours. We collared 8 males to study ranging during this critical and

high-risk life-history phase. Here we present three years of data on young male ranging strategies; link this to the knowledge we have from our long-term monitoring; and show the extensive connectivity that remains around Amboseli, including the first documented elephant movement from Amboseli to Maasai Mara. We discuss our results in the light of habitat transformation and conservation challenges, and how these young males likely influence the human-elephant interface.

1.2.26 Population distribution and abundance of the common hippopotamus *(Hippopotamus amphibious)* in Lakes Naivasha and Nakuru, Kenya.

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Abstract

The common hippopotamus *Hippopotamus amphibius* is a mega-herbivore which may greatly modify its habitat and cause major conflicts with humans. It is listed by IUCN as vulnerable and in appendix II of CITES. Despite its conservation status, there are few studies focusing on the hippo in many parts of its range. A dry season survey was conducted in December 2022 in Lake Naivasha and adjacent wetlands and Lake Nakuru to establish the population size, spatial distribution and identify key threats to inform management actions. Ground count method using boats and vehicles was used to estimate its population size. Key threats along the transects were documented and their spatial locations recorded using GPS. Overall, 686 individual hippos were counted in Lake Naivasha and 35 in Lake Nakuru. In Lake Naivasha, large hippo populations were observed in Malewa bay, Oloidien and Crescent Island while in Lake Nakuru most hippos were sighted at the Sarova-Murram sections, shoreline, and at Old main gate-Njoro river mouth. The threats observed to their habitats included illegal fishing, riparian habitat destruction and encroachment. A regular hippo monitoring programme and integration with hippo conflict data are recommended to understand the population dynamics to inform the formulation of appropriate conservation strategies. The identified threats and illegal activities need to be addressed. Community sensitization programmes can be enhanced by the relevant management agencies using a multi-agency approach.

Keywords: Community sensitization, habitat, multi-agency approach. population dynamics, threats

1.2.27 Rural socioeconomic trends, and not ecological competition with livestock, as a main driver of wildlife declines in East Africa.

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Abstract

In recent years, extreme wildlife declines have been documented for large parts of Africa, creating big concern among conservationists. While such declines have been linked to livestock outcompeting wild herbivores, the human dimension of the problem has been generally overlooked. Our study analyzes and re-interprets existing data for East Africa, with Kenya as a source of data at the larger scale, and the Ngorongoro Conservations Area in Tanzania at the smaller scale. Our analysis incorporates agronomic methodologies by using biomass and Tropical Livestock Units as the main tool to evaluate herbivore trends, and we feature the emerging social trends which can also explain wildlife declines. We also examine published evidence on potential coexistence between wildlife and local livestock, and the underlying ecological processes. Our findings revealed a stable domestic biomass among domestic herbivores in East Africa in the long term, disproving the claims for increased competition with wildlife. Observed increases in livestock heads are due to a transition from cattle to small ruminants. This trend points to increasing poverty levels among pastoralists as a powerful structuring factor, confirmed by an increased urban ownership of rural livestock. Opportunistic hunting, to avoid encroaching on the herd, is therefore likely to be impacting wildlife numbers. To address this crisis, reducing economic and social pressures by tackling poverty, unemployment, and women's empowerment is vital. Access to formal education could be a crucial tool, as it facilitates incorporation into e.g. ecotourism ventures, and provides valuable benefits to local stakeholders. Specific field studies should be conducted that capture the multidisciplinary factors we describe here. A full integration of human dimensions into ecosystem perspectives would yield more sound and sustainable conservation models.

Keywords: Coexistence, Competition, Decline, East Africa, Human Dimension.

1.2.28 Spatially-explicit future landscape scenarios for population growth of the African elephant *(Loxodonta africana)* in Africa

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Abstract

The distribution and abundance of the African elephant (*Loxodonta africana*) is primarily determined by ecological and anthropogenic factors. Vegetation types and productivity, elevation, temperature, rainfall and water are among the key ecological factors while human population density, the level of human socio-economic development, literacy levels and existing conservation policies are the key anthropogenic factors influencing the occurrence and abundance of elephants. Various Species Distribution Modelling (SDM) approaches have been used for predictive habitat distribution modelling. These approaches have generated valuable scientific information on the overall suitable habitat for the target species. However, the results from SDMs are rather cumbersome for management action. In addition to SDM, here we incorporate a robust approach mimicking dispersal by using the RangeShifter® software, an individual-based spatially explicit and stochastic model that integrates population dynamics with movement behaviour to simulate stochastic and stepwise dispersal. To develop the habitat quality map, we ran a total of 28 explanatory variables both biophysical and anthropogenic, used the Variance Inflation Factor to check for multi-collinearity, then fitted four SDM algorithms i.e. boosted regression trees, generalised additive models, maximum entropy and random forest and finally constructed an ensemble based on the Area Under the Curve (AUC) for the four algorithms. The movement costs map was based on the proportion of land cover under farming, water, bare ground and built up. At the maximum threshold for sensitivity and specificity, the SDM predicted the suitable elephant habitat of 9,908,040.9 km^2. The mechanistic movement model predicted a 54% occupancy of the suitable elephant habitat by the end of the 21 Century. It further predicted a 2.5% annual population growth for the continental elephant population by 2100. Additionally, since we adopted the least cost path for movement, the mechanistic model identifies key dispersal areas and population connectivity routes that can help prioritize management action.

Keywords: African elephant, connectivity, Least Cost Path, RangeShifter, species, distribution modelling

1.2.29 Temporal dynamics in observations of rare antelope endemic to Shimba Hills National Reserve, Kenya

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Abstract

We present results of temporal (two dry - wet season counts), and two-month routine monitoring of sable antelope (*Hippotragus niger roosevelti*) population in Shimba Hills National Reserve. The initiative was in response to challenges involved in sighting the antelope at certain times of the year in the reserve. The shy nature of the antelope impeded our efforts to describe the population during the count. We therefore routinely monitored the population for two months as well. Total count involved vehicles and foot based systematic searching for the antelope by six teams distributed across six blocks established within sable habitats in the reserve in open glades in the morning (0600-1000 hrs) and evening (1600-1830 hrs), when sables are typically active. Routine monitoring is relatively more intensive, permitting collection of substantial data on sex and age structure, herd identity, description and size information on the population. Both routine monitoring and total counts were aided by GPS receivers, binoculars and digital cameras. Seasonal total counts conducted in March 2023, and in November and January 2022 recorded 36, 30 and 18 sables respectively. The two-month routine monitoring recorded 32 and 31 sables in April and March 2022, respectively. Sex ratio analysis from the routine monitoring established a male to female sex ratio of 1:2 for both April and March. Similar analysis was not performed for the total counts due to inadequate population structure data. The female-biased sex ratios indicate a good breeding potential for the polygynous sable antelope population. These findings underscore the need to use different methods to monitor sable populations, including deployment of modern ecological monitoring technologies.

Keywords: seasonal counts, routine monitoring, sable antelope, Shimba Hills national reserve

1.2.30 The social structure and demographic status of lion *(Panthera leo)* population in Meru National Park, Kenya.

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Abstract

Pride of Meru Programme's (POM) overarching aim is to safeguard and protect ecologically viable lion (*Panthera leo)* populations, their prey, and habitat in the Meru Conservation Area, by promoting enhanced coexistence and protection. The key objective is to sustainably conserve lions by determining their current and long-term status, identifying the major threats that could be causing declines in their current population and developing community-led sustainable nature-based solutions to emerging conservation challenges not only for lions and the people, but also for the entire ecosystem. We actively and routinely monitor individual lions, their prides, and other wildlife species. We use opportunistic sightings, track spoors, and use innovative methodologies such as camera traps and GPS enabled collars to obtain real-time location updates and other essential data for effective conservation action. The lion monitoring data has been collected since 2016. This data includes information on the pride composition, age, sex, births, and deaths. From 2021, the data has been collected using survey123 and quick capture. This monitoring has built a detailed database that contains extensive information about the

social structure and demographic status of the lion population in the Meru National Park. The current population is estimated at 93, with 73 individual lions being >1 year and 20 less than one year old. The estimated density of lions older than one year is 10.7 lions per 100 km^2 while the female to male sex ratio is 1.43, with a cub to female ratio of 0.97. The population comprises four prides (Bisanadi, Elsa, Mulika and Virginia). Additionally, there are several groups and coalitions. Through long-term monitoring, we have generated valuable data on the demographics, ecology, and behaviuor of this important felid species which can inform their adaptive management and conservation.

Keywords: *Panthera leo*, Meru Conservation Area, monitoring, social structure, demographic status.

1.2.31 Wildlife and livestock in the Samburu and Buffalo Springs National Reserves: insights from 17 years of monitoring

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Abstract

The ecological integrity and economic viability of the Samburu and Buffalo Springs National Reserves have been negatively affected by decades of insecurity, increasing livestock invasions, and declining tourist numbers. Combined with emerging threats such as loss of landscape connectivity and disruption of seasonal rainfall, this could jeopardize the role of the two reserves as safe havens for endangered species in northern Kenya. Here we used 17 years of road count data to identify how ecological and anthropogenic factors might have interacted to affect the abundance and diversity of large mammals in the two reserves over time. We found that, although some wild herbivores had increased in numbers over the years, others (e.g. buffalo *Syncerus caffer;* waterbuck *Kobus ellipsiprymnus*) had become almost locally extinct, leading to a significant loss in species diversity. Meanwhile, the abundance of livestock inside the reserves had increased to unprecedented levels, triggering behavioural avoidance by some wildlife species (e.g. the African elephant *Loxodonta africana*). We also found that, although several ungulates used the reserves as dry season refuges, three species classified as "endangered" (elephant, reticulated giraffe *Giraffa camelopardalis*, and beisa oryx (*Oryx beisa*) did not - and were reliant on unprotected land to acquire key resources during droughts. This suggests that the role of the reserves as safe havens for wildlife might have been compromised by livestock invasions, with the current protected area design possibly inadequate to effectively safeguard key resources for flagship species. In summary, our findings indicate the Samburu and Buffalo Springs National Reserves are increasingly being affected by human-induced environmental changes, portending a bleak future for protected areas in the arid regions of northern Kenya.

Keywords: Elephants, population trends, protected area management, Samburu, Ungulates

1.2.32 Lion *(Panthera leo)* monitoring and community conservation within the Greater Mara Ecosystem

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Abstract

In 2016, a significant decline in lion populations in East Africa, specifically a 59% decrease between 1993 and 2014, was highlighted by the IUCN Red List of Threatened Species. The Maasai Mara ecosystem in Kenya, known for its strong lion presence and renowned wildlife viewing opportunities, reported a disturbing 54% decline in lion numbers. This alarming trend also raised concerns about the declining cheetah populations. In response, the Kenya Wildlife Trust (KWT), a wildlife trust, established a science-based conservation project aimed at designing and implementing a long-term monitoring program for lions and cheetahs. Recognizing the limitations of previous estimation methods used in the Mara and across Africa, KWT adopted cutting-edge monitoring techniques initially employed for tiger monitoring and has been consistently deploying them annually to address specific conservation questions regarding lions and cheetahs. This talk will provide insights into KWT's experiences and demonstrate how a monitoring program, initially developed almost a decade ago to address key questions, has evolved into the longest-running study on lion and cheetah trends in Kenya, utilizing the Spatially Explicit Capture-Recapture (SECR) methodology. In addition to the predator monitoring program, KWT recognizes the importance of community conservation efforts for the conservation of predators. Engaging and involving local communities in conservation activities is crucial for promoting coexistence and ensuring the long-term survival of lions and cheetahs. KWT has implemented community conservation initiatives aimed at raising awareness, providing education, and creating incentives for local communities to actively participate in predator conservation. These efforts involve collaborating with community leaders, organizing workshops and outreach programs, and supporting livelihood development projects that emphasize sustainable practices. By working hand in hand with communities, KWT aims to foster a sense of ownership and stewardship among the local population, fostering a positive environment for predator conservation and reducing human-wildlife conflicts.

Keywords: Community Conservation, lion monitoring, Masai Mara ecosystem, spatially explicit capture-recapture

02

Initiatives Towards Wildlife Habitat Restoration and Connectivity

2.1 Keynote Speaker

Adopting landscape approach in restoration of Tana River Delta, Kenya
Dr. Paul Matiku & Rudolf Makhanu, Nature Kenya

The speakers observed that almost all the wildlife dispersal areas and migratory corridors in the Kenya rangelands have been interfered with by human activities to an extent that some are highly threatened or have been completely blocked. Biodiversity provides important ecosystem and cultural services for peoples' livelihoods. Low ecosystem services due to advanced degradation may serve as a disincentive for community engagement in restoration. They identified the following as the key drivers of land degradation: poor farming practices, rapid population growth, low household income, charcoal making, overstocking, overgrazing, climate change, insecure land tenure rights, agricultural expansion and weak governance. To be cost effective, restoration efforts should be initiated during the early stages of degradation and research is critical in removing barriers to restoration.

2.2 Presentations

2.2.1 A spatial planning framework for informing integrated biodiversity and ecosystem service conservation and restoration across terrestrial Kenya

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Abstract

Spatial planning that integrates biodiversity conservation with broader land-use planning can benefit biodiversity, ecological processes, human health, wellbeing and the wider society. Systematic conservation planning is a comprehensive, transparent, and repeatable approach for designing ecological networks, finding priority areas to meet conservation targets whilst maintaining connectivity and minimizing cost. We used this approach to identify the best places to locate zones for conservation and restoration in Kenya to meet area-based targets for 36 vegetation types and 127 important species. We also compared the results from 10 scenarios, based on specifying that increasingly large patches of natural habitat should be excluded from the conservation zone and targets met instead by restoring larger patches elsewhere. We then compared the outputs based on their financial cost, land area, patch characteristics, and overlap with human populations and carbon and water services. Kenya's protected areas cover 12% of its land area and meet a third of habitat and species targets. Additional sites were needed to meet representation gaps, requiring conservation attention on 29% and restoration on 6% of Kenya, overlapping with a seventh of total carbon and 80% of total clean water. The scenarios show that the estimated management cost for this ranged from $7.73 to $9.41 billion, with the cost of restoration three orders of magnitude more expensive than conservation. Restoring land to reduce habitat fragmentation, instead of conserving small vegetation patches, increased mean patch size by up to 800% but also increased costs, land area, and the number of affected people. Targeted interventions would meet draft CBD policy commitments for area-based conservation and other restoration commitments. This has unprecedented implications for the 12-13 million people living in these areas. If incentivised and implemented equitably, this is a chance to mainstream biodiversity within these communities for the benefit of both the planet and its people.

Keywords: biodiversity conservation, ecosystem restoration, landscape connectivity, systematic conservation planning.

2.2.2 Infrastructure and wildlife mortality: Current Research and Future Directions

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Abstract

Maintaining the connectivity of ecosystems and wildlife populations is increasingly becoming a global challenge as growth in infrastructure to meet growing human population needs and development transverse traditionally pristine wildlife ecosystems and areas protected for nature conservation. The survival of wildlife species in nature requires interconnected landscapes where animal movement is unhindered as it enhances the genetic and ecological viability of wildlife populations. Major infrastructural developments such as multi-lane highways and railways can sever wildlife movement often with negative consequences. Currently in East Africa there are several major infrastructure development corridors that are planned or in progress. These projects will transverse the continent, passing through remote regions and key ecosystems that sustain high levels of biodiversity. The global and regional impacts of rail and roadkill are significant. Animal-vehicle collisions also have a direct impact on humans via accidents and insurance claims for wildlife–vehicle collisions and can also indirectly decrease tourism due to frequent roadkill encounters. In some areas, roadkill has surpassed hunting as the leading cause of anthropogenic wildlife mortality. Wildlife crossing structures, underpasses and "fauna passages" are critical tools for maintaining landscape connectivity in areas affected by these developments and their capacity to sustain wildlife populations. Here we highlight current research aimed at understanding the differential and varied impacts of infrastructure on a diverse wildlife community, and how "green infrastructure designs" are addressing some problems in the East African context. Recent research has identified hotspots and drivers of wildlife roadkill and has highlighted how different wildlife species respond to or are affected by "green infrastructure designs". Analyses of traffic flow patterns and retrospective studies are ongoing to understand the impact of infrastructure on the ecology and behaviour of flagship species. From recent and ongoing work, upgrading existing infrastructure and incorporating "green technologies" in planned infrastructure is recommended.

Keywords: Community Conservation, lion monitoring, Masai Mara ecosystem, spatially explicit capture-recapture

2.2.3 Can market-based mechanisms enhance connectivity of landscapes? Lessons from Kasigau Corridor, Southern Kenya

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Abstract

Market-based solutions such as Reducing Emissions from Deforestation and Forest Degradation (REDD+) have been implemented in many global south countries since the onset of the mechanism in 2007. The mechanism incentivizes forest protection through a system of credits based on the amount of forest biomass protected that would otherwise have been lost through deforestation. The Kasigau corridor connects the southern sectors of Tsavo East and West National Parks, allowing dispersal of wildlife from the parks and enhancing connectivity between the two national parks. Prior to the implementation of the Kasigau Corridor REDD+ project in 2010, the communities practised cattle ranching, slash and burn agriculture and charcoal burning. These activities were responsible for the degradation and loss of the natural Acacia / Commiphora habitat characteristic of the Kasigau corridor, which is contiguous with the Tsavo ecosystem. We assessed the

impact of corridor protection through the REDD+ mechanism on habitat connectivity in Kasigau corridor, southern Kenya. We developed remote sensing-based land cover classifications and post-classification connectivity analysis, by using data from Landsat's medium resolution sensors Thematic Mapper and Operational Land Imager to assess land use changes and the shift in landscape configuration in Kasigau corridor during the last 11 years. Percentage deforestation reduced cumulatively by 39.9% between 2010 and 2022. The area under Acacia / Commiphora forest and high montane forest significantly increased, while the area under grassland and sparse shrubs reduced. However, fire threats have increased due to the increased availability of biomass fuel, prolonged drought and isolated incidences of charcoal burning. Market solutions, if well implemented, have the potential to improve connectivity of habitats.

2.2.4 Distribution and seasonal movements of savanna elephants *(Loxodonta africana)* around Lake Jipe, a function of foraging resources

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Abstract

This study aimed to investigate seasonal patterns of resource use by African Savanna elephants in Lake Jipe and the adjacent matrix. The Jipe ecosystem is an important dry season refuge for elephants and other wildlife; however, it has undergone severe ecological degradation. The objectives of the study were to: examine the relative abundance of elephants, their seasonal movement patterns in protected and unprotected areas, compare ground vegetation cover and composition between the protected and unprotected areas, and examine seasonal variation in forage availability and quality in the Jipe ecosystem. Adaptive stratified sampling method based on dung pile count density was used to establish sampling units (5 x 100 m transects) inside and outside the protected area. Replicate transects (15 x1000 m) and 2 km long transects were used to complement the data from the sample units and enhance consistency of the relative abundance estimates derived from dung counts and visual sightings using the distance transect sampling technique. Generalised linear mixed models and the Shannon-Weiner diversity index were used to analyse the data. The results show that elephants spent more time in the protected area in the Jipe ecosystem and their numbers increased during the wet season. The unprotected area did not show a significant increase in elephant numbers across the seasons. Forage quality and availability increased during the wet season with increasing nutrient concentration in herbaceous vegetation growing in the lake and shrubs in the ecosystem. The unprotected area of the Jipe ecosystem is home to a resident elephant population whose movement is apparently independent of forage quality, availability, and seasons. The resident population capitalises on aquatic vegetation particularly *Typha domingensis* and the higher diversity of woody vegetation outside the park. There is thus a need to implement adaptive human elephant coexistence strategies to promote positive human elephant interactions in the Lake Jipe ecosystem.

Keywords: *Coexistence, Distribution, Elephants, Forage, Nutrients*

2.2.5 How anthropogenic features and threats contribute to shape cheetah *(acinonyx jubatus)* activities and connectivity

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Abstract

The Tsavo ecosystem, encompassing two national parks, is considered one of East Africa's last remaining strongholds for the cheetah (*Acinonyx jubatus*). However, the ecosystem is subject to increasing anthropogenic pressures that escalate cheetah mortality risk associated with infrastructure development. We are studying cheetah movements via camera traps to understand how and why cheetahs are moving across adjacent ranches and conservancies, including the obstacles and the ecosystem characteristics that may facilitate their movements. This study incorporates local collaborators and is critical to securing the cheetah population residing in or using this corridor as a dispersal area. These ranches and conservancies join along a 1-million-acre corridor in-between the Tsavo National Parks, so are essential for the connectivity of Tsavo's cheetah population. Evidence - based data from infrared camera captures are showing us where individually identified cheetahs are moving, and what their obstacles are in a human - dominated environment. These data will provide the science necessary to facilitate interventions at a government level, as well as support sustaining programs that will ensure the reasonable safety and connectivity of Tsavo's cheetah population. Present and forthcoming data will further complement the Tsavo Cheetah Project's ongoing cheetah monitoring and established education and community conservation programs and partnerships.

Keywords: Cheetah, Coexistence, Connectivity, Movements, Threats

2.2.6 Implementing community-based corridors to enhance wildlife connectivity

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Abstract

Infrastructure development, agricultural expansion and human population growth often lead to the decline in wilderness and fragmentation of open rangelands. Given fragmentation can inhibit the movement of people, livestock and wildlife, it is critical to protect corridors between remaining rangeland areas for wildlife and pastoralist people. In northern Kenya, the landscape is being transformed by road development, human expansion and energy infrastructure. Such changes are expected to accelerate with future development and human population growth. To protect the integrity of open rangelands in northern Kenya, we outline the Save the Elephants livestock and wildlife corridor program. First, we identified key corridors in the ecosystem using tracking data from over 100 GPS tracked elephants. Second, we conducted numerous community meetings about the need to maintain connective corridors across the arid landscape of northern Kenya and discussed the location of the key elephant corridors. After numerous sensitization meetings, we facilitated the community demarcation of livestock and wildlife corridors in key areas for the maintenance of open rangelands. Corridors are demarcated as multi-use areas, with prohibitions on the building of permanent structures or fences. This approach ensures community support for the establishment of the corridors, which offer critical, long-term solutions to habitat fragmentation in northern Kenya.

2.2.7 Key biodiversity areas: conserving critical species and restoring sites for a sustainable future

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Abstract

Key Biodiversity Areas are sites recognized globally to contribute significantly to the persistence of biodiversity. Identification of these sites follows a scientifically defensible criterion that encompasses all species from all taxonomic groups. Kenya has 68 Key Biodiversity Areas identified on the basis of birds. These sites are assessed annually using the Basic Monitoring protocol which determines the STATE, PRESSURE, and RESPONSES. Since 2004, Basic Monitoring has been carried out in Kenya's KBAs, one of the long-term monitoring schemes providing useful data for influencing policy and decision making. Overall , the PRESSURE on the sites has been Mounting, RESPONSES, Reducing and the STATE of the sites has remained relatively Stable. Given these results, using the Key Biodiversity Areas approach serves as a valuable tool for setting conservation priorities, establishing protected areas, and guiding land-use planning. Applying the KBAs approach can thus contribute to securing a sustainable future for wildlife and ensuring the long-term health and resilience of our ecosystems.

Keywords: Key biodiversity areas, pressure, response, threatened species, threats

2.2.8 Rangeland restoration for a refugee species: re-establishment of grass cover using large scale multi-site experiments in Garissa County

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Abstract

Habitat loss via invasive tree encroachment linked to overgrazing, mega herbivore extirpation, fire suppression and climate change are thought to be key drivers of hirola antelope (*Beatragus hunteri)* decline in eastern Kenya. Today, as few as 500 hirola remain – less than 3% of the population estimated from the 1960s. Rangeland restoration can improve habitat for the grass dependent hirola. However, restoration success likely varies across soil types and targeted species, as well as the restoration approach used. Across 3 soil types (black cotton, loam soil and red sandy soil), we experimentally tested the responses of 4 native grass species to 4 different restoration approaches (tilling, seeding + manure, seeding, no treatment). We applied mixed models to understand the response of planted grass species to different restoration treatments and also assessed the influence of temperature and rainfall conditions on grass cover in three soil types. In this poster presentation, we will discuss the role of soil type, grass species, rainfall and temperature in driving the seasonal fluctuations in grass cover as well as our indigenous led conservation efforts to boost hirola population growth through landscape level range restoration.

Keywords: Refugee species, habitat loss, hirola, rangeland restoration, tree encroachment, and grass cover

2.2.9 Socio-economic and environment sustainability outcomes of the competing land use systems in Northern Tanzania.

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Abstract

Community-based conservation provides combined social, economic, and environmental outcomes by integrating income from wildlife tourism, and those from crop and pastoral production systems. Such combined land use can significantly host high wildlife populations while also supporting high livestock densities through a coexistence model. However, the community conservation model in East Africa faces a series of challenges that hamper its further development, particularly from the social side. We used a multidisciplinary approach to characterize the economic, environmental and social outcomes resulting from the interaction between wildlife conservation, pastoralism and crop production in Northern Tanzania. The Economics perspective was imperative in understanding the amount of income each of the land uses is yielding, and at which price to pay in terms of ecosystem services that are gained or lost. But the outcomes can also be explained through ecological and sociological viewpoints. We ultimately placed these outcomes along a centre-periphery gradient - an important factor in disentangling elements that determine inequalities and opportunities for livelihood diversification and understanding the impact of such gradients on multidimensional sustainability. Our results suggest that policy unpredictability, human-wildlife conflicts, and invasive or unpalatable plant species, are affecting the sustainability outcomes from each land use type we studied. In particular, the centralized policies that take rights from the communities and deny access to important livestock resources prompt grievances which ultimately trigger conflicts. For community-based conservation to be sustainable, justice and social values including coexistence with wildlife should be promoted, while containing the human population and controlling unstainable crop expansion. Social services should be improved, including access to livestock markets, and provision of education and healthcare. These factors are determinants in improving human wellbeing and empowering local communities living with wildlife to achieve long-term sustainability.

Key words: Competition, land use systems, northern Tanzania, sustainability, wildlife management areas.

03

Approaches to Enhance Human-Wildlife Coexistence In Human-Dominated Landscapes

3.1 Keynote Speaker

Dr. Noah Sitati, WWF Wildlife Species Expert / SOKNOT Tanzania Lead

The speaker observed that human-wildlife coexistence remains a contemporary conservation challenge. It impacts on both biodiversity in general and rural livelihoods and can also undermine local and national economies that depend on wildlife tourism. Historically, wildlife wandered all over when human population density was low. However, with humans dominating the landscape there are several implications including reduced human-wildlife coexistence, increased wildlife damages, loss of livelihoods, retaliatory attacks on wildlife and negative attitude towards conservation. There are several management strategies that are used for human-wildlife coexistence including government support to community wildlife management, insurance, land use plans/ spatial planning, erection of barriers, securing corridors, transboundary and inter- ministerial collaborations. Other than the existing management strategies, it is imperative to address the root causes of conflicts such as climate change, poaching, infrastructural development, implement the existing strategies and use appropriate technology in the management of HWC.

3.2 Presentations

3.2.1 Building a landscape of resilience: large carnivore governance and management implications of farmers' attitudes and livestock husbandry practices in a multicultural setting within the Meru National Park, Kenya.

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Abstract

We conducted 120 semi-structured interviews with members of five ethnic groups living across nine different villages around the semi-fenced Meru National Park, Kenya. We assessed the respondents' socio-economic characteristics, their knowledge of carnivores, their attitude towards carnivores, the perceived value of carnivores in their landscapes, and their livestock husbandry practices. We found that 95% of the respondents perceived a problem with wildlife, and respondents viewed lions (*Panthera leo*), spotted hyenas (*Crocuta crocuta*) and leopards (*Panthera pardus*) as significantly more problematic than other species due to the threats they posed to livestock and humans. Despite this, only 15% of the people admitted to having killed any large carnivore. Livestock depredation was widespread, has affected 95% of households, and was also the most common form of livestock loss – survey data revealed that 61.4% of the lost stock was predated, compared to 20.2% lost to disease and 18.2% to theft. An increase in livestock depredation predicted the highest variation in farmers' attitudes towards carnivores. Moreover, other socio-economic factors such as the respondent's ethnic group, age, education level, knowledge of carnivores, wealth status, the height of the boma fence, and distance from the park boundary also had some influence on the local farmers' attitude towards large carnivores. The study demonstrates the complexity of human-carnivore interactions in a multicultural context, whereby perceived problems could vary or potentially be exacerbated

in relation to cultural differences. Effective livestock husbandry practices have also been recorded to be useful in mitigating human-carnivore conflict in the area. This study recommends instituting measures to improve positive attitudes of local farmers, their livestock husbandry practices, predator-related benefits to local farmers, effective early warning systems; and highlights the importance of taking action to also address the socio-cultural drivers of conflict, rather than merely focusing upon reducing damage to livestock by large carnivores.

Key words: Competition, land use systems, northern Tanzania, sustainability, wildlife management areas.

3.2.2 Amboseli Trust for Elephants HECx Program - Learning how to coexist by understanding elephant behaviour in Kenya

Lydia Tiller, Keith Lindsay, Norah Njiriani, Catherine Sayialel and Cynthia Moss.

Amboseli Trust for Elephants

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Abstract

Knowledge of animal behaviour is essential for improving Human Elephant Coexistence (HWCx) in designing deterrence mechanisms or promoting compatible land use. However, integration of research into human contexts is still not well-established as standard practice. Understanding which individuals, how many and with which characteristics, are driving conflict scenarios is key to developing effective responses, for humans and elephants. ATE's experience shows that coexistence between people and African elephants (*Loxodonta africana*) can be improved by targeted interventions. An example is ATE's Consolation Program. Spearing of elephants in retaliation to livestock killed by elephants suggested that spearing incidents could lead to a deterioration in both elephant and human tolerance. With the Consolation Program, elephant-human relations improved and spearing incidents decreased. Another example is the outreach work in relation to the iconic bull elephant, Tim. Sharing with rangers ATE's knowledge of Tim's personality and strategy led to greater awareness. This appreciation, together with the stories they then recounted to community members, improved tolerance and understanding. ATE's HECx programme initiation this year, built on using partner perspectives – including trends from Big Life Foundation's HEC data from across Amboseli, will focus in part on using elephant behaviour to understand HEC scenarios. The programme will seek to de-escalate conflict by recognising individual elephants involved in interactions with people, and to facilitate engagement of communities with their issues and solutions. The research team will record specific conflict behaviours, identify tactics being developed and used by the elephants involved and determine how this behaviour is being transferred to other individual elephants. This knowledge will be used to adapt and tailor the approaches being taken to prevent and mitigate conflict, and to promote coexistence. Underpinning and complementing this observational work is ATE's 50-year database of individual life histories and behavioural records.

Keywords: Behaviour, human-wildlife conflict, coexistence, mitigation, *Loxodonta africana,*

3.2.3 Appraisal of the Government and Private Compensation Schemes for Human Wildlife Conflict in Kenya

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Abstract

Human-wildlife conflict (HWC) is a global concern threatening wildlife conservation, human security, and livelihoods. This has led to severe socio-cultural and economic effects especially in countries where people depend on crop and livestock farming for their livelihood. Adaptive strategies such as financial compensation, insurance and performance payment have been enforced to ensure wildlife survival, increased wildlife tolerance and improved livelihoods. However, studies criticize financial compensation policies as it does not address root causes of HWCs, an expensive and unsustainable source of funds, weak policies, poor governance, lack of transparency and does not enhance tolerance for wildlife therefore undermining its objectives. This study, therefore, appraised the effectiveness of the Kenyan Government compensation scheme around Tsavo West National Park versus a Private compensation scheme in Mbirikani Group Ranch, in Makueni and Kajiado County. This study identified strengths, weaknesses, opportunities, and threats associated with the two compensation schemes to potentially minimize HWCs in Kenya. This study investigated people's views on financial reimbursement and alternatives to compensation. The Kenyan Government compensation scheme was considered ineffective in reimbursing for losses. On the contrary, the Private Compensation scheme i.e., Predator Compensation Fund (PCF) in collaboration with Mbirikani Group Ranch has been effective in recompensing for predator attacks on a timely basis, although it does not totally enhance tolerance to wildlife such as reducing retaliatory killings especially of carnivores. Therefore, there is a need to integrate compensation with awareness on preventative measures to protect livelihoods and wildlife.

3.2.4 Assessing the drivers of attitude, tolerance and perception of local communities on elephants *(Loxodonta africana)* and human wildlife conflicts: a case study of Meru Conservation Area, Kenya

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Abstract

Human-wildlife conflict (HWC) is a global concern threatening wildlife conservation, human security, and livelihoods. This has led to severe socio-cultural and economic effects especially in countries where people depend on crop and livestock farming for their livelihood. Adaptive strategies such as financial compensation, insurance and performance payment have been enforced to ensure wildlife survival, increased wildlife tolerance and improved livelihoods. However, studies criticize financial compensation policies as it does not address root causes of HWCs, an expensive and unsustainable source of funds, weak policies, poor governance, lack of transparency and does not enhance tolerance for wildlife therefore undermining its objectives. This study, therefore, appraised the effectiveness of the Kenyan Government compensation scheme around Tsavo West National Park versus a Private compensation scheme in Mbirikani Group Ranch, in Makueni and Kajiado County. This study identified strengths, weaknesses, opportunities, and threats associated with the two compensation schemes to

potentially minimize HWCs in Kenya. This study investigated people's views on financial reimbursement and alternatives to compensation. The Kenyan Government compensation scheme was considered ineffective in reimbursing for losses. On the contrary, the Private Compensation scheme i.e., Predator Compensation Fund (PCF) in collaboration with Mbirikani Group Ranch has been effective in recompensing for predator attacks on a timely basis, although it does not totally enhance tolerance to wildlife such as reducing retaliatory killings especially of carnivores. Therefore, there is a need to integrate compensation with awareness on preventative measures to protect livelihoods and wildlife.

Keywords: Attitude, Coexistence, Human-elephant conflict, Meru Conservation Area, Perception.

3.2.5 Behavior of rescued and rehabilitated elephant calves with an eye toward release success

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Abstract

Rescue, rehabilitation, and release of wildlife, which may become more common as human and wildlife populations increasingly intersect, necessitates periods during which wildlife are under human care before they can be released. Once released, wildlife face a number of challenges as they learn about their new environment. Behavior of wildlife while in captivity may provide insights that can be leveraged to facilitate their transition to the wild. This may be particularly important for socially complex and cognitively advanced species like elephants. The Reteti Elephant Sanctuary rescues and rehabilitates calves found in distress across northern Kenya, with the aim to release them back to the wild when they are old enough. In the wild, released calves will face numerous challenges in order to survive, including social integration into wild herds and avoidance of humans in dangerous contexts. The behavior of calves pre-release may be predictive of their behavior post-release, and thus may be an important source of information to guide release decisions. We describe a monitoring program to characterize calf behavior prior to release at the Reteti Elephant Sanctuary, including social behavior and behavior toward humans. We present results describing trends in the behavior of the herd as well as individual variation among calves, and discuss the implications of this type of monitoring in guiding release decisions to maximize the success of calves following release to the wild.

3.2.6 Capabilities, opportunities and motivations for poaching reticulated Giraffe in Central-Northern Kenya

Symon Masiaine[1], Natalie Rose Asai[1], Jonathan Lenyakopiro[1], Antony Liosoi[1], Emmanuel Emilio[1], Paul Wachira[2], Jenna Stacy-Dawes[3], Kirstie Ruppert[3], and Tomas Pickering[3]

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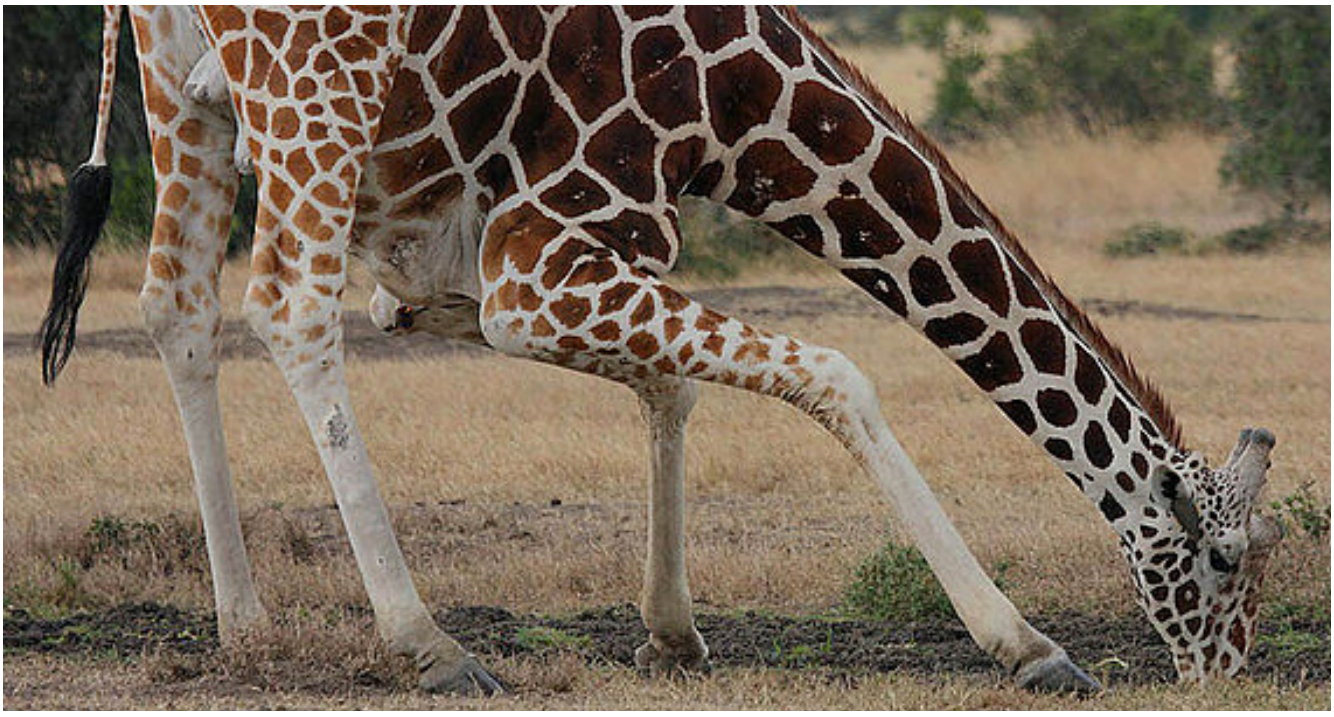
Abstract

In central-northern Kenya, pastoralists hunt giraffe. Over recent decades, this illegal behavior has contributed to a decline in the reticulated giraffe population and continues to inhibit their population recovery. Enforcement interventions to reduce giraffe poaching exist; however, complementary approaches that engage pastoralist communities could further reduce poaching. To assist conservation practitioners, our research objective was to understand pastoralists' capabilities, opportunities, and motivations of the *poaching giraffe* behavior from their perspective. As part of the Twiga Walinzi program, we conducted 18 focus group discussions across six community conservancies with mostly Samburu and Laikipiak Maasai participants. With each group of elders, women, or moran, we discussed who, how, and why giraffe are hunted and what interventions might reduce poaching. We thematically analyzed our written notes of responses to summarize findings. We then administered a structured questionnaire with over 600 moran, junior elders, elders, and women from three of the community conservancies to quantifiably investigate the current and specific factors that contribute to people's motivations to hunt giraffe or consume giraffe meat. Our findings show that moran and junior elders are largely responsible for hunting giraffe and are primarily motivated out of hunger, especially when herding during droughts. However, we found that there are additional nuanced reasons for targeting giraffe over other wildlife species. Furthermore, hunting giraffe is typically a group activity and is now more easily facilitated by the proliferation of guns. The opportunity and motivation to hunt giraffes is perceived to have decreased because of the greater law enforcement, greater wildlife benefits from the conservancies and increased education outreach from conservation programs like Twiga Walinzi. Participants recommended ways to increase community engagement and benefits from wildlife conservation which they thought would further reduce giraffe poaching.

Keywords: Community conservancy, Reticulated giraffe (*Giraffa camelopardalis reticulata),* Human-wildlife coexistence, Poaching, Wild meat



3.2.7 Community engagement in vulture conservation in the Southern Rangelands of Kenya

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Abstract

Wildlife poisoning poses a great threat to the survival of African vulture species in Kenya. A key driver of wildlife poisoning is human-wildlife conflict as a result of livestock depredation. To mitigate wildlife poisoning, we rolled out community outreach programs aimed at changing attitudes and perceptions of local communities. A low-cost approach of working with community volunteers was rolled out in 5 poisoning hotspots in the southern rangelands of Kenya. Volunteers created awareness, collected data on HWC, and supported in response to wildlife poisoning incidents. Between August 2019 and December 2021, results indicate there was an increase of 47% in reporting HWC incidents to relevant authorities and an increase of 51% in non-poisoning or wildlife killing as HWC deterrent techniques approach applied by local communities. Our work shows that community awareness campaigns coupled with other interventions i.e., boma reinforcement; can contribute to the reduction of wildlife poisoning incidents

Keywords: Awareness, community volunteers, human wildlife conflict, vulture conservation, and wildlife poisoning

3.2.8 Ewaso Lions - a story of community-led conservation

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Ewaso Lions

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Abstract

Lion, *Panthera leo*, numbers have declined by approximately 43% over the past 20 years across Africa. In Kenya, there are ~2,489 lions found in both protected and unprotected areas. Habitat loss and conflict with humans has largely contributed to their decline.

Ewaso Lions, a Kenyan non-profit organisation, is dedicated to conserving lions and other large carnivores by promoting continued co-existence between people and wildlife in the Samburu-Isiolo landscape. We engage and build the capacity of key demographic groups (warriors, women, elders and children) by developing approaches to reduce human-carnivore conflict. The Warrior Watch programme, initiated by a Samburu warrior, makes warriors ambassadors for lions within their communities, while raising awareness about conservation and advocating for peaceful coexistence with lions. Through self-initiated initiatives, Mama Simba empowers Samburu women to be the voice for lions with the firm cultural belief that wildlife belongs to women. The women work on recovering lion habitat, lead discussions on culture and conservation and work on drought related activities. Kura's Pride improves domestic animal welfare through an innovative domestic animal veterinary unit. Lion Kids Camps inspire a new generation of wildlife conservationists and give school-going and herding children the chance to experience wildlife in a positive way. Eleven lions were known when Ewaso Lions started, and currently, they are almost 50 lions. This increase has largely been as a result of our community-led programmes. We are securing a future for lions in a dynamic, cultural landscape, achieved through community-led conservation. Although we began our work with a quest to understand conflict, the journey became a mission to promote coexistence. With a focus on lions, local leadership, and embracing the pastoral way of life, a thriving lion population is now safe on community lands, and we have seen true ownership of lions grow across the landscape.

Keywords: coexistence, community, conservation, lions, Samburu

3.2.9 Human-lion Coexistence: Lessons learned from Predator-proof bomas project in Amboseli-West Kilimanjaro Ecosystem, Kenya and Tanzania

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Abstract

Livestock depredation by lions (*Panthera leo*) deprives pastoralists their livelihoods, and can lead to retaliatory killing of lions. It is therefore unsurprising that lion populations have been eradicated from at least 30% of their historical range in Eastern and Southern Africa. Despite the well-known threats facing lions, few solutions have been implemented to protect both communities' livelihoods and lion populations on a long-term basis. The Born Free Foundation initiated the Pride of Amboseli project in March 2010 to promote coexistence between people and lions by upgrading traditional Maasai boma-TBs (kraals) to Predator-proof bomas (PPBs) in Amboseli-West Kilimanjaro Ecosystem. Unlike the TBs, the PPBs have 1.8m high rolls of chain-links attached to strong posts (3 m apart) and strong doors. Between March 2010 and March 2023, 383 PPBs were constructed, averaging 30 annually. Our analysis indicates that most PPBs (74%) were constructed on cost share, with beneficiaries contributing 15% (n=44), 25% (n=214) and 50% (n=25) of the total costs. The PPB's average circumference was 205.97 m (n=316), had 18.23 people (n=271) and protected an average of 318 livestock (n=276). A total of 87,646 livestock (64.24% shoats, 35.90% cattle & 0.86% donkeys) were protected from predation at night. Before the PPBs construction, 83.18% (n=214) of the beneficiaries lost their livestock to predators at night. Since the project's inception, only 2.09% (n=8) of PPBs had predator incursion due to low maintenance (7 incidents) and leaving the door open (1 incident). A large proportion, 85% (n=227) of the beneficiaries guarded their stock every night before the PPBs. However, 12 months later, guarding time reduced to 'normal checks' of 5.2 days (n=74) per week. PPBs can contribute to conflict mitigation and coexistence of people and carnivores. Maintenance is key to PPBs' effectiveness, and cost-sharing promotes the sustainability and community ownership of the project.

Keywords: Coexistence, Cost sharing, lion, livestock predation, Predator-proof boma.

3.2.10 Impact of drought and development on the effectiveness of beehive fences as elephant deterrents over nine years.

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Abstract

Human-elephant conflict is growing in Africa as both the human populace and development increases creating disturbance to both elephant habitats and migration corridors. Finding socially acceptable, economically viable, farmer-managed elephant deterrents is a priority to help turn human-elephant conflict into coexistence. Beehive fences have been trialled in Kenya since 2007 with some success but all studies have looked at small sample sizes over a short time period. Our study analyses the

behaviour of 3,999 elephants that approached or attempted to enter a network of beehive fence protected farms over almost 9-years on the border of Tsavo East National Park. Although climatic and landscape conditions varied dramatically over six peak crop growing seasons (Nov-January 2014-2020) the beehive fences kept between 78.3% and 86.3% of elephants out of the farms during their most attractive periods of crop production. The mean deterrent rate over all 9 years, including an extended period of drought mid-way through the study, saw 74% of all elephants deterred from farm plots protected by beehive fences. The beehive fences produced just over one ton of honey for the 26 farms engaged in the study, boosting income for the farmers by US $2,250. The drought caused a 75% reduction in honey production for 3 years after the drought and negatively impacted the effectiveness of the beehive fence when elephant visits resumed due to poorer hive occupation rates. Our study suggests that although beehive fences are very effective at reducing up to 86.3% of elephant crop-raids during peak crop seasons when good rainfall has occurred, any increase in the frequency and duration of droughts and/or warmer/drier conditions in the future could negatively impact the effectiveness of beehive fences as a successful farmer-managed human-elephant coexistence tool.

Keywords: Human-hippopotamus conflict, hippopotamus, Tanzania, crop damage, mitigation measures, Lake Victoria,

3.2.11 The effectiveness of bomas with wire-fencing and lights at deterring livestock depredation and its influence on pastoralists' attitudes towards carnivore conservation in Northern Kenya.

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Abstract

Kenya's rangelands are home to pastoral people, their livestock, and large carnivores, such as hyenas (*Crocuta Crocuta*) and leopards (*Panthera pardus*) which frequently come into conflict via livestock depredation events. Livestock depredation fuels people's resentment towards predators and conservation efforts, and occasionally leads to pastoralists killing carnivores in retaliation. To better understand what types of carnivore-livestock attacks are occurring from March 2018 to June 2022 our Leopard Conservation program (*Uhifadhi wa Chui*) monitored all livestock depredation events across six community areas, which included ~760 households with shoat bomas, neighboring Loisaba and Mpala Conservancies in Laikipia, Isiolo, and Samburu Counties. From June 2019 to March 2021, we assisted 161 households install 82 light-deterrents and replaced 81 bush-bomas with wire-fencing for their shoat bomas. Our before-after-control-intervention study allowed us to evaluate the effectiveness of these two types of interventions (lights and wire-fences) at reducing livestock depredation events in bomas. During the 4 years of monitoring, we recorded over 3000 livestock depredation events inside and outside of bomas, averaging about 60 attacks per month, with 40% due to hyenas and 36% due to leopards. Our results show both interventions to be highly effective when properly installed, with wire-fencing more effective than light-deterrents. After the monitoring period we did a follow-up survey with participating households and neighboring control households to evaluate pastoralists' experiences with the interventions and whether it changed their attitudes towards carnivores. Participants in the intervention study valued direct and indirect benefits of better protecting their livestock and showed greater tolerance towards carnivores and support for carnivore conservation; however, households identified ways to improve the interventions and participating households perceived an increase in day-time livestock depredation. This increase in the proportion of day-time attacks does not appear to be an overall trend in our conflict monitoring assessment.

Keywords: Community conservancy, human-wildlife conflict and coexistence, leopard (*Panthera pardus*), livestock

3.2.12 The Elephant Queen: can a nature documentary improve tolerance for elephants?

Williams, H.F. [*,2], Leneuiyia, K.L.[1,3], Mwalavo, B[#1], Serem, G.[#1], Sempeyo, V.[1], Pope, F.[1], King, L.E.[1,2] and Verissimo, D[2]

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Abstract

Human-elephant conflict represents one of the more intricate cases of human-wildlife interaction, posing a significant hurdle for wildlife preservation. Numerous strategies have been implemented to separate humans and elephants, yet initiatives aimed at promoting coexistence between the two species are limited. This research evaluates whether a wildlife documentary, The Elephant Queen (TEQ), can inspire tolerance in communities residing near elephant populations (*Loxodonta africana*). Prior to and after screening the film via mobile cinema in Southern Kenya, we gathered data through questionnaires and interviews. Using a robust double ordinal regression analysis, we applied 357 matching specifications to quantify the impact of viewing TEQ on six factors identified as key drivers of tolerance towards wildlife according to the Hazard Acceptance model. We observed that students aged 16-18 demonstrated an increase in knowledge (mean effect size=0.27) and affection (mean effect size=0.17) for elephants and expressed a greater appreciation for the benefits of elephants (mean effect size=0.26) after watching TEQ. Community members aged 16-80 also exhibited increased knowledge (mean effect size=0.21) and recognition of the benefits of elephants (mean effect size=0.15), but they reported a more profound understanding of the challenges of living alongside elephants after viewing the film (mean effect size=-0.11). A follow-up survey conducted after 90 days indicated a significant rise in community "affection" for elephants (mean effect size=0.11), though the costs, benefits, and knowledge initially gained diminished over time to become insignificant. These findings suggest that wildlife documentaries could prove instrumental in inspiring a younger audience. However, the impact on an adult audience presented a more nuanced picture and some effects were short-term, lasting less than three months.

Keywords: Behaviour change; coexistence; human-elephant conflict; impact assessment.

04

Approaches to Climate Change Mitigation and Adaptability

4.1 Keynote Speaker

Prof. Daniel Olago, Research Director, Institute for Climate Change and Adaptation
Chairman, Department of Earth and Climate Sciences
University of Nairobi

The speaker observed that Africa is home to 8 of the world's 34 biodiversity hotspots (IPBES), and also home to one-fifth of all known mammal, bird and plant species. There are 93 freshwater or wetland ecological regions in the continent and by the year 2100, 50% of Africa's bird and mammal species could disappear and 20-30% of lake productivity could similarly be lost. Between 1946 and 2010, 70% of Africa's protected areas were affected by war whilst in the recent past, climate change is expected to be one of the major drivers of African biodiversity loss over the next 50 to 100 years and biodiversity loss is projected to be widespread and escalating with every 0.5°C increase above present-day global warming. With increasing warming, there is a lower likelihood species can migrate rapidly enough to track shifting climates, increasing global extinction risk and biodiversity loss across more of Africa. Climate change is contributing to land degradation, loss of biodiversity, bush encroachment and spread of pests and invasive species and is expected to change patterns of invasive species spread. Sustainable use of biodiversity, conservation agriculture, reduced deforestation, land and watershed restoration, rainwater harvesting and well-planned reforestation can have multiple benefits for adaptation and mitigation, including water security, food security, biodiversity, soil conservation and local surface cooling. Ecosystem-based adaptation (EbA) uses biodiversity and ecosystem services to assist people to adapt to climate change. Appropriate nature-based solutions that are applicable at scale should be identified and strongly embedded in these approaches to deliver multiple benefits while maintaining the integrity of ecosystems and biodiversity.

4.2 Presentations

4.2.1 Are Marine Protected Areas the key to coral reef resilience? A temporal study from Kenya

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Abstract

Coral reefs provide a great deal of goods and services that support socioeconomic systems along tropical coasts throughout the world. However, these systems face a plethora of threats ranging from localized pressures, such as overfishing, sediment loading and nutrient enrichment, to global pressures, such as pulse ocean warming events which result in coral bleaching. Research has shown that Marine Protected Areas (MPAs) have the capacity to increase coral reef resilience by increasing species richness, which promotes inherent ecological functions that are crucial for the longevity of coral reefs, while reducing the localized pressures. This study, therefore, sheds light on 3 MPAs in Kenya (Malindi, Mombasa and Kisite) located on a gradient of localized anthropogenic stressors. The ability of the MPAs to offset the impacts of bleaching was tested based on analysis of fish family composition and abundance and benthic substrate cover composition. Univariate and multivariate tools were thus applied to long term monitoring data between 2005 to 2018. The results showed Kisite to have no reaction to climate-induced warming, which could indicate higher resilience owing to relatively lower anthropogenic stressors in its vicinity. Fish and benthic substrate cover in the Mombasa MPA, however, exhibited a significant difference in the bleaching years: 2005, 2006 and 2013. Since 2006 was not a bleaching year, a lag in recovery is suspected. Similar results were shown for fish in Malindi, except for 2006, which showed no significant difference to the other non-bleaching years. In the MPAs of both Mombasa and Malindi, an inverse relationship was found between Acanthuridae and Siganidae, where the former was higher in bleaching years, though only Malindi showed statistical significance. This could be an

indication of response diversity in the MPAs, which might have promoted recovery in post-bleaching years. Furthermore, the Mombasa MPA had more prominent algal turf and rubble in 2005 and 2006, whereas 2013 showed higher prevalence of macroalgae. This could demonstrate a gradual phase-shift towards an algal dominated system for this MPA.

Keywords: Coral reef ecology, Marine Protected Area, Coral bleaching, herbivory, sea urchin, bioerosion, Coral reef trends, Kenya

4.2.2 Assessing the Aberdare fire incidence in Kenya: causes, impacts, and multistakeholder-based approaches for effective mitigation

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Abstract

The Aberdare fire incidence in Kenya has become a recurring environmental challenge, threatening the delicate balance of the Aberdare ecosystem. This abstract aims to contribute to the upcoming scientific conference in Naivasha by providing insights into the causes, impacts, and multi-stakeholder-based approaches for effective mitigation of the Aberdare fire incidents. Through a multidisciplinary lens, this research delves into the factors contributing to the Aberdare fire incidence, encompassing both natural and human-induced elements. The study analyzes the role of climatic conditions, vegetation dynamics, land-use practices, and socio-economic factors in shaping fire regimes in the Aberdare region. Furthermore, this research investigates the ecological and socio-economic impacts of the Aberdare fire incidents. It examines the effects of fires on biodiversity, ecosystem services, water resources, and tourism. To address the challenges posed by the Aberdare fire incidence, this abstract presents multi-stakeholder-based approaches for effective fire mitigation. It highlights the significance of stakeholder involvement in preventing, managing, and suppressing fires in the Aberdare ecosystem. The findings of this study have practical implications for policymakers, park managers, and local communities in the Aberdare region. The research provides valuable insights for the development of integrated fire management strategies that combine scientific knowledge with traditional practices. These strategies aim to enhance fire prevention, early detection, and timely response mechanisms in order to minimize the occurrence and impacts of Aberdare fire incidents. By presenting this abstract at the conference, we hope to engage with fellow researchers, scientists, and stakeholders to foster meaningful discussions, exchange ideas, and explore collaborative opportunities for addressing the Aberdare fire incidence. This research contributes to the growing body of knowledge on fire ecology, sustainable land management, and multi-stakeholder-based approaches for effective fire mitigation in the Kenyan context.

Keywords: Aberdare, causes, ecology, fire, Kenya.

4.2.3 Assessment of vegetation changes in Kilombe Caldera, Baringo County Kenya; inferences from micro-botanical remains and current vegetation.

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Abstract

Human interactions with landscape and climate changes played roles in shaping paleo-vegetation and impacting paleo-environments. This study explores the effects of climate change and anthropogenic activities on paleo and current vegetation in Kilombe caldera, Baringo County, Kenya. Multiproxy analysis using plant micro-botanical remains (pollen, phytoliths, and charcoal) was adopted to reconstruct past vegetation. Forty two sediment samples collected in a pit were processed using specific acids /alkali; the paleo data obtained was analysed using the Tilia program and Cluster analysis. Current vegetation was sampled from nine transects using stratified random sampling. Identification, tallying and recording of all plant species was done. Species abundance, frequency, density and structural composition of lifeforms was calculated to determine variation in species composition. Spatial distribution along environmental gradients was also determined. Paleo data results indicated existence of dry montane forest represented by *Juniperus* and *Podocarpus*, shrubs and herbaceous species represented by Amaranthaceae, while aquatics by *Typha*. Current vegetation data showed gradual succession from primary to secondary vegetation. Some plant species documented in the paleo data were not found in the current vegetation, similarly, a few plant species represented in the current vegetation were not represented in the paleo data, e.g., *Diospyros abyssinica*. Consequently, some species were over-represented in the current vegetation, e.g., *Dodonaea viscosa*. Paleo-data analysis indicated that prior to human settlements, the area had a relatively open woodland with abundant assemblages of grass phytoliths, indicating cool /warm temperate past environments. Human activities were reflected in the paleo data by the presence of cereals in phytolith data, and pollen grains, e.g., *Zea mays*. The main drivers of the changes were the past patterns of climate variability and human activities, like livestock keeping, fire and agriculture. This research demonstrated the existence of long-term human-mediated changes and climate driven changes. Amore detailed study is required to establish the full impacts of anthropogenic activities on the ecologically and economically important plant species that have disappeared from the Kilombe caldera.

Keywords; Landscape, Micro-botanical, Paleo-data Paleo-environment, Paleo-vegetation

4.2.4 Impacts of a severe drought on the Samburu elephants

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Abstract

Population processes can be disproportionately impacted by extreme conditions. With climate change, years that experience vastly different levels of rain or temperatures from average are expected to increase across much of the world. Arid lands are particularly prone to extreme events. The arid lands of Northern Kenya experienced severe drought between 2021 and 2023. We summarize the impacts of this drought on the elephant population inhabiting the Samburu and Buffalo Springs National Reserves in northern Kenya. In the heart of the drought in 2022, we experienced high mortality among juveniles and older aged adults in the population. However, coinciding with the drought, the population experienced a birth pulse driven by above average rains in 2020. While mortality was above average, the birth pulse resulted in a net increase in the population despite the drought. We discuss the demographic and behavioral impacts of the drought for the elephants of northern Kenya.

4.2.5 Developing drought mitigation measures for African elephants *(Loxodonta africana-L)* in the Tsavo ecosystem, Kenya, by understanding long-term elephant distribution and mortality patterns in relation to NDVI, vegetation, and rainfall

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Abstract

Drought is a form of environmental stress that originates from a deficiency in precipitation over an extended period long enough to cause moisture deficiency, biotic loss, crop failure, human and wildlife deaths, and cause general hardships. Drought has been a persistent cause of elephant mortality in the Tsavo ecosystem. It causes elephant mortality more directly through starvation, increases disease susceptibility, increases human-elephant conflict and associated elephant mortality, and increases elephant susceptibility to poaching as elephants move closer to human habitation. The mismatch in the distribution of forage and water resources, which are essential for elephant survival during severe droughts, has been linked to the increased vulnerability of elephants to drought-related mortality. We examined the temporal and spatial patterns in elephant mortality in relation to rainfall, the Normalized Difference Vegetation Index (NDVI), and waterholes. Through training, we also strengthened the capacity of Kenya Wildlife Service (KWs) rangers on monitoring elephant drought-related mortality. The NDVI was used to predict the availability of forage for elephants in Tsavo. Remotely sensed images were analyzed using the Google Earth Engine (GEE). Subsequently, the Maximum Entropy (MaxEnt) software was used for modelling. Over 60 elephant lower jaws were measured to determine the age of the elephants that died during the 2018 to 2019 period. The results indicated that the spatial and temporal distribution of elephants was directly related to the distribution of water and the availability of forage and rainfall patterns. The thrust of the analyses was the mismatch between the carcass and elephant distributions. Since there were no disparities, the clustering of water points was seen to be a contributing factor to the elephant deaths. We therefore recommend that management should distribute artificial water sources in the protected area using sound ecological principles and guidelines.

Key words: Spatial-Temporal, GEE, elephant mortality, NDVI, MAXENT

4.2.6 Effects of climate change on elephant population in Amboseli National Park in Kenya

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Abstract

Climate change is a long-term shift in temperatures and weather patterns. These shifts can be natural or human induced. Human activities are the main drivers of climate change primarily due to the use of fossil fuels. Climate change is a big threat to biodiversity and natural ecosystems. Climate change is a major contributor to the loss of biodiversity especially of large mammals such as elephants. Increased water shortage as a result of climate change and the attendant persistent droughts, has been identified as a serious threat to the survival of large mammals. In Kenya, high mortality of African elephants (*Loxodanta africana)* especially in the Amboseli National Park has been an issue of great concern to the government and conservationists. Although studies have attributed the death of elephants to human wildlife conflict and poaching, there is a scarcity of robust evidence on the relationship between climate change and elephant population. Using time series data on the elephant population in the Amboseli National Park and data on environmental changes in the park overtime, we analyzed the relationship between elephant population and climate change. The study established that drying of vegetation due to high temperatures, elephant feeding behavior as well as drying up of water points in areas mostly habited by elephants contributed significantly to the elephant population. The study recommends that conservation efforts of African elephants should focus on mitigating the adverse effects of climate change in the park such as by drilling groundwater powered by solar energy to ensure sustainability.

Keywords: Biodiversity, Climate change, Elephant, National Park

4.2.7 A million-year vegetation history and palaeoenvironmental record from the Lake Magadi Basin, Kenya Rift Valley

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Abstract

This study examines a one-million-year pollen record from a 194-m-long Lake Magadi core (HSPDP-MAG14-2A) in the south Kenya Rift Valley. The pollen indicates a general trend through the last 740 kyr from wetter conditions to generally drier environments. Grassland dominated with less common *Podocarpus* and Cyperaceae in a sparse flora between 1000 and 740 ka. Poaceae, woodland and herbaceous plants are common through the remaining core and abundant between 740 and 528 ka and after 200 ka. Pollen diversity increased after 200 ka. *Podocarpus* and Cyperaceae reached a peak abundance at ~575 ka with a subsequent decline that suggests a progressive increase in aridity, interrupted by wetter intervals. Podocarpus-dominated forests expanded and contracted many times during the Quaternary and documented an anti-phased relationship with data from Lake Malawi. Similar anti-phased correlations are noted for herbaceous plants, suggesting that the two basins responded differently to the same climate or were influenced by contrasting climate regimes. Increases in macrocharcoal correlate with increasing pollen abundance and suggest wetter conditions. Data from the Magadi, Koora and Olorgesailie basins indicate similar trends and a dominant climate control on vegetation and habitats. Large lakes characterised all three basins at 740–528 ka with climate subsequently becoming drier, but with many wetter intervals. At various times the lakes expanded, contracted and dried out, except at Lake Magadi where spring inflows maintained lacustrine conditions through the late Quaternary. Faulting also contributed to fragmentation of the landscape and formation of a mosaic of habitats. An especially intense period of aridity at ~528–392 ka coincided with extinction of many large-bodied mammals and may have helped to drive a change from the use of Acheulean hand axes to the production of Middle Stone Age tools by 320 ka. After 200 ka pollen diversity increased substantially with a mix of montane, riparian and dry forest associations that were present in varying amounts through to ~4.2 ka at the core top.

Key words: Lake Magadi, macrochacoal, mosaic, olorgesailie basin, pollen, quaternary

4.2.8 Modelling trends and variation in rainfall, temperature, NDVI, SOI and DMI in the Greater Mara-Serengeti Ecosystem: Implications for biodiversity dynamics and conservation

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Abstract

Understanding the regional manifestations of global climate change and their consequences for biodiversity conservation and dynamics is crucial, especially in biodiversity-rich systems such as East Africa's Greater Mara-Serengeti Ecosystem. Global climate change in the southern hemisphere is partially manifested through trends and variations in the hemispheric El Niño-Southern Oscillation (SOI), the regional Indian Ocean Dipole Mode (DMI), and in changes in rainfall and temperature. While individual climatic components can be analyzed using univariate statistical methods to infer regional impacts of climate change, considering interdependencies and covariation between multiple components requires multivariate models. State-space models, both univariate and multivariate, can efficiently analyze climatic variable time series by decomposing them into trends, cycles, seasonal patterns, and irregularities. The joint analyses of trends and variations using multivariate state-space models can provide more insightful patterns than univariate models alone. For instance, bivariate models are more effective in characterizing the relationships between weather components, such as rainfall and temperature, and their distinct impacts on vegetation and animals. Feedback mechanisms among temperature, rainfall and vegetation productivity complicate modelling of their interrelationships. Seasonal and inter-annual cycles in these factors influence plant and animal reproduction, migration patterns and herbivore mortality, thereby impacting biodiversity dynamics and conservation outcomes. Consequently, in studying these patterns in the Greater Mara-Serengeti Ecosystem, we use historic rainfall, temperature, and vegetation data to construct state-space models. These models aim to identify trends and oscillations in weather and vegetation components and explore potential modulating influences of oceanic and atmospheric oscillations, such as the DMI and the SOI, on regional rainfall and temperature trends. Employing both univariate and multivariate state-space models, this study aims to uncover critical trends and variations in climatic and vegetation components, thereby offering valuable insights essential for biodiversity dynamics and conservation. Understanding these patterns is crucial for formulating effective strategies to address the impacts of climate change on ecosystems and their biodiversity.

4.2.9 Potential impacts of climate change on wildlife protected areas, A case study of Maasai Mara National Game Reserve

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Abstract

Climate change via erratic rainfall and temperature is increasingly recognized as one of the most substantial factors affecting wildlife population in protected areas. Based on systems theory, this study investigated the effects of rainfall and temperature variations on wildlife population dynamics in Maasai Mara National Game Reserve (MMNGR). Rainfall and temperature data was obtained from 15 rain gauges located in MMNGR operated by World Wide Fund and Friends for conservation. Wildlife data was collected from the Directorate of Resource Surveys and Remote Sensing (DRSRS). Satellite imagery vegetation data was obtained from Regional Center for Mapping of Resources for Development (RCMRD). The study adopted explanatory research design. Changes in vegetation cover were determined from satellite imagery using the Normalized Difference Vegetation

Index (NDVI). The NDVI images from the years 1975 to 2018 were processed to obtain specific NDVI values per land cover category. The mean monthly rainfall and air temperature in MMNGR for the last 54 years were analyzed. Time series was applied to analyze rainfall and temperature data. Findings indicate that rainfall and temperature variations influence the decline in wildlife populations but there could be other factors too. The study findings suggest that high amounts of vegetation cover as indicated by NDVI maps are associated with high survival rates for wildlife. The study proposes that rainfall extremes and rising temperatures are likely to increase wildlife mortality and drive wildlife population declines.

Key words: Climate change impacts, wildlife population

4.2.10 Vulnerability assessment of chondrichthyan species to fisheries in coastal Kenya: implications for conservation and management

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Abstract

Ecological risk assessment (ERA) of species in fisheries is useful for making informed management decisions especially in data-scarce situations. Knowledge of vulnerability of species to gear-fisheries is important for targeted management measures especially for elasmobranch species known to have delicate life-history strategies. As part of a National Plan of Action for Sharks (NPOA-sharks) Initiative, the Kenya Fisheries Service (KeFS) organized a three-day workshop (during April 2022) involving various experts and stakeholders to analyze relative vulnerability risks of shark and ray species to fishing gears in Kenya's EEZ. The workshop applied a Productivity and Susceptibility Analysis (PSA) approach to estimate relative vulnerability of species to gears based on the values of their productivity and susceptibility attributes. A total of 30 shark and 29 ray species were used for the analysis of relative vulnerability to artisanal gears, prawn trawlers, and the industrial pelagic longline fishery within Kenya's EEZ. Overall, we found high species vulnerability to the prawn trawl fishery (35% for rays and 66% for sharks and shark-like rays) and to the industrial longlines (100% for rays and 46% for sharks and shark-like rays). There were variable but lower vulnerability ranges for species in the artisanal gears. About 30 species are assessed to have High Relative Vulnerabilities to the gears and form a High Vulnerability Species Assemblage (HVSA) that will require more targeted management strategies applied through a hierarchical approach. Of the HVSA group, five species (*Sphryna lewini, Pseudoginglymostoma brevicaudatum, Rhina ancyclostoma, Rhynchobatus djiddensis, Rhynchobatus laevi*) are Critically Endangered (CR), while another five (*Carcharhinus plumbeus, Mobula birostris, Mobula eregoodoo, Stegostoma tigrinum, Rhinoptera jayakari*) are Endangered (EN) with Extinction as per the IUCN Red List assessment (www.iucnredlist.org, release 2022-1). The results indicate a lower fishing pressure threshold is required to predispose the prawn trawl bycatch species to High Vulnerability on the Kenyan coast. More than 50% of the species evaluated as being of High Vulnerability are those also Threatened with extinction. The PSA will require continuous updating to include more species and improve its sensitivity. A Shark and Ray Management Plan (SRMP) that takes into account the outputs of the PSA is recommended for the management and conservation of the chondrichthyan stocks within the framework of NPOA-Sharks for Kenya.

Keywords: Productivity, susceptibility, overfishing, conservation, policy, management

05

Addressing Wildlife Health Challenges Through one Health Approach

5.1 Keynote Speaker

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The speaker observed that Kenya has a rich wildlife resource which fulfils critical ecological functions fundamental to the interconnected web of life-supporting systems, has economic value and constitutes a unique natural heritage. Protecting wildlife health is central to safeguarding biodiversity and in the process investing in a healthier, more sustainable future because wildlife health is essential for life on earth. The health of our wildlife is shaped by among other things wildlife diseases, and this makes disease an important factor in the conservation and management of species. However, wildlife health is not just the presence or absence of disease, but the outcome of dynamic interactions between various biotic, abiotic and social elements that influence health. In this respect, wildlife health assumes multiple dimensions as there are multiple determinants of wildlife health outcomes. Collectively, there are a number of factors that influence wildlife health outcomes in their shared environment with domestic animals and humans. Major among these are those driven by climate change; those that drive the emergence and re-emergence of infectious diseases / pathogens / zoonoses; human-wildlife conflicts at the shared interfaces; predation; and those factors driving biodiversity loss. It is the interplay between all these factors that culminates in wildlife health challenges. In developing strategies to address wildlife health challenges therefore, the role of these factors must be understood and considered. One Health is the integrative effort of multiple disciplines and sectors working locally, nationally, and globally to attain optimal health for people, animals, and the environment. This approach has been identified and certainly has proven to be an effective way of fighting health issues at the human-animal-environment interface. It is fronted and endorsed as an initiative that promotes a holistic approach to addressing complex global health issues, including wildlife health challenges. There is an opportunity to employ this approach through wildlife stakeholder partnerships, to develop strategies and mount appropriate interventions, to address wildlife health challenges, now, and into the future.

5.2 Presentations

5.2.1 Recurrent anthrax outbreaks in humans, livestock and wildlife in the same locality, Kenya 2014-2017

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Abstract

Epidemiologic data indicate a global distribution of anthrax outbreaks associated with particular ecosystems that promote the survival and viability of *Bacillus anthracis* spores. Here, we characterized three anthrax outbreaks involving humans, livestock, and wildlife that occurred in the same locality in Kenya between 2014 and 2017. Clinical and epidemiologic data on the outbreaks were collected using active case finding and human, livestock, and wildlife health records review. Information on the temporal and spatial distribution of prior outbreaks in the area was collected using participatory epidemiology. The 2014-2017 outbreaks in Nakuru West Subcounty affected 15 of 71 people who had contact with infected cattle (attack rate = 21.1%), including seven with gastrointestinal, six with cutaneous, and two with oropharyngeal forms of the disease. Two (13.3%) gastrointestinal human anthrax cases died. No human cases were associated with infected wildlife. Of the 54 cattle owned in 11 of the affected households, 20 died (attack rate = 37%). The 2015 outbreak resulted in the death of 10.5% of the affected herbivorous wildlife at Lake Nakuru National Park, including 745 of 4,500 African buffaloes (species-specific mortality rate = 17%) and three of 18 endangered white rhinos (species-specific mortality rate = 16%). The species mortality rate ranged from 1% to 5% for the other affected wildlife species. Participatory epidemiology identified prior outbreaks between 1973 and 2011 in the same area. The frequency and severity of outbreaks in this area suggest that it is an anthrax hotspot ideal for investigating risk factors associated with the long-term survival of anthrax spores and outbreak occurrence.

Keywords: Anthrax outbreaks, *Bacillus anthracis*, participatory epidemiology, temporal and spatial distribution, spores

5.2.2 Evaluating temporal patterns of anthrax outbreaks in Kenyan wildlife and the control measures instituted to control and prevent anthrax events in the country

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Abstract

Anthrax, a bacterial zoonosis of global health security and public health importance, is primarily a disease of domestic and wild herbivores transmitted through ingestion of *Bacillus anthracis* spores from soil and/or vegetation. The disease can cause large-scale loss of wildlife and domestic animals and is a major threat to the conservation of endangered wildlife species. We investigated the frequency of outbreaks and control measures put in place by reviewing records of anthrax cases and outbreaks in wildlife in Kenya from 2000 to 2022 from the veterinary services database at the Kenya Wildlife Service. Although isolated wildlife anthrax cases have been reported over time in Kenya, an increased frequency of outbreaks has been observed from 2006 to 2022, occurring every three to five years and affecting different species in different geographical areas. Recurrence of an outbreak within the same area was reported in one wildlife protected area but the second outbreak was less severe causing lower mortality and affecting a lesser number of species than the first one. Control measures instituted following outbreaks include early detection through clinical syndrome and laboratory confirmation, intensive carcass mopping-up and disposal, disinfection of carcass sites and vaccination of endangered species within the outbreak area. From the findings of the study, the recommended method of control is deep burying of carcasses coupled with disinfection of burial and carcass sites with 10% formaldehyde and caustic soda as this proved effective in containing outbreaks and to a large extent preventing recurrence as well as reducing intensity of recurrent outbreaks. We concluded that due to the emerging temporal patterns of anthrax outbreaks, the wildlife management authorities should be alert and vigilant and put up contingency measures for prevention and control.

Keywords: Anthrax, bacillus, control, outbreak, Kenya

5.2.3 Behavior and parasitism in a wild baboon population

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Abstract

Parasites have wide ranging detrimental effects on host health and survival. Host behavior has previously been shown to influence parasite burdens, although the reverse has also been reported. Here we present results from two studies that investigated how behavior influences parasitism in the Amboseli baboon population, which has been the subject of long-term, individual-based monitoring for decades. Data collection included social interactions, blood, and stool samples. In the first study we investigated whether grooming behaviour, which is a major social activity for many non-human primates, confers health benefits linked to reduced tick burdens. We tested the relationship between grooming and tick infestation and found that individuals that receive more grooming have lower tick loads and higher packed cell volume (a general measure of health status) than individuals that receive less grooming. In the second study, we tested how processes operating at multiple scales—from individual hosts to social groups and the population at large—work together to predict patterns of helminth parasitism and their consequences for female fertility. We found that female infection risk was best predicted by factors at the host-, social group-, and population level: females facing the highest risk were old, socially isolated, living in dry conditions, and infected with other helminths. Further, females infected with more diverse parasite communities exhibited longer interbirth intervals than females infected by fewer parasite taxa. In aggregate, these results provide clues about potential evolutionary costs associated with social behavior.

Keywords: Wild primates, parasites, behavior, disease, Amboseli

5.2.4 Evidence of co-exposure with Brucella spp, Coxiella burnetii, and Rift Valley fever virus among various species of wildlife in Kenya

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Abstract

Co-infection, especially with pathogens of dissimilar genetic makeup, may result in a more devastating impact on the host. Investigations on co-infection with neglected zoonotic pathogens in wildlife are necessary to inform appropriate prevention and control strategies to reduce disease burden in wildlife and the potential transmission of these pathogens between wildlife, livestock, and humans. This study assessed the co-exposure of various Kenyan wildlife species with *Brucella spp*, *Coxiella burnetii,* and Rift Valley fever virus (RVF). A total of 363 sera from 16 different wildlife species, most of them (92.6%) herbivores, were analysed by Enzyme-linked immunosorbent assay (ELISA) for IgG antibodies against *Brucella* spp, *C. burnetii* and RVFV. Further, 280 of these were tested by PCR to identify *Brucella* species. Of the 16 wildlife species tested, 15 (93.8%) were seropositive for at least one of the pathogens. Mean seropositivities were 18.9% (95% CI: 15.0–23.3) for RVFV, 13.7% (95% CI: 10.3–17.7) for *Brucella spp* and 9.1% (95% CI: 6.3–12.5) for *C. burnetii*. Buffaloes (n = 269) had higher seropositivity for *Brucella* spp. (17.1%, 95% CI: 13.0–21.7%) and RVFV (23.4%, 95% CI: 18.6–28.6%), while giraffes (n = 36) had the highest seropositivity for *C. burnetii* (44.4%, 95% CI: 27.9–61.9%). Importantly, 23 of the 93 (24.7%) animals positive for at least one pathogen were co-exposed, with 25.4% (18/71) of the positive buffaloes positive for brucellosis and RVFV. Based on molecular analysis, *Brucella* DNA was detected in 46 (19.5%, CI: 14.9–24.7) samples, with 4 (8.6%, 95% CI: 2.2–15.8) identified as *B. melitensis*. The Fisher's Exact test indicated that seropositivity varied significantly within the different animal families, with *Brucella* (p = 0.013), *C. burnetii* (p = <0.001), and RVFV (p = 0.007). Location was also significantly associated (p = <0.001) with *Brucella spp*. and *C. burnetii* seropositivities. Of ~20% of Kenyan wildlife that are seropositive for *Brucella* spp, *C. burnetii* and RVFV, almost 25% indicate co-infections with the three pathogens, particularly with *Brucella spp* and RVFV.

Key words: Co-infections, pathogens, *Brucella spp*., RVFV, *Coxiella burnetti*

5.2.5 Conservation of lions in Samburu through improving domestic carnivore welfare

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Abstract

The Samburu community have lived with their livestock for a long time alongside wildlife. With these close interactions, conflict often occurs when wild carnivores attack livestock. To mitigate this conflict, the communities keep dogs to guard their livestock from predation – both whilst herding during the day and watching over villages at night. However, the thriving population of dogs and close interactions with wild carnivores has led to diseases being a conservation threat to wildlife from disease spillovers. These diseases include Rabies and Canine Distemper that are fatal to lions. The Community Animal Health Initiative was started in October 2021 to improve domestic carnivore welfare thus preventing disease in domestic dogs that could spread to wildlife. The partnership programme operates in Westgate Conservancy as a Mobile Veterinary Unit. Its objectives include vaccinations against Rabies and Canine Distemper, availing population control services, treating domestic animals injured by wildlife and education on responsible animal ownership and One Health.

Over 1500 animals have received treatments and over 6000 animal vaccinations completed in Samburu East together with partners. The programme has created an early detection system where any disease outbreak is detected and managed before it spreads to livestock, people and wildlife. One Health is a necessary tool in addressing disease spillovers in community areas where wildlife live with domestic animals.

Keywords: Dogs, Disease spillover, One Health, Wildlife.

5.2.6 Gastrointestinal Nematodes and Physiology at the Livestock-Wildlife Interface in Laikipia, Kenya

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Abstract

In Laikipia County in Kenya, wildlife and livestock co-exist, sharing space and resources. While this has advantages for communities and conservation compared to exclusionary approaches, it presents challenges for managing animal health, agricultural productivity, and disease transmission. Gastrointestinal parasites are common infections in wildlife and livestock, known to impact body condition, growth rates and mortality, resulting in economic losses and public health concerns. Their physiological impacts on host species, particularly for wildlife, can be difficult to study *in-situ* however, due to a lack of non-invasive tools. This study investigated the burden of gastrointestinal nematodes in co-grazing ungulates, which are ubiquitous parasites transmitted via the faecal-oral route. Inter-specific transmission is likely, however transmission dynamics and the fitness costs of these parasites, are largely unknown. Faecal samples from 6 wildlife and 5 livestock species were collected across two sites, a private conservancy (Mpala) and a community-owned rangeland (Il Motiok). Livestock stocking densities are much higher on Il Motiok, resulting in a lower observed density of wildlife on the rangeland. Parasite burdens were estimated using a modified McMaster technique. Burden was predicted by host species, and was higher in wildlife than livestock, but no differences were found between the two properties. Future work will identify differences in

nematode species composition using DNA metabarcoding at the ITS-2 region, to identify potential transmission pathways. We have developed novel in-house enzyme immunoassays to measure faecal immune (IgA, IgG) and inflammatory (lactoferrin) biomarkers in bovid and equid species, and will use these assays to measure the physiological responses to infection burdens in our samples. These preliminary findings suggest the potential for wildlife disease reservoirs, but did not indicate that habitat management or intensity of livestock-wildlife interactions significantly impacted gastrointestinal nematode burdens. This is important for local stakeholders, and for understanding future conservation challenges in Laikipia.

Keywords: Livestock, Nematode, Parasite, Physiology, Wildlife

5.2.7 Gastrointestinal Parasite Dynamics at the Livestock-Wildlife Interface in Laikipia, Kenya

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Abstract

Laikipia County in Kenya, is home to many wildlife and livestock species that co-exist in the same areas. While this has several benefits, it also presents challenges such as the transfer of disease. Gastrointestinal parasites are common infections in wildlife and livestock. This study identified the prevalence of two groups of parasites: *Giardia spp.* and *Cryptosporidium spp*. These are both ubiquitous parasites, transmitted via faecal-oral and waterborne routes. In mixed landscapes interspecies transmission is likely, however the dynamics are largely unknown. Overall, 182 faecal samples from 6 wildlife and 5 livestock species were collected across two sites, a private conservancy (Mpala) and a community-owned rangeland (Il Motiok). Wildlife densities are lower on Il Motiok, due to overgrazing of livestock whilst Mpala has much higher levels of interspecies interaction. Protozoa prevalence was determined using PCR screening, and multilocus sequencing was used to identify species. *Giardia spp.* prevalence was 45% in wildlife and 28% in livestock. Most infections were *G. duodenalis* assemblage A followed by assemblage B. These are both zoonotic generalists. One assemblage E was found in cattle. *Cryptosporidium* was not identified in this initial sampling. These findings suggest the potential for cross-species transmission and for wildlife disease reservoirs due to the high prevalence of the same pathogens across a variety of wildlife and livestock species. This is significant for local stakeholders, and for comprehending future conservation and health challenges in Laikipia.

Keywords: Cryptosporidium, Giardia, Laikipia, Livestock, Wildlife

5.2.8 Non-invasive assessment of ovarian activity in free-ranging eastern black rhinoceros (Dceros bicornis michaeli) in Kenya

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Abstract

Eastern black rhinos (*Diceros bicornis michaeli*) are a critically endangered species living in diverse habitats across Africa. In Kenya, once threatened with extinction due to massive poaching pressures, increased protection has resulted in losses being less than 1% annually today. Still, some populations have failed to achieve desired population growth targets. At Ol Jogi Wildlife Conservancy, some individuals are experiencing sub-optimal reproduction based on historical calving records and long inter-calving intervals (>3 years). Hormones drive the reproductive process, so non-invasive assessments of endocrine patterns can be useful indicators of individual reproductive health. In this study, we analysed longitudinal fecal progestagen metabolite (fPM) concentrations in all breeding female eastern black rhinos at Ol Jogi (n = 17) and compared the prevalence of irregular estrous cycles (longer or shorter than 20–40 days) and anestrous periods (interluteal period more than twice the length of a normal follicular phase, i.e. > 10 days) between optimal (inter-calving interval < 3 years) and sub-optimal (>3 years) reproducing individuals. Ten rhinos were pregnant during at least part of the study period. A total of 12 complete cycles were observed in seven females with an average length of 36 ± 3 days and equal numbers of regular and irregular cycles. Single anestrous periods averaging 67 ± 13 days were observed in five females. Surprisingly, a majority of cycles in optimal reproducing individuals were categorized as irregular based on fPM profiles. Overall, results suggest that irregular ovarian activity and isolated bouts of anestrus do not have negative impacts on reproductive performance in this subpopulation at Ol Jogi. A high priority is to continue using noninvasive hormone monitoring to evaluate how ecological or other variables influence reproductive success in this and other eastern black rhino subpopulations in Kenya.

Keywords: Eastern black rhinoceros, hormone monitoring, ovarian activity, progestagen metabolites, reproductive performance

5.2.9 Assessment of Heavy Metal Contaminants in Nkenye Stream in Meru South-Kenya

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Abstract

Heavy metals are metals with high densities and atomic weights or atomic numbers. Heavy metal contamination can be observed in soil, water (rivers), air (atmosphere), etc. Heavy metal contamination in surface water may pose a health risk and can be very harmful if present in drinking water and in consumed food. Contamination of stream water can be detrimental to hydrophytes, animals as well as human beings. A significant number of serious animal and human health problems have been reported to have occurred among people who depend on contaminated water sources. Nkenye stream which is

located in Chuka Tharaka Nithi County is not an exception. Metals that exist in Nkenye stream are in colloidal, particulate, and dissolved phases. Nkenye stream is a critical resource for the local inhabitants yet little attention has been accorded to its water quality. Studies on major rivers such as the Tana River have been conducted to determine water flow and volumes. This study therefore analyzed water samples drawn from Nkenye stream in order to determine the relationship between water quality and wildlife health. Samples were collected at designated locations based on several criteria using ecological surveys. Samples were analyzed in Chuka University laboratory. Macrophyte roots were cleaned and dried then powdered and digested using nitric acid. The sediment was dried, ground to pass a 2 mm non-metal sieve, digested samples were diluted and analyzed using atomic absorption spectrometry model PG990. The concentration of anions was determined by ion chromatography. The statistical analyses were done using a general linear model (GLM) in the Statistical Analysis System (SAS) version 9.4 and differences in means tested for significance using the Least significance difference (LSD) test with, alpha = 0.05. The results showed that the Nkenye stream is definitely polluted with iron, copper and lead. This highlights the critical and urgent need for the Tharaka Nithi county government to seriously consider providing sustainable waste management disposal systems to minimize river water pollution and its deleterious effects on human, animal and ecosystem health.

Keywords: Animal health, contaminants, heavy metals, pollutants, water quality,

5.2.10 A One Health approach to engaging communities better in long term African elephants *(Loxodonta africana)* conservation in Sagalla, Kenya

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Abstract

Human wildlife conflict often creates negative attitudes and perceptions towards elephants and conservation players in local communities living with wildlife or near protected areas. Our work highlights the benefits of community engagement and accountability in identifying and addressing causes of conflict and discontentment, tackling hidden costs and vulnerabilities that are typically not factored in human wildlife conflict management strategies, with a One Health approach. By providing timely, relevant and actionable information and services based on community questions and concerns, and mainstreaming conservation actions across all sectors of society, we are able to capture attitudes and perceptions on wildlife that can hinder conservation progress. We present a holistic and comprehensive approach that considers the needs and perspectives of all stakeholders. This approach enhances cost-effective information sharing forums, facilitating cross messaging to dispel myths and misconceptions. It encourages innovative ideas that both efficiently and humanely mitigate human elephant conflicts, along with other underlying health problems. Additionally, it involves behavior change communication strategies to address the major cause of people's opposition to conservation, aiming to minimize the undue burden on marginalized people. We explain how the multidisciplinary approach has broadened the conversation, engaging more people to address confounding factors. Through coordinated interventions, we find that individuals become more open and willing to listen and learn about conservation priorities once their personal health and wellbeing needs are met.

Keywords: Human-wildlife conflict, community engagement and accountability, One Health, cross messaging, behavior change communicatio

5.2.11 Southern white Rhino gifts to Aitong, Kenya - fly in the ointment?

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Abstract

Gifts of wildlife from Heads of State to other countries were once common as a part of diplomacy. In this context, whilst celebrating the opening of relations between South Africa and Kenya in the 1990s, 10 southern white rhinoceros *Ceratotherium simum simum* were gifted. The species is exotic to Kenya, a species out with National species legislation and responsibility therefore left to the private sector and local authorities. The Kenya Wildlife Service (KWS) vets advised against the move, based on risk of novel tsetse-trypansome challenges, which even with the indigenous black rhinoceros, had caused mortalities. Exporting vet's opinion was conflicting and without any firm consensus, the move was approved with experts co-opted to address the tsetse risk. Initial fly trapping was employed, showing some suppression of flies in the grazing areas. This control was not sustained, despite the benefit, for initial trial introductions, and tragically followed by mortalities of South African rhino. A few were saved by subsequent removal from the area. This whole unfortunate event was complicated by unclear responsibilities for the animal's health, comprehensive management was not possible, with samples only sporadically collected. What was done, came through collaboration between the KWS veterinary unit and the ICIPE scientists monitoring the translocation release site and where invited for some cases or mortalities. Diagnostics proved severe infection with *Trypanosome brucei*, with variable symptoms from sudden death associated with intestinal atony, to a semi-paralysed animal responsive to treatment for tryps. This paper provides a diagnostic summary, hitherto unpublished due to sensitivities around this event. The material can now be archived as a warning to future movements of this species that are planned or likely in Africa, for conservation or other purposes.

Keywords: Southern white rhinoceros, trypanosomiasis, translocation, tsetse, *Trypanosoma brucei*

5.2.12 Seroprevalence of *Neospora caninum* in spotted hyena (*Crocuta crocuta*) populations in areas of high and low anthropogenic activity in the Maasai Mara National Reserve, Kenya.

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Abstract

Neospora Caninum is a globally distributed intracellular parasite that infects both warm blooded domestic and wild animals. It is one of the causes of abortion in cattle and causes severe pathologies in canids. In domestic animals, the parasite's transmission, distribution, and manifestations are clearly understood, but in the wild, it is uncertain how it affects different sexes and age groups. This is despite the parasite detection in several wildlife species both in Kenya and across the world. There is horizontal and vertical transmission of this parasite making it easier to spill over from domestic to wild animals thus posing a risk to wild canids. This has been precipitated by the high level of anthropogenic disturbance within wildlife conservation sites such as the Mara National Reserve in Kenya. It has been observed that some pastoralist communities graze their livestock in protected areas such as the Maasai Mara National Reserve in Kenya, thus fostering anthropogenic disturbance, increased livestock-large carnivore interactions, and thus a reduction of space for roaming of large carnivores like *Crocuta crocuta*. **:** The overall objective of the study was to determine the seroprevalence of *Neospora caninum* in *Crocuta crocuta* populations in areas of high and low anthropogenic activity in the Maasai Mara National Reserve. The project characterized the epidemiology of *N. caninum* infection in *Crocuta crocuta* populations using long term data from the Mara Hyena project. Overall, 196 *Crocuta crocuta* were sampled from four clans in the Maasai Mara National Reserve. They were tranquilized with telazol then blood sera were collected from their jugular veins. *Neospora caninum* IgG antibodies were analyzed using IFAT, with infection defined by standard titers (>100). Plasma samples underwent duplicate assays for cortisol and testosterone levels and were compared between infected and non-infected hyenas, stratified by sex and age. The study determined that the overall prevalence of *N. caninum* infection was 67.1% with populations living next to high anthropogenic activities showing the highest prevalence rates. The prevalence rate in females (70%) was higher than males (59.6%) but was not statistically significant. Cubs were 50.3 times more likely to test positive for neosporosis compared to adults. Hyenas with increased seropositivity ratio of toxoplasmosis had increased odds (74.4) of testing positive for neosporosis. There was a significant variation in the level of corticosterone found between *N. caninum* negative and *N. caninum* positive hyenas g (98 vs 53; p-value 0.035). Other factors associated with *N. caninum* infection included relative rank at darting. The findings of the study are essential for the development and implementation of control programs within the wildlife-protected sites in Kenya for the *Crocuta crocuta* population. Moreover, since the prevalence of infection varies by sex and age categories, these differences will be designed to meet the needs for the effective conservation of this species.

Keywords: Anthropogenic-Activity, *Crocuta crocuta*- Spotted hyena, Maasai-Mara, *Neospora caninum*, Seroprevalence

5.2.13 The physiological condition of orphaned African elephants in the Samburu and Buffalo Springs National Reserves, Kenya

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Abstract

Prolonged maternal care is critical for many social mammal species, illustrated by lowered survival of weaned orphans as compared to weaned nonorphans. However, our understanding of the physiological mechanisms leading to lowered survival for these orphans who are no longer dependent on their mother's milk is lacking. Moreover, many long-lived species for which prolonged maternal care is fundamental are also of conservation concern, yet orphan deaths are rarely considered in models of population growth. We compared the physiological condition of surviving orphaned and nonorphaned African elephants (*Loxodonta africana*), an endangered species with a high degree of maternal care, in a population of Samburu, Kenya, that has been monitored since 1998 such that each individual is known. The physiological metrics we compared include strongylid (parasitic worm) loads as approximated by fecal egg counts, average baseline glucocorticoid levels as approximated by fecal glucocorticoid concentrations, and growth as approximated by heights calculated with a range finder. Further, we applied a robust quantitative approach to empirically assess whether orphan deaths measurably affect population growth. Results with respect to strongylids and glucocorticoids were nuanced, with orphans who had left their family showing differences to orphans who were still with their family and nonorphans. Orphans were shorter than nonorphans for their age, and critically, we found that lowered survival of African elephant orphans has a large negative correlation with population growth. This suggests that the total impact of adult female deaths on elephant populations and populations of other social mammals species has not been realized.

Keywords: Conservation, elephant, orphan, physiology, poaching

5.2.14 Variability in water quality parameters within Kenyan Rhino areas and potential toxicity from water uptake

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Abstract

Assessing water sources, quantity, quality, and seasonal variations within Black Rhino Conservation areas helps evaluate the sites' suitability for sustaining rhinos in the long-term. Such routine analysis also assists managers to compare standards within their conservancies and mitigate against water stress and other potential ecological stress factors that may be associated with water. Water is the most important nutrient in animal feeding and animal health in general and water quality is an issue receiving widespread attention. High quality water is essential for successful Black Rhino production. Saline water could potentially reduce performance and overall productivity of Black rhinos with Rhinos becoming more apparent with exposure to increase in concentrations that stress the kidney. When establishing new Rhino areas, a comprehensive multi-dimensional approach has been embraced in Kenya that considers a wide range of ecological factors with an influence on the carrying capacity. The current practice is that there is consideration for vegetation composition, water resources, soil quality, and veterinary considerations among other factors. This paper compares the major physical and chemical parameters

from natural water sources in 10 Rhino areas, namely; Lake Nakuru National Park, Nairobi National Park, Solio Ranch, Lewa Borana, Ruma National Park, Chyulu Hills National Park, Meru National Park, Olpejeta Conservancy, Tsavo NP EPZ zone and the SERA Community conservancy. For the majority of the sites, data for a full chemical analysis exists and we are able to compare these data from Total Dissolved Solids, Major Elements and some heavy metal concentrations. Results indicate high variations in the various water sources within these sanctuaries, confirming the relative tolerance of Black Rhinos to varying salinity levels (TDS mgl^{-1}, n=41, max=984, min=24, SD=216; pH n=48, max= 9, min=6.4, SD= 0.8; Na^{+} mgl^{-1}, max=189, min=3.5, SD=43.) In the majority of Rhino areas in Kenya, salinity has previously been flagged out as a major potential mortality threat, however, important to note is that wildlife is able to adapt to saline water but abrupt changes from low to high salinity can be harmful. The salinity of drinking water affects productivity, performance, feed conversion ratio, water metabolism distribution of body fluids, kidney function and blood constituents of animals. Although wildlife is able to adapt to saline water, we recommend that analysis of water at source and release sites should be undertaken to reduce the potentially fatal effects of abrupt changes from low to high salinity Levels.

Keywords: Black rhinos, water quality, salinity

5.2.15 Using a One Health approach to address wildlife disease challenge

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Abstract

Wildlife health is defined as the ability or the capacity to realise full function, satisfy daily needs and adopt or cope with changing environments. Wittrock and Stephen of the University of Saskatchewan and Duncan of the Colorado state University classified the determinants of wildlife health into six themes: "the biological endowment of the individual and population, the animal's social environment, the quality and abundance of the animals' needs for daily living, the abiotic environment in which the animal lives, sources of direct mortality and the changing human expectations". These themes, translated into their functional attributes, bring into focus issues such as habitat availability and quality, competition, prey availability, escapement, parasites, and diseases. These factors play important roles in wildlife health planning. According to the World Organization for Animal Health and the World Health Organization, the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent. Many studies reveal the presence of Reverse Zoonosis (Zooanthroponoses), for example, the case of *methicillin-resistant staphylococcus aureus*. Strategies for preventing anthroponoses and zooanthroponoses, such as minimising human-wildlife interface erosion, eliminating transmission points, and regulating and monitoring wildlife trade as well as markets for wild animals and their products, will positively impact wildlife health. Implementing and monitoring policies that mitigate the negative impacts on wildlife health determinants is crucial. This includes enhancing collaboration and coordination among various stakeholders to ensure the conservation of wildlife and their natural habitats. Additionally, it is important to transform food production systems to safeguard wildlife habitats. Elevating programmes for the prevention of emerging infectious diseases, pandemics and wildlife disease control is also key. This paper will link the impacts of human, animal and environmental health (biotic and abiotic environment) on the determinants of wildlife health, and subsequently, on wildlife health itself.

Keywords: Determinants of wildlife health, functional attributes of the determinants of wildlife health, One Health, wildlife health, zooantroponosis.

06

Use of New Technology in Addressing Wildlife Conservation Challenges

6.1 Keynote Speaker

Dr. Jake Wall, Director of Research & Conservation, MEP and Bruce Jones, Partnership Director, EarthRanger

The speaker observed that conservationists need ways to easily collect data and turn it into information that informs policy and management. In the recent past, there have been rapid advances in technology, data access, and processing. Conservationists have often had to leverage technologies built in other sectors (finance, engineering) to support conservation efforts. However, in the recent past considerable investment in newer conservation technology driven by the needs of conservation practitioners has been seen. Such recent development includes the Earth ranger which consolidates data from around 100 manufacturers of sensors, mobile devices, vehicles, trackers, field reports and many other devices to feed into the platform. The Earth ranger platform collects, integrates, and displays this data and combines it with reports from the field which is eventually displayed in one unified picture that enhances the way you protect wildlife. Earth ranger is an easy to use, all-in-one system which makes the operations of the organizations using Earth ranger more effective and efficient. It is also able to visualize real-time and historical data. The technology combines a data-driven, best-in-market intelligence platform. This means better informed conservation decisions and device agnostic. Earth ranger also mixes and matches the best technology for the job to help you go from being reactive to proactive. There is no cost as the software, training, and ongoing support are free so you can stretch your money elsewhere. Earth ranger can be used for ecological management, human- wildlife coexistence, security, and to enhance logistics.

6.2 Presentations

6.2.1 Compatibility of livestock and wildlife in human-occupied rangelands: Using traditional pastoralism to enhance conservation of lions and their wild prey in Laikipia, Kenya

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Abstract

Large carnivores come into conflict with pastoralists, thereby compromising livelihoods dependent on livestock production. Lions (*Panthera leo*) have returned to the Laikipia Plateau in central Kenya after decades of lethal control, and their restoration has been fueled by an abundant population of their primary prey, plains zebra (*Equus quagga*). Zebra aggregate around glades—lush grazing lawns derived from manure from cattle corrals. As a result, lions focus their hunting activity in and around glades, thereby increasing predation risk for various species of antelope that occur in proximity to zebra (and thus glades). In particular, an endangered antelope—Jackson's hartebeest (*Alcelaphus buselaphus jacksoni*)—is declining due to this dynamic of "apparent competition", in which lion prey preferences are disproportionately reducing hartebeest survival relative to that of zebra. Strategically placing corrals >0.5 km from hartebeest territories could provide spatial separation between hartebeest and zebra, thereby enticing lions to hunt (and thus kill) zebra far away from hartebeest. I propose to remotely quantify zebra aggregation behavior around glades of different age classes via camera trap imagery. I will couple these methods with kill-site "clusters" (derived from GPS-telemetered lions) and hartebeest vital rates (derived from sight-resight methods of individual hartebeest). My analyses will enhance our understanding of the spatial and temporal scales over which glades attract zebra, and how proactive cattle production may be used as a tool to conserve lions and their wild prey all while minimizing conflict with pastoralism. This project is therefore likely to result in a rare win-win in wildlife conservation: hartebeest are conserved without resorting to lethal control of lions, through active collaborations with pastoralists.

Key words: Apparent competition, wildlife-livestock interactions, conservation, ecosystem dynamics, human-wildlife coexistence

6.2.2 Combining technologies to examine human-lion interactions across scales for improved coexistence

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Abstract

As worsening environmental crises harm humans and nonhumans alike, the need for improved human-wildlife interactions is increasingly dire. Multispecies coexistence is especially critical for the predator guild, wherein threatened carnivores and humans often come into conflict over shared resources. Technology provides important tools for mitigating these conflicts, though greater integration of technologies across scales of space, time, and biological organization can advance our understanding of coexistence dynamics. Here we demonstrate how an interdisciplinary combination

of technologies enables us to examine novel dimensions of interactions among people, livestock, and lions (*Panthera leo*) to promote sustainable coexistence in Laikipia, Kenya. In collaboration with local communities, conservancies, and organizations, we study human-lion interactions from individual to landscape scales using four main categories of state-of-the-art technology: 1) biologging, 2) remote sensing, 3) eDNA, 4) mobile apps and computer software. By combining biologging tools used in animal movement ecology (e.g., species movement, acceleration, & radio tracking [SMART] collars) and human mobility science (e.g., smart phones and watches), we can collect high-resolution, spatiotemporally-aligned data for interacting lion, livestock, and human individuals. Drone-based remote sensing surveys using an integrated Light Detection and Ranging (LiDAR), red-green blue (RGB), and thermal sensor package enable us to create extremely detailed maps of landscape features in three dimensions. Using in-country molecular technologies, we compare DNA from lion scat samples collected from the field and at collaring events to assess wild vs. domestic prey in the diets of different lion individuals. Software utilized on portable electronic devices facilitates all field-, lab-, and computer-based data collection and analyses. Overall, this integration of diverse technologies across scales will not only advance scientific knowledge of human-carnivore interactions, but also inform conservation management for enhanced human, wildlife, and ecosystem wellbeing.

Keywords: Carnivore ecology; Conservation technology; Human-wildlife coexistence; Lion; Socioecological systems

6.2.3 Flooding of Lake Nakuru National Park in Kenya and its effects on the resident wildlife.

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Abstract

Lake Nakuru is one of Kenya's Rift Valley Lakes and lies within the Lake Nakuru National Park. As a key habitat for both greater flamingo (*Phoenicopterus roseus)* and lesser flamingo (*Phoenicopterus minor*) and other water birds, the lake is a major tourist attraction. Lake Nakuru National Park covers an area of approximately 188 km² and is fully enclosed with a perimeter fence. The park is home to about 56 different species of mammals, 550 plant species, and 450 species of terrestrial birds as well as flamingos and other water birds. In the last decade, the lake has experienced continuous flooding, increasing the lake area from 35 km² in 2009 to 54 km² in 2018. This impacted negatively on the available space for wildlife. The main objective of this study was to investigate the effects of this flooding on the wildlife and their habitats in Lake Nakuru National Park. The methodology used Land use and land cover (LULC) interpretation of Landsat Satellite imagery from two epochs, 2009 and 2018, and integration of the results with relevant wildlife data provided by the Kenya Wildlife Service (KWS). The results, which include LULC change maps and wildlife distribution maps, have shown that the flooding impacted negatively on the available space for wildlife. In addition, the floods also compromised key park infrastructure such as roads and the main gate making it very difficult to maintain the normal park operations, and hence adversely affecting the local and national economies. The information provided by this study is useful for planning mitigation measures in respect of the current and potential future flooding.

Keywords: Change detection, Flooding, Lake Nakuru, Land cover, Land use

6.2.4 Hippopotamus (*Hippopotamus amphibius*) suitable habitat analysis in the Pendjari biosphere reserve using remote sensing and GIS tools

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Abstract

Lake Nakuru is one of Kenya's Rift Valley Lakes and lies within the Lake Nakuru National Park. As a key habitat for both greater flamingo (*Phoenicopterus roseus)* and lesser flamingo (*Phoenicopterus minor*) and other water birds, the lake is a major tourist attraction. Lake Nakuru National Park covers an area of approximately 188 km² and is fully enclosed with a perimeter fence. The park is home to about 56 different species of mammals, 550 plant species, and 450 species of terrestrial birds as well as flamingos and other water birds. In the last decade, the lake has experienced continuous flooding, increasing the lake area from 35 km² in 2009 to 54 km² in 2018. This impacted negatively on the available space for wildlife. The main objective of this study was to investigate the effects of this flooding on the wildlife and their habitats in Lake Nakuru National Park. The methodology used Land use and land cover (LULC) interpretation of Landsat Satellite imagery from two epochs, 2009 and 2018, and integration of the results with relevant wildlife data provided by the Kenya Wildlife Service (KWS). The results, which include LULC change maps and wildlife distribution maps, have shown that the flooding impacted negatively on the available space for wildlife. In addition, the floods also compromised key park infrastructure such as roads and the main gate making it very difficult to maintain the normal park operations, and hence adversely affecting the local and national economies. The information provided by this study is useful for planning mitigation measures in respect of the current and potential future flooding.

Keywords: Hippopotamus benefit, suitable habitat, Positive perception, grassland, Savannah

6.2.5 Impacts of the Loisaba conservancy rhino fence on the behavior of other wildlife species

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Abstract

Fences around rhino conservation areas are a necessary feature in Kenya's rhino meta-population management because of the high illicit demand for rhino horn on the international black market. However, fences have known detrimental impacts on other species, for example, entanglement, limits to dispersal and resource acquisition, and increased vulnerability to predation. Yet, little information is available on the ways in which wildlife adapt to new fencing. Using camera traps, fence flags, and fence attendants, we determined how wildlife adapted to corridor usage and how fence flagging affected wildlife fence breakages. We report on the behaviors observed, including fence crossings, vigilance, direction reversals, and fence breakages, and how these patterns varied by species. We present our findings in the context of the habituation process that occurs among wildlife species encountering the fence. Preliminary results indicate that wildlife are getting used to the corridors and fence, but flagging is not effective in deterring wildlife from breaking the fence since most breakages occurred on flagged sections of the fence. These findings will be valuable for those managing fenced landscapes for multiple species.

6.2.6 Enhancing mapping of illegal wildlife trade hotspots in Kenya: Integrating market survey and confiscated wildlife meat analysis

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Abstract

Illegal wildlife trade is a severe threat to survival of wildlife populations and has been linked to documented declines of some species. Poachers and illegal wildlife traders often mask meat as livestock meat to sell to consumers. However, new technology can now accurately identify the species from which the meat sold in markets is sourced. In this study, we combined market survey sampling and analysis of specimens obtained through enforcement confiscations in Kenya to test the fidelity of market surveys in jurisdictions where wildlife meat consumption is illegal. Random meat sampling and molecular analysis are routinely used in detecting wildlife meat and identifying poaching hotspots. As such, we sought to map wildlife poaching hotspots to guide conservation management market surveys within five Kenyan conservation areas and analysis of confiscated wildlife meat samples. The market survey samples were sequenced using standard mammalian barcode primers used for confiscated samples for species identification. Wildlife meat samples confiscated over a seven-year period were also analyzed to assess temporal trends. Out of the 241 market survey meat samples collected over a two-year period (2020-2021), 13 tested positive and corresponded to five species. Over the same period, 112 out of 116 confiscated samples belonging to 48 wildlife species tested positive. At least 48 wildlife species were identified from a total of 568 wildlife samples that were confiscated during the 2015-2021 period, with 2021 recording the highest incidences. Overall, the market survey under-estimated presence of wildlife products but competitively unmasked poaching hotspots. The combined dataset identified Amboseli (Kajiado) and Nakuru-Naivasha highway (Naivasha) as illegal wildlife trade hotspots, with the Masai giraffe being the most targeted species. We discuss the implications of our findings in the context of conservation through the lens of changing socioeconomic factors and potential public health impacts to highlight the importance of enforcement and continued monitoring.

Key words: Bushmeat, conservation, forensic, trade, biodiversity, poaching

6.2.7 Introducing a new HEC Toolbox and Trainer of Trainers workshops to enhance human-elephant co-existence.

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Save the Elephants

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Abstract

Save the Elephants' (STE's) Human-Elephant Co-Existence Program has been testing a Toolbox Manual of tried and tested mitigation methods gathered from across countries to increase tolerance between farming communities and elephants in Kenya using science-based approaches to reduce the socio-economic impact of living with crop-raiding elephants. The project will share insights into a new Human-Elephant Co-Existence (HEC) Toolbox Manual (freely available) while sharing case studies of implementation success and including a new Trainer of Trainers program initiated by Save the Elephants in 2023. Examples of some of the 80+ tools being taught in the ToT program include novel farm boundaries, water point and tree protection, non-palatable crops, elephant-aware behaviour and alternative income-generating projects. We illustrate how offering project officers and communities with sufficient training in a tested set of HEC tools is increasing tolerance towards elephants, which in turn, is reducing the need for permanent fencing solutions.

Keywords: Human-Elephant Co-existence Program (HEC), Toolbox Manual, Mitigation methods, Crop-raiding elephants, Trainer of Trainers program.

6.2.8 Keeping watch on Olgulului Ololarashi Group Ranch

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Abstract

About 90% of Amboseli National Park (ANP) is surrounded by Olgulului Ololarashi Group Ranch (OOGR). This ranch acts as a wildlife dispersal area to ANP and hence is of great importance. There is a need to monitor what happens in OOGR since this has a direct bearing in most cases on the park itself. The monitoring of OOGR is, in the main, undertaken by the Olgulului Community Wildlife Rangers (OCWR) with support from the International Fund for Animal Welfare (IFAW) and the Kenya Wildlife Service (KWS). Now, effective monitoring requires, among others, a good information system that enables one to gather data, process it and then display it in simple and easily understood formats. Further, the system should enable one to store data securely. Having observed that OOGR did not have a good information system, IFAW teamed up with OCWR and started developing an online near-real-time OCWR information system in July 2021. The system comprises two customized mobile apps and the ArcGIS Enterprise platform. The mobile apps are used to collect data on wildlife sightings, human wildlife conflict, poaching, wildlife mortalities and ranger patrol movements. The data collected are then uploaded onto an ArcGIS Enterprise platform and from where they are processed. The processed data are output via dashboards. The information from these dashboards has increased the effectiveness of OCWR in the conservation and management of OOGR. The information has also increased OCWR's potential to enhance the conservation and management of ANP and beyond.

Keywords: Amboseli National Park, ArcGIS Enterprise, ArcGIS Survey 123, Dashboards, Olgulului Ololarashi Group Ranch.

6.2.9 Leveraging AI and satellite to push the boundary of wildlife survey technologies

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Abstract

New satellite remote sensing and machine learning techniques offer untapped possibilities to monitor global biodiversity with unprecedented speed and precision. These efficiencies promise to reveal novel ecological insights at spatial scales which are germane to the management of populations and entire ecosystems. Here, we present a robust transferable deep learning pipeline to automatically locate and count large herds of migratory ungulates (wildebeest and zebra) in the Mara-Serengeti ecosystem using fine-resolution (38-50 cm) satellite imagery. Our results achieve accurate detection of nearly 500,000 individuals across thousands of square kilometres and multiple habitat types, with an overall F1-score of 84.75% (Precision: 87.85%, Recall: 81.86%). Our research demonstrates the capability of satellite remote sensing and machine learning techniques to automatically and accurately count very large populations of terrestrial mammals across a highly heterogeneous landscape. Our approach holds extreme promise for scaling spatially to produce the first ever total counts of migratory ungulates in open landscapes. In addition to facilitating total counts for multiple species, the ability to observe expansive herds of migratory ungulates from space presents an exciting opportunity for the study of the ecology of animal aggregations from an entirely novel perspective.

Keywords: Artificial intelligence, Deep learning, Mara-Serengeti ecosystem, very high-resolution satellite imagery, Wildebeest migration

6.2.10 Photo identification as a tool to study *Chelonia mydas* and *Eretmochelys imbricata* populations in Kenyan Marine Protected Areas

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Abstract

Kenya possesses an extensive coastline that boasts a variety of marine ecosystems, including coral reefs, mangroves, and seagrass lagoons that host rich biodiversity. Beyond these coastal waters are migratory corridors for marine megafauna, including humpback whales, whale sharks, and sea turtles, which are also known to nest on Kenya's beaches. The data on foraging and developmental habitats of sea turtles along the coast and on turtles migrating out of Kenyan waters is scarce, hindering our understanding of the full extent of threats to these populations. A sea turtle photo ID program was initiated in July 2018 in the Diani-Chale Marine National Reserve, located on Kenya's south coast, and is managed by the Olive Ridley Project. The program has been used to obtain discrete information about individuals' locations at a given time, which is essential knowledge for spatial planning and conservation management of endangered species, as well as to create a baseline for juvenile green turtle foraging populations in the south coast of Kenya. In a three-year nine-month period,

from July 2018 to March 2022, ORP has recorded 3,369 sea turtle encounters, 2,939 of which were 653 individual green turtles (*Chelonia mydas*), and 430 of which were 87 individual hawksbill turtles (*Eretmochelys imbricata*). Nearly half of the turtles (48%) have been re-sighted, showing strong site fidelity. Data shows the importance of this protected area as a site where sea turtles exhibit strong site fidelity for foraging aggregations. However, the preferences for shallow, nearshore habitats are likely to increase the encounter risk with artisanal fisheries and tourism activities. This pioneer work in Kenya has since expanded to 3 more marine protected areas in Kenya and has become the basis for an in-water sea turtle juvenile population monitoring network.

Keywords: Chelonia, eretmochelys, identification, Kenya, population

6.2.11 Post-release behavior of rehabilitated and released elephant calves in Sera Rhino Sanctuary

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Abstract

Kenya possesses an extensive coastline that boasts a variety of marine ecosystems, including coral reefs, mangroves, and seagrass lagoons that host rich biodiversity. Beyond these coastal waters are migratory corridors for marine megafauna, including humpback whales, whale sharks, and sea turtles, which are also known to nest on Kenya's beaches. The data on foraging and developmental habitats of sea turtles along the coast and on turtles migrating out of Kenyan waters is scarce, hindering our understanding of the full extent of threats to these populations. A sea turtle photo ID program was initiated in July 2018 in the Diani-Chale Marine National Reserve, located on Kenya's south coast, and is managed by the Olive Ridley Project. The program has been used to obtain discrete information about individuals' locations at a given time, which is essential knowledge for spatial planning and conservation management of endangered species, as well as to create a baseline for juvenile green turtle foraging populations in the south coast of Kenya. In a three-year nine-month period, from July 2018 to March 2022, ORP has recorded 3,369 sea turtle encounters, 2,939 of which were 653 individual green turtles (*Chelonia mydas*), and 430 of which were 87 individual hawksbill turtles (*Eretmochelys imbricata*). Nearly half of the turtles (48%) have been re-sighted, showing strong site fidelity. Data shows the importance of this protected area as a site where sea turtles exhibit strong site fidelity for foraging aggregations. However, the preferences for shallow, nearshore habitats are likely to increase the encounter risk with artisanal fisheries and tourism activities. This pioneer work in Kenya has since expanded to 3 more marine protected areas in Kenya and has become the basis for an in-water sea turtle juvenile population monitoring network.

Keywords: Chelonia, eretmochelys, identification, Kenya, population

6.2.12 Real-time water quality monitoring using innovative Wireless Sensor Network technology: A pilot study in Lake Nakuru, Kenya

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Abstract

Water quality is an important attribute of aquatic ecosystems and hence its monitoring is useful in understanding its ecological dynamics. Over the last decade, the hydrological dynamics in the rift valley lakes including Lake Nakuru have changed significantly. These changes have not only influenced the water balance but also the water quality and by extension the limnological conditions in the lake leading to changes in aquatic flora and fauna. Water quality monitoring is usually necessary to inform such changes and the resultant management interventions. The common approach used for water quality monitoring in Kenya is manual field sample collection and subsequently followed by laboratory analysis. The objective of this project was to set up pilot infrastructure and network support for real-time wireless sensor network (WSN) for water quality monitoring and to develop human and technological capacity for such innovative approaches. Considering the lack of internet connectivity and poor GSM network in the lake, LoRaWAN (low-power, wide area networking) protocol built on top of the LoRa radio modulation technique was selected as a means of communication between end-node devices and network gateway. Link profiles and data collection plan was done prior to installation of sensor nodes and gateway. Selected sensors were acquired and custom buoys were designed, fabricated, tested and used for the deployment of sensor nodes at points of interest in the lake open waters. In this project, libelium waspmote was used to set up nodes in the lake for transmitting data to a gateway. The sensors currently deployed measure temperature, pH, turbidity and conductivity. The sensor output data is viewed through the Thingspeak IOT platform. The MQTT script developed that allowed data transmission protocols from the nodes to the gateway and to the access platform has been successful. Stakeholder sensitization on new approaches for real time water quality monitoring has also been done as part of a continuous process of engagement. Some of the key challenges experienced include the need for regular cleaning and re-calibration of sensors as well as the lake level dynamics. The results of this pilot project show that such low cost infrastructure for real time monitoring is possible as consistent data transmission has been achieved. The study further confirms the potential role of digital technology and internet of things (IoT) in environmental monitoring are workable and can be used to complement conventional approaches. This therefore provides an opportunity for application of the innovative WSN technology for real time environmental monitoring in aquatic ecosystems to generate high frequency and real-time data that can contribute to the management of aquatic ecosystems.

Keywords: Real-time monitoring, water quality, sensors, Internet of T

6.2.13 Status of animal forensics in Kenya with a focus on wildlife

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Abstract

Forensic science is the solicitation of multidisciplinary science to matters of law. Animal forensics is the convergence of these wide-ranging varieties of sciences including veterinary medicine with tenacity to afford riposte(s) to interrogation(s) of concern to a court of law regarding animal crimes of domesticated animals and their derivatives. When it involves wildlife animals, their derivatives and habitat, the term commonly applied is wildlife forensics. Both cases embrace animal-related litigations focusing on the violation of animal/wildlife laws (national, regional and international) amongst other legal disputes surrounding the fauna and faunal environment. This presentation explores the essential issues related to the status of animal forensics in Kenya including animal-related litigations and associated agencies, connotation and the prospective for the future of wildlife forensics in Kenya. Animal forensics in Kenya is increasingly developing, however the veterinary aspect still remains an incipient field apart from the area of animal welfare. Even though Kenya has good animal welfare legislations coupled with well-organized animal welfare agencies, several factors have resulted in inadequate inclination towards making veterinary forensics a national priority. On the other hand, owing to Kenya's reliance on tourism as a source of national income and international significance of wildlife, wildlife matters (welfare and crime) have received much more attention. Wildlife forensic techniques especially those used to curtail wildlife crimes are handled slightly differently with better enforcement of the legislation. Currently, there is a dearth in pertinent wildlife forensic capacities/establishments; nonetheless, a few analytical techniques and methodologies exist in a few institutions within the Country. With the recent establishment of the National Forensic Laboratory, it is expected that the missing forensic tools and technologies essential for wildlife forensics capabilities are set to improve.

Keywords: Animal forensics, animal litigations, capabilities, forensic techniques, Kenya

6.2.14 Using GPS tracking data to assess elephant *(Loxodonta africana)* movement in relation to risk in Laikipia Samburu landscape.

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Abstract

Poaching escalated in the years 2009 to 2012 and was the greatest immediate threat to elephants' survival, before subsiding recently. Since elephants are known to respond to anthropogenic risks by alterations in their speed of travel, we quantified this alteration as a ratio of night-time speed to daytime speed (night-day speed ratio) and examined its relationship with poaching levels. Our hypothesis was that poaching is a clear daytime risk, and thus an increase in nighttime movement rates over those seen during the day will support this hypothesis. Using elephant GPS tracking and mortality data collected in the Laikipia-Samburu ecosystem of northern Kenya between 2002 and 2012, we calculated the mean night-day speed ratio for collared elephants that utilized any of 13 contiguous land units, each under different ownership and management status, and related this ratio to the corresponding poaching levels before and during a poaching

surge. Our study showed that elephants moved more at night than during the day where and when risk levels were high. We concluded that the variation in the night-day speed ratio of elephants might be used as an effective indicator for changes in poaching levels on a near real-time basis. We recommend the adoption of the Night Speed Ratio as a complimentary anti-poaching tool and an exploration of the same metric against other anthropogenic risks where GPS tracking data is already available. The significant alteration in movement behavior by elephants in response to risk also has potential implications for their foraging strategy, reproduction, and ultimate survival, all of which are not yet fully understood.

Key Words: African elephant, Poaching, Risk, GPS tracking, Night-day speed ratio

6.2.15 No-Take or Regulated-Take? A study on coral reef conservation in Kenya

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Abstract

Climate change poses a major threat to coral reefs and an effective global action is a prerequisite. While marine protected areas (MPAs) have been adopted to secure coral reef resilience, which management regime is more effective: the no-take (dubbed parks in this study) and the regulated take (dubbed reserves). Kenya, being a global pioneer nation to establish MPAs, the effectiveness of the management regimes is assessed. Three MPAs, under similar management regimes, of different ages, located in different geographic locations and exposed to different conditions: Malindi, Mombasa and Kisite are assessed for the status of the dominant taxa and functional groups of fish, macroinvertebrates and benthic substrate cover. Differences were prominent between management regimes in Malindi, where the park exhibited a coral-algal codominance and high fish density, whereas the reserve entailed a turf algal-dominated system with low fish density. Mombasa Marine Park and reserve veered more toward patterns observed in Malindi reserve. Kisite park and reserve showed similar patterns, each being hard coral-dominated, with a similar high fish density to Malindi park. Higher abundance of herbivorous fish corresponded to lower turf algal cover in all cases. Sea urchins (Echinometridae) were more abundant in the reserves – an indicator of overfishing. From the results, it is suspected that wrasses (Labridae) could be the main predators of the Echinometridae as the former was more abundant in the parks. The lower hard coral cover in Mombasa can be justified by the relatively younger age of the MPA. Further, its peri-urban nature predisposes it to pollution from urban sewage and stormwater discharge. For Malindi, fluvial nutrient enrichment is impacting the reserve more than the park. Kisite, however, is positioned in a lower anthropogenic impact area, which could allow it to perform better. There is, however, a need for more assay analyses to identify all herbivore and invertivore species that play a role in controlling algae and sea urchins respectively. Furthermore, efforts need to be put in place to control pollution from affecting the resilience of Mombasa and Malindi MPAs.

Keywords: Marine Protected Area, Marine Park, Marine Reserve, No-take zone, Regulated-Take, resilience, coral reef, herbivory, sea urchins, bioerosion

07

Use of Biotechnology and Bio-Prospecting for Enhanced Socio-Economic Benefits

7.1 Keynote Speaker

Bioprospecting and biotechnology: An ethical human rights perspective

Prof Marion Mutugi, EBS. Commissioner at Kenya National Commission on Human Rights

The speaker observed that bioprospecting stages include collection of samples from the biosphere, identification, isolation and characterization of compounds, screening and confirmation of bioactivity and product development, testing and commercialization. Among the bioprospecting players are resource local producers, contact researchers, network of laboratories and academic researchers. These prayers work with harvesters, bio-traders (export sales), bio-prospectors (internet sales and retail sales) and contract manufacturers, traditional knowledge providers, formal commercial bioprospecting sector and NGOs. Tropical bioprospecting includes bushmeat and traditional medicine. Bodiversity-based industries include those that are established (agriculture, forestry, fisheries and tourism), those benefiting from biodiversity exploration (pharmaceuticals, crop protection, botanical medicines, and cosmetics) and novel (biomining, biomonitoring, bioremediation, ecological restoration, industrial biomimetics, ecotourism). The taxa of bioprospecting interest include chordates, plants, mollusks, crustaceans, protozoans, insects, algae, arachnids, nematodes, fungi, viruses, bacteria, and others. She further observed that the social benefits of bioprospecting is through enhancing local science (scientists and funding), supports environmental protection and management and encourages conservation in other sectors such as business, industry and economic developments. She stated that the key threat to bioprospecting is Biopiracy, where indigenous knowledge of nature, originating with indigenous people is unethically appropriated or commercially exploited, without authorization or compensation to the indigenous people themselves. The UN Convention on Biological Diversity of 1993 calls for secured rights to control access to genetic resources or the countries in which those resources are located and enables lesser-developed countries to better benefit from their resources and traditional knowledge. Bioprospectors are therefore required to obtain informed consent to access such resources and share any benefits with the biodiversity-rich country. The Nagoya Protocol of 2014 provides the regulations to operationalize the Convention on Biological Diversity to avoid Illegal Unsustainable Wildlife Trade. Extraction of materials from the environment for human use results in soil degradation, water shortages, biodiversity loss, and damage to ecosystem functions and exacerbation of global warming.A 50-year status of wildlife species shows declining populations due to several challenges. Human rights have responsibilities. The state shall protect cultural heritage, indigenous knowledge, promote intellectual property rights and the environment for the present and future generations.

7.2 Presentations

7.2.16 A New Gem: *Steganotaenia araliacea*, a new host plant for edible *Bunaea alcinoe* larva in Yatta plateau, Machakos, Kenya

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Abstract

Moths are Lepidopteran, and they occur in hundreds of millions worldwide and in all sizes, colours and shapes. They play various ecosystem services as pollinators, pests, prey, and as hosts of parasitoids as well as feed for animals and food for millions of people. More than 2,000 edible insect species are recorded globally as traditional food sources because of their high proteins, amino acids, vitamins and micronutrient contents. Edible larvae are the most recorded popular edible insects in sub-Saharan Africa. They are big,colourful caterpillars with spines on their bodies and feed on specific trees and shrubs as they show high specificity and preference to host plants. Various Saturniidae species have been documented in Africa as both oligophagous and polyphagous feeders. *Bunaea alcinoe* is one of the recorded edible larvae that is found in various regions of Kenya. *B. alcinoe* larvae have been documented to feed on *Balanites aegyptiaca* and *Balanites glabra* only. *B. alcinoe* caterpillars were observed continuously in the month of May and June 2023 feeding on Steganotaenia araliacea in Kikuyuni,

Yatta plateau, Machakos until they pupated. A 30 centimeter voucher specimen was cut from the host plant and taken to the East Africa Natural History herbarium for identification. The results identified *S. araliacea* as a new record for *B. alcinoe* host plants in Kenya and Africa. This study recommends further research on the effect of the different host plants on biology and nutritional value of *B. alcinoe* larvae in order to foster food and nutrient security and create livelihoods through sale of caterpillars. Finally, this study recommends genetic analysis of the host plants as most host plants show 97-100% similarity in GenBank sequences, and assessment of conservation status of *S. araliacea* because it has various medicinal uses and the seeds are small and difficult to collect.

Keywords: *Bunaea alcinoe*, edible larvae, host plants, *Steganotaenia araliacea*

7.2.17 Bioprospecting for Extremophiles break-down of keratin-laden biomass waste

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Abstract

Environmental pollution is a major problem in cities across the world. Feathers are keratin laden fibrous and recalcitrant structural proteins and are the third most abundant polymers in nature after cellulose and chitin. A wide spectrum of animals have developed a diversity of keratins used as structural parts of their outer protection which make up a major component of feathers, hair, horns, hooves, cloves, nails etc. They are produced in large amounts as a waste by-product at poultry-processing plants, reaching millions of tons annually throughout the world. Their recalcitrant nature is due to properties such as a high degree of cross-linking by disulphide bonds, hydrogen bonds and hydrophobic interactions. Many Poultry slaughterhouses dispose of feathers directly into the environment or through open air burning. Sewerage effluent mixed with feathers directly contributes to the blockage of sewerage pipes, increase in air pollution and ultimately increase in environmental pollution. Similar challenges exist for other keratin-containing biomass waste. This project addresses the bioprospecting and application of selected anaerobic extremophilic bacteria which are optimized for keratin-laden waste material degradation. This leads to improved control and understanding of the overall keratin-degrading process and its improvement and efficiency by using organisms expressing the using novel enzyme cascades of thermophilic keratin degrading enzymes *in vitro* optimized for keratin breakdown in a cost effective and controllable manner. A multidisciplinary team of scientists and industry partners come together to translate the results obtained, including upscaling of the process. The project will contribute to the design of more sustainable and resilient environmental remediation systems and contribute to the vision of a circular economy by using waste products and converting them to other valuable commercial products.

Key words: bioremediation; enzymes; extremophiles; feathers, keratin,

7.2.18 Effective access and benefit sharing systems key for wildlife conservation and livelihood improvement.

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Abstract

Studies reveal an increased trend of wildlife biodiversity loss globally. This has been attributed to increased human populations and demands exerting pressure on habitats in terms of agricultural expansions, industrialization, overexploitation, and pollution. Other factors include impacts of climate change and lack of effective legal framework that attract investments in biodiversity which is not an incentive for sustainable conservation and enhanced livelihoods. Lack of effective access, benefit sharing, and incentive systems have been cited as part of the key challenges to wildlife biodiversity conservation. Kenya's rich wildlife biodiversity provides various products and services both at international and local markets. It has been stated that optimizing these benefits through an effective ABS system can contribute to wildlife conservation. Therefore, this study focused on the country's gene-trade and bio-trade under the ABS system in line with the international and domestic obligations. This study is part of the on-going global monitoring of benefits arising from bio-trade and gene-trade under the ABS systems and their contribution to conservation and livelihood under the Convention on Biological Diversity and Nagoya Protocol on access and benefit sharing. The methodology involved desk reviews and field assessment of the identified country's gene -trade and bio-trade, isolating case studies, review of existing legal frameworks, assessment of benefits and impacts on conservation and livelihoods. Seventy cases of gene-trade were reviewed, 4 cases of bio-trade, intellectual property policies from key universities and research institutions were reviewed. The paper gives the status of the ABS system in the country in terms of gene-trade and bio-trade and impacts on conservation and livelihoods. Findings reveal effective ABS systems may contribute to biodiversity conservation and livelihood improvement.

7.2.19 Promoting a new species of *Cotesia* as a first biological control agent against the Mediterranean corn borer, an expanding pest

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Abstract

Insect parasitoids play an important role in limiting phytophagous insect populations. Because they often have a narrow host range, many parasitoid species are used for pest insect control. A research program on the diversity of Lepidoptera stemborers and their parasitoids in sub-Saharan Africa has led to the identification of a new parasitoid species, *Cotesia typhae* (Hymenoptera, Braconidae), specialized on the stem borer, *Sesamia nonagrioides*. This stem borer is an important maize pest in France whereas in Kenya it is not infesting maize present only on *Cyperus* sp. and *Typha* sp. A Kenyan *C. typhae* strain was found to have high parasitic success on the French *S. nonagrioides* host populations. A French-Kenyan research program is currently investigating the potential of this parasitoid to control the pest *via* yearly releases, while addressing the following aspects: (i) mechanisms of parasitism success and specificity; (ii) risk of establishment in the French environment; (iii) conditions of success in greenhouses; and (iv) mass-rearing techniques. The decision to authorize the use of exotic macro-organisms for crop protection in France depends on the environmental cost-benefit balance. We expect the cost to be low considering: (i) the rare presence in non-crop habitats of *C. typhae*; and (ii) the results highlighting a low probability of

long-term establishment of this parasitoid in France. In addition, preliminary greenhouse data on parasitism rates and length of efficiency of a single release are encouraging. Upscaling to field conditions will also benefit from experience regarding the marketing of *C. flavipes* to control sugarcane stem borers in Brazil. If successful, the use of *C. typhae* for biological control will demonstrate the crucial role of long-term ecological and biological studies to the setting up of effective and sustainable management of crop insect pests through biological means.

Keywords: classical biological control, *Cotesia typhae*, larval parasitoids, maize pest, *Sesamia nonagrioides*.

7.2.20 The use of cryopreservation in species conservation: Nature's SAFE The Living Biobank

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Abstract

Human activity has caused the rate of animal extinction to be 100-1000 times above normal, ultimately affecting our own survival. This unprecedented challenge requires ambitious and innovative action: to preserve all animals and their genetic diversity at speed. Nature's SAFE identified that cryopreservation and live biobanking (cryobanking) of tissues/cells from threatened animal species was a viable solution. In an approach analogous to the global seed banks, Nature's SAFE's goal is to preserve global animal genetic diversity at scale. Cryobanking has been long established for many domestic species but is not widely available for endangered animal conservation. To address this, Nature's SAFE connects experts in animal cryobanking with animal conservation programmes, bridging the gap between technology and conservation. Sample and species-specific protocols are used to ensure functionality is retained post-thaw. The samples, including gametes, reproductive tissue and somatic tissue, cryopreserved by Nature's SAFE provide a robust living biobank with multiple possibilities to help in future species restoration through advanced assisted reproductive technologies (aART). Since Nature's SAFE was established in December 2020, samples from 378 individuals representing 173 species totalling 477 samples have been cryopreserved. This includes 9 amphibians, 69 birds, 18 reptiles, 72 mammals, 5 fish and 1 invertebrate species. To capture the widest genetic diversity, Nature's SAFE is focused on supporting live biobanking efforts from endangered species such as the Eastern black rhino (*Diceros bicornis*), mountain bongo (*Tragelaphus eurycerus isaaci*), and African elephant (*Loxodonta africana*) from both zoo-managed and *in-situ* populations. Nature's SAFE works in partnership with conservation management plans, which help to determine which species and individuals to prioritise. To maximise conservation impact, Nature's SAFE provides its cryobanking services and expertise for free. Cryobanking is not a complete conservation solution; but a conservation aid ensuring the survival of genetic diversity of future populations as required.

Keywords: Cryopreservation, live biobanking, wildlife, conservation, advanced assisted reproductive technologies (aART)

08

Use of Science for Harmonized Policy Engagement

8.1.2 Assessment of management effectiveness of the Greater Mara and Mara Triangle conservation areas: the case of the Masai Mara National Reserve, Siana, Oloisukut, and Olkinyei conservancies

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Abstract

The Management Effectiveness Tracking Tool (METT) is a globally adopted tool used to monitor and track progress in achieving protected area management effectiveness targets worldwide. It helps in assessing the implementation of protected areas commitments under various environmental agreements. The tool consists of datasheets and an assessment form, which are completed in collaboration with key stakeholders. The datasheets gather information about the protected area, including its name, size, location, and a list of potential threats ranked by their impact. The assessment form comprises 38 questions grouped into different management elements. Each question is assigned a score ranging from 0 to 3, with higher scores indicating better management effectiveness. The total scores for each management element are converted to a percentage score. The results of the assessments reveal that the Siana Conservancy achieved the highest METT score (71.4%), making it the best-managed conservation area. It is followed by Olkinyei (69.9%), Masai Mara National Reserve (65.9%), and Oloisukut Conservancy (60.2%). All sites scored above 60%, indicating significant efforts toward sustainable management of these wildlife conservation areas. A closer look at the management elements shows that there is a strong planning framework in place for the conservation areas, with scores ranging from 76.2% to 81.0%, except for Oloisukut Conservancy, which scored the lowest at 52.4%. Inputs, such as resources and support, were also relatively high in the three conservation areas mentioned earlier, ranging from 61.1% to 72.2%, while Oloisukut Conservancy had the lowest score for inputs at 50.0%. The management elements related to processes and outputs scored above 60% for all conservation areas. Siana Conservancy achieved the highest score of 73.3% for processes, while the Masai Mara National Reserve had the highest score of 73.3% for outputs. Regarding outcomes, Siana and Oloisukut Conservancies scored the highest (83.3%), followed by Olkinyei (75.0%), whereas the Masai Mara National Reserve scored the lowest (50.0%). Overall, the implementation status of the management elements is expected to contribute to favourable conservation outcomes. Siana Conservancy emerges as the best-managed area with the highest overall METT score (71.4%) and the highest score for conservation outcomes (83.3%). A more detailed assessment is recommended to explore the factors influencing the effective management of these conservation areas. The implementation of effective planning processes is strongly correlated with positive conservation outcomes, leading to higher overall METT scores. The major threats to the entire conservation area include natural habitat modifications, climate change, and residential and commercial developments. The key indicator species for the greater Mara and Mara Triangle are elephants, lions, cheetahs, leopards, giraffes, black rhinos, and wild dogs. There has been a significant decrease in their range and an increase in the extent of threats affecting them in the conservancies and the reserve. Siana Conservancy is particularly suitable for carnivores such as lions, cheetahs, and leopards, making it a refuge for these critical species. On the other hand, there is a decreasing range and increasing threats to riverine forests in Olkinyei, Oloisukut, and Masai Mara National Reserve. These findings emphasize the importance of effective management and conservation efforts to address threats and protect the diverse wildlife and habitats in the Mara region.

Keywords: Conservation areas, management, effectiveness

8.1.22 Comparative analysis of wildlife governance approaches in African countries.

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Abstract

The evolution of environmental politics since the second half of the 20th century has centered on anthropogenic existential threats to the environment and has elevated the issue of wildlife conservation as urgent. With its significant wildlife ecosystems, Africa has been one of the testing grounds for institution-driven governance. The work of these wildlife institutions has considerable consequences for Africans whose compliance with the various measures has been deemed necessary for successful conservation ventures. Rarely have these wildlife institutions been studied, yet their form and governance structures, which they owe to colonial legacy, affect how millions of Africans live and subsist on wildlife resources. The traditions and cultures of African communities have defined how to sustainably utilize wildlife as a common-pool resource. Increasingly, the colonial and subsequent postcolonial governments encroached into this way of life and enacted regulations and laws to govern wildlife as landed property through the austere framework of protected areas. This form of governance structure mostly happened without the consent of the communities adjacent to these resources. Without such consent and the little comparative understanding of wildlife institutions that govern these vital resources, it is imperative to interrogate if they indeed exercise their authority to the expectations of African citizens. Confining and separating wildlife from African citizens has brought forth two problems: the persistent dispute about the utilization of these resources by the governors and the adjacent communities and the threats to wildlife emanating from this governance system of wildlife as landed property. Through legal analysis of the constitutions, wildlife policies, and laws of African countries and spatial analysis of land use and land cover change for 20 years, this study examines how wildlife institutions address these challenges. The findings indicate that countries with effective wildlife institutions have legal frameworks that promote participatory governance, enabling successful conservation efforts while ensuring the sustainable use of wildlife without endangering habitats and ecosystems. This analysis incorporates visual representations of spatial data to support these findings.

8.1.23 Evidenced-based decision support for guiding biodiversity conservation strategies associated with urban growth and infrastructural development in East Africa

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Abstract

Linear infrastructural development projects have been accelerating in East Africa, yet the degree of habitat fragmentation and its impact on biodiversity remains unclear. Insufficient data on biodiversity imperiled by such projects has continued to undermine biodiversity conservation efforts. This review explores the potential of deploying citizen science approaches in collecting biodiversity data and essential biodiversity metrics (EBM) that can provide spatially-explicit records and models for guiding conservation planning and mitigating risks of biodiversity loss associated with natural and anthropogenic factors at a variety of scales. We demonstrate using examples drawn from similar initiatives that citizen science platforms can address gaps in biodiversity data in East Africa, which can be combined with remotely sensed data to facilitate development of spatially explicit EBM for conservation planning, biodiversity management, and hazard mitigation. These metrics are essential for supporting evidence-based biodiversity assessment, monitoring, and restoration initiatives in the region.

8.1.24 Mainstreaming of birds conservation into energy sector-lessons in engaging in energy issues in Kenya

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Abstract

Kenya is a biodiversity rich Country. There is growing demand for energy as the economy grows. With this increase in demand for power production comes associated infrastructure, which includes transmission lines and roads which have an impact on biodiversity. Balancing development demands and biodiversity conservation is critical. An assessment done on the impact of power lines on bird communities has been carried out around systematically along the Rift Valley –Red Sea Flyway. Results indicate that high voltage transmission lines and local distribution power lines have negative impacts on birds through electrocution and collisions. Main drivers of electrocution and collision of birds with power lines is associated with power routing and designs of power lines. Mainstreaming birds and biodiversity into the energy sector is important. Tools and best practices exist for replication in Kenya. Utilisation bird sensitivity maps by energy sector players in planning and executing energy development.

Keywords: birds' conservation, Electrocution, Energy Sector, Flyway, and power lines

8.1.25 Morally Contested Conservation: Use of science for effective and inclusive policy implementation

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Abstract

Intensifying international debates over who should make decisions on wildlife conservation in Sub-Saharan Africa (SSA) brings to light several contested issues. Strong conservation policies have elicited diverse opinions among conservation actors, with apparently different views among actors from the Global North versus those from the Global South. For conservation policies to be inclusive and effective, there is a need for platforms where all voices are taken into consideration, especially on controversial issues. The Morally Contested Conservation project (MCC) strives to link multiple voices through research on contested issues in conservation, collecting robust data to inform decisions from local to global scales. By casting a wider net to question sensitive issues such as the acceptability of militarised conservation, punishments for wildlife crimes, ownership of wildlife among local versus different external groups across the world, enables policymakers to expand their lens of view beyond local or regional interest and address contentious issues that are rarely talked about.

MCC is working in five different locations in SSA; in Southern Kenya – Northern Tanzania (SOKNOT) and Kavango–Zambezi (KAZA) regions combining on-the-ground data collection with online methods for respondents in urban areas of SSA, the UK and the USA. The ultimate goal of this work is to collect and synthesise data that can inform policy on contested issues in wildlife conservation using evidence, with the aim of driving discussions about the appropriate roles for local and external views on decisions over wildlife and economic development in SSA.

Keywords: Morally contested conservation, militarized conservation, Global North – Global South, Local Vs External views

8.1.26 The Greater Mara Monitoring Framework: a practical model for linking scientific evidence to management and policy needs in Kenya

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Abstract

In parallel with the finalization and adoption of the Narok County Spatial Plan, the Greater Maasai Mara Ecosystem Management Plan and the Maasai Mara Reserve Management Plan over the past few years, work on collaboratively designing and developing a conceptual monitoring framework for the Greater Mara was undertaken over a 15-month period from February 2022 through May 2023. The process included virtual meetings, extensive one-on-one consultations and a series of feedback workshops. This process resulted in the completion of the Greater Mara Monitoring Framework (version 1) - or the GMMF (v1) - and its accompanying list of essential environmental, social, cultural and economic indicators, as well as a living, open-access inventory of datasets for the ecosystem. The GMMF is now poised to begin supporting management, policy and decision-making. By providing the Narok County Government, the Wildlife Training and Research Institute, the Maasai Mara Wildlife Conservancies Association and the Kenya Wildlife Service with data and information in support of their mandates, the GMMF(v1) offers a practical model for better linking the scientific evidence base to management and policy needs through regular monitoring of an agreed set of performance indicators. A better understanding of what data are being collected, by whom, over what timelines and at what spatial resolution together with closer collaboration between data providers and mandated data users and supported by the growing availability of advanced information technologies and platforms heralds a breakthrough for science-based management in this critical ecosystem, other important areas in Kenya and beyond.

Keywords: Adaptive management, Indicators, Maasai Mara, Monitoring, Policy engagement

09

Emerging Alternative Wildlife Utilization and Enterprises

9.1 Keynote Speaker

Dr. Daudi Sumba, Regional Director WWF-East & Southern Africa

The speaker observed that Kenya has a diverse natural resources which can be harnessed for the benefit of the society. For a long time, wildlife tourism has been fronted as the main use of wildlife in Kenya. However, wildlife is competing with other land uses, which raises the question "Is wildlife conservation a viable land use?" Currently, agriculture is the single biggest driver of habitat loss due to return on investment on land. Kenya already has a thriving wildlife economy, and we need to make use of this opportunity to create alternative enterprises and diversify them. Other than the tourism wildlife economy, there are several other options including non-timber forest products (Kenya is the 3rd largest producer of honey in Africa, but the sector is not fully exploited), fisheries (there is a need to commercialize the sector), bioprospecting (with 34,747 identified species; 1,841 microbes; 2,714 protozoa; 6,817 plants and 23,375 animal), carbon market (Kenya command 25% of all the voluntary carbon market in Africa and more potential lies in forest carbon, soil carbon and blue carbon), spot hunting (estimated opportunity cost to landowners placed at USD63 million annually), wildlife ranching (over 250 ranches in Kenya and over 260 conservancies that could do ranching), wildlife photography (movies, filming including scenes where films were shot-valued at USD3.4 million annually). Despite all these potentials, there are several barriers to developing the wildlife economy in Kenya. The speaker recommended the following enabling environment for exploring wildlife economy in Kenya: Ownership and wildlife movement, the need for ownership or use rights: strengthen management of declining wildlife resources; opening domestic and international markets for wildlife products, reforming tourism which has stagnated both in diversifying products and destinations as well as overall business model; equity and conflict between actors, steps to develop an inclusive and equitable wildlife economy especially to include landowners and communities with conservancies; contribution towards national goals, policies to favour wildlife biomass for food security; logistical, infrastructural, and regulatory sustainability, an enabling regulatory environment; and economic and demographic development, focus on areas better suited for the wildlife economy.

9.2 Presentations

9.2.1 Inventory of wild mushrooms (*basidiomycetes*) from central and Nairobi regions in Kenya

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Abstract

The tropical region supports a rich wildlife of plants, animals and fungi. Mushrooms are fruiting bodies of fungi which form during and immediately after the rainy seasons. They offer ecosystem services such as nutrient cycling for the regeneration of plants, source of nutritious food to man and wild animals and valuable medicine sources. They are also indicators of a healthy forest. However, despite the importance of mushroom wildlife, inadequate studies have been carried out to document and map the distribution of species in Kenya. Also destructive human activities that have reduced the forest cover below 10% are a major threat to wildlife. The aim of this study was to collect, characterize and map the distribution of mushrooms from different areas in Kenya. The study was carried out in March – June 2021 during the long rainy season. Collection of the samples was carried out in Kiambu environs (Kereita forest, Wangunyu area, Karura forest and Limuru ecosystem), Nairobi environs (Arboretum, City Park, Michuki park), Kajiado (Ngong hills forest) and Narok (Loita hills forest). Random and opportunistic sampling methods were used within the forest, farmlands, grasslands and the species were collected from the soil, dung, litter and humus. In total, 150 samples were collected belonging to 20 families and 35 genera. The family with the highest number of species was Agaricaceae (79) followed by Auriculariaceae (11) and strophariaceae (9). The families with the least samples belonged to Suillaceae (1), Hydnangiaceae (1) and Ganodermataceae (1). Saprophytic fungi were the most abundant (96%) followed by Termite mushrooms (2%), ectomycorrhizal (1%) and parasitic (1%) mushrooms. The study also documented the wild edible mushrooms, Pleurotus, Auricularia, Termitomycetes, some Agaricus species and Macrolepiota species with potential for cultivation and exploitation in the mushroom industry. In conclusion, mushroom wildlife is rich and widely distributed in Kenya under different habitats.

Keywords: Distribution, edible, fungi, habitats, mushrooms

9.2.2 Nature-based tourism in the era of climate change challenges faced by national parks in arid and semi-arid environments

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Abstract

Arid and semi-arid environments are areas of extremes even before the advent of anthropogenic climate change. Most believe that plants and animal communities in these areas are well adapted to their existing conditions. This understanding has led to research on climate change not paying attention to these areas. This has resulted in knowledge gaps about these areas' climate and conservation challenges, even though some studies have demonstrated the vulnerability of desert tourism to climate change. This study examines the impact of climate change challenges facing desert and semi-desert national parks in South Africa. Using primary data collected from national park officials through interviews and questionnaire surveys, this study seeks to explore the impacts of climate change and extreme weather events on Kgalagadi National Parks, Ai Ai Richtersveld National Parks, and the rugged Augrabies National Parks. Using a mixed-methods approach, the study found that

climate change and other human activities are worsening the impact of climate change on national parks in desert and semi-desert conditions. Challenges observed include increasing fire incidences, prolonged droughts, increasing temperatures, and reduced water flow affecting desert and semi-desert national parks. The climate challenges mentioned above resulted in changes to animal migration, tourism, tourist comfort, and the dying of some animal and plant species considered critical to these areas. Climate change is also causing increased water shortages in these parks, and calls are being made to assist such national parks in building robust resilience systems and diversifying tourism product offerings to alleviate some of the climate change impacts. The construction of seedbanks of threatened species is a noble response that needs to be backed up with continuous empirical research on the real impacts of climate change on flora and fauna in desert areas. Parks need to relook at the animal stock density of these parks to ensure sustainability.

Keywords: climate change, desert tourism, nature, climate vulnerability, adaptation

9.2.3 Socio-economic benefits and advantages for households living in the "W" Transboundary Biosphere Reserve in Benin (WTBR): Necessity to improve the ecodevelopment contribution of natural resources

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Abstract

This study investigated the socio-economic benefits and the relationships in terms of dependence or resources between the W Transboundary Biosphere Reserve (WTBR) in Benin and adjacent communities, over the period from 2000 to 2017. The methodological approach included a survey of opinions and incomes conducted among 340 households. The statistical analyses included logistic regressions and covariance analysis to assess the relationships between residents and the WTBR and their variation over time and space, followed by generalized linear regressions to assess the monetary and non-monetary contributions of the WTBR to the incomes of resident households. The results revealed their dependence on the reserve, particularly for agricultural and grazing land. These relationships varied significantly according to geographical locations (municipality, distance) and were sometimes strong even for households living at a considerable distance from the WTBR. The contribution of the reserve to annual household incomes (from May of year n-1 to April of year n) and cash flows decreased over time to only 3.02% for the 2016-2017 crop year. Furthermore, the results highlight land tenure (agricultural land) and transhumance (rangelands) as issues common to all residents regardless of their geographical location. In the current context of weakening ties and poor economic incentives, households living in or near the WTBR may, at best, lose their motivation to counter internal and external threats to conservation and, at worst, become a threat to conservation themselves. There is a huge and deep work for all stakeholders to improve the role of natural resources in human development.

Keywords: income, dependence, W Transboundary Biosphere Reserve (WTBR), protected area, governance,

9.2.4 Women's Enterprise and Empowerment helps to foster tolerance for the African elephants (Loxodonta africana) in Sagalla, Taita Taveta, Kenya

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Abstract

Small-scale, subsistence farmers living with elephants face immense challenges: physical risk, food insecurity, sleep deprivation, stress, malnutrition and declining income due to crop raids and the growing threat of climate change affecting rainfall patterns adding further to the poverty trap. Faced with these realities and often unable to move, farmers and women, in particular, have to think differently about their options of generating an income within an elephant-inhabited zone resulting in the overexploitation of natural resources. In Mwakoma village, women rely on crop farming as the primary source of income for their families. Women feel the impact of human-elephant conflict and prolonged drought as they mainly depend on natural resources for food, fuel and water. Continuous exploitation of the environment for fuel and food leads to further loss of biodiversity important to elephants. To mitigate this, Save the Elephants constructed a hub for women from this village to encourage the pursuit of a diverse set of elephant-friendly income-generating activities to increase their financial resilience. Our discussions will introduce the process, attitudes, and lessons learned from constructing a women's enterprise centre in the Sagalla community. The study shows how this innovative long-term safe space for women has encouraged women to engage in new income streams, which promotes the retention of the traditional values of the Taita people. We hope our case studies can serve as examples for scaling across Kenya to engender better elephant tolerance.

Keywords: Climate change, enterprises, human elephant conflict, food insecurity, women empowerment

9.2.5 Community perceptions on the enhancement of avitourism activities in Arabuko Sokoke forest in Kilifi County, Kenya

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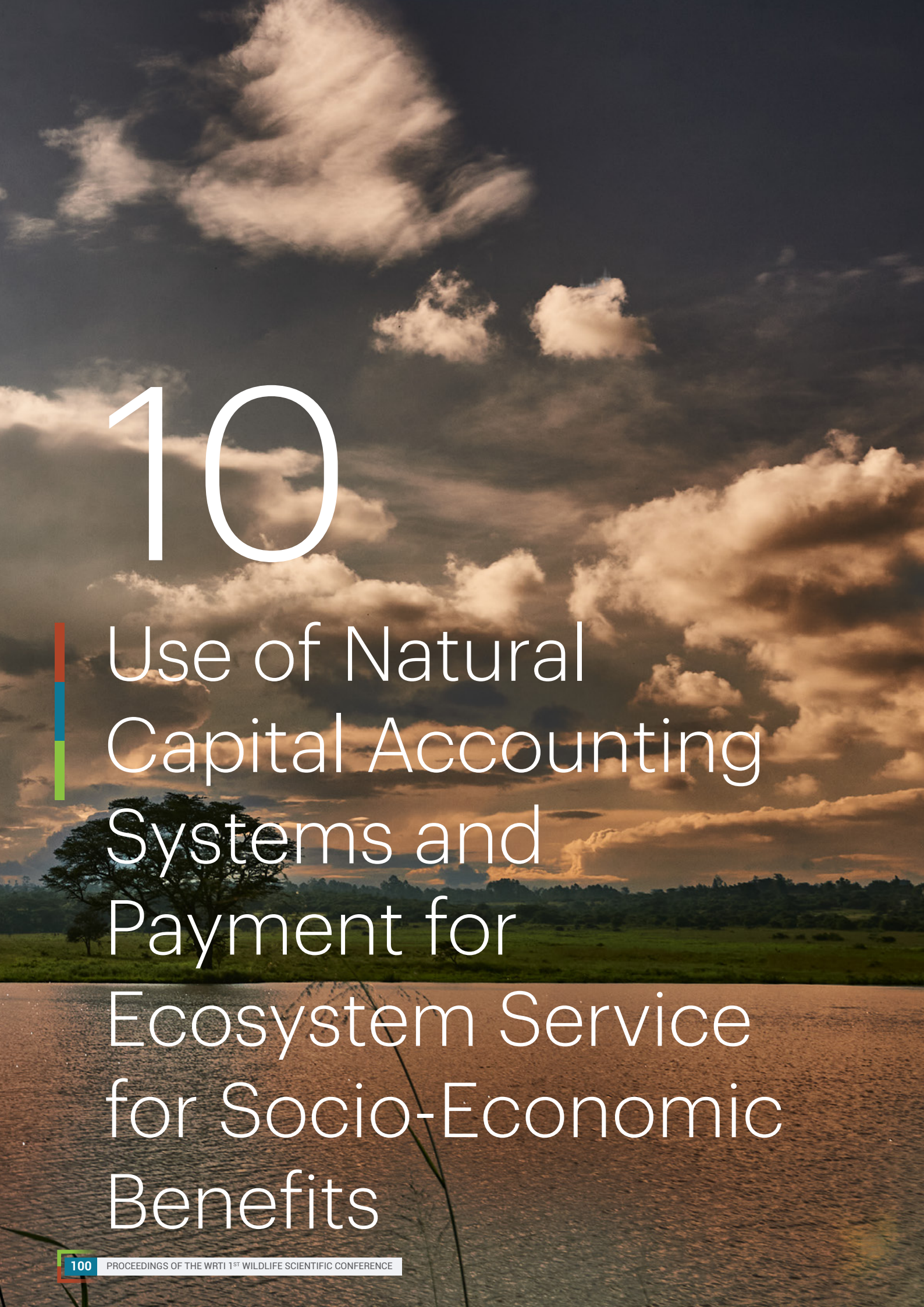
Abstract

Avitourism is an inter-connected nature-based tourism activity where its success or failure is determined by community involvement and perceptions. The purpose of this study to evaluate local community perceptions on the enhancement of avitourism within Arabuko Sokoke forest through the adoption of community participation theory and mixed research design. The study targeted 7399 households located in four sub locations where 361 household respondents were sampled by use of stratified and random sampling techniques. The study utilized questionnaire, focus group discussion and observation as data collection methods. The study findings revealed that (63.2%) of the local community were involved in avitourism activities and the activities contribute 43.2% to their household livelihoods. The study findings further revealed that the local community had positive perception on the economic, political and social benefits accruing from avitourism at 74.2%, 69.7% and 66.3% respectively while 63.3% of the local community supported avitourism activities enhancement with 36.7% opposed it. The correlation between community perception and avitourism enhancement was fairly positive (ρ=0.001) as perception was observed to contribute 29.7% towards avitourism enhancement. The findings further revealed that the local community were highly willing (72.9%) to participate in the enhancement avitourism activities and programs. As Arabuko Sokoke forest exemplify greater potentials for avitourism growth, this study recommends greater avitourism awareness and involvement of the local community to improve positive perception and boost avitourism growth in Arabuko Sokoke forest. This paper agrees with the theme wildlife utilization and enterprises.

Keywords: Avitourism, community, enhancement, involvement and perception



10

Use of Natural Capital Accounting Systems and Payment for Ecosystem Service for Socio-Economic Benefits

10.1 Keynote Speaker

Benard Opaa, Deputy Director & Head, Natural Resource Management, National Land Commission

The speaker noted that land resource is a central factor of production that catapults socio-economic, ecological and cultural development in Kenya. It is the main pillar supporting food security and livelihoods of the people of Kenya. Land is the first natural resource that hosts a myriad of other natural resources. The resources are intimately connected like a web of life on land. He further noted that Natural Capital Accounting (NCA) is about measurement and information. It is both a tool and a process. It's a tool to measure the changes in the stock and condition of natural capital (ecosystems) at a variety of scales and to integrate the flow and value of ecosystem services into accounting and reporting systems in a standard way. It is the process of calculating the total stocks and flows of natural resources and services in a given ecosystem or region. Accounting for such goods may occur in physical or monetary terms. Natural capital includes all of the resources that we easily recognize and measure such as minerals, energy, timber, agricultural land, fisheries and water. It also includes the ecosystem services that are often "invisible" to most people, such as air and water filtration, flood protection, carbon storage, pollination of crops, and habitats for wildlife. He went further to state that Payment for Ecosystem Services (PES) occur when the beneficiaries or users of an ecosystem service make payments to the providers of that service. PES refers to the various situations where users of an ecosystem service make payments to the providers/protectors of the service. In return, the payments guarantee the flow of these ecosystem services. In conclusion he stated that NCA is a tool that supports decision-making, planning and conservation of natural resources. It's the big picture wealth data that goes beyond the traditional GDP. The economic /production instruments must infuse NCA/datasets and deliberately collect and analyse such data for policy.

10.2 Presentations

10.2.1 Implementing payment for ecosystem services scheme in Kenya: The case of Lake Naivasha Basin.

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Abstract

Lake Naivasha Basin (LNB) is located in Nakuru and Nyandarua counties in the Republic of Kenya. It is an important ecosystem to the economy of Kenya, consistently contributing upwards of 1% of national Gross Domestic Production. However, this landscape is continuously and rapidly degrading due to intensive land use practices and land fragmentation in spite of the existence of various natural resource management policies in Kenya. The promotion of Payment for Ecosystem Services (PES) as a policy option to foster ecosystems sustainability by increasing the capacity of government authorities and local communities in Kenya to conserve riparian and forest ecosystems so as to reduce the vulnerability of dependent communities and production enterprises to the observed and anticipated effects of climate change is implied in the key environmental and natural resources policies in Kenya. I examined whether the Lake Naivasha Basin Payment for Ecosystem Services (LNB-PES) scheme embodied the critical characteristics of an effective PES mechanism and if it achieved the desired ecological and livelihood results. A total of 1,191 heads of households and 11 key informants were interviewed for this study. The study results indicate that the LNB-PES scheme had some functional and conceptual inadequacies although it achieved remarkable adoption and compliance by participating farmers. Based on these results, it is recommended that a new PES scheme with a conditionalities enforcement mechanism be initiated for the LNB with a view to informing the mainstreaming of the concept of enforceable PES in the existing policy framework, the development of a national or basin-level PES policy, and, support watershed restoration and climate change adaptation through provision of forest technical extension services to land owners for the creation of woodlots and other watershed protection initiatives at farm level.

Keywords: Ecosystems goods and services, payment for ecosystem services, watershed protection, policy, land degradation, land use, climate change

10.2.2 Dakatcha woodland, Kilifi County, Kenya ecosystem service assessment

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Abstract

Dakatcha Woodland Important Bird Area/Key Biodiversity Area in Kilifi County, Kenya, is a biodiversity hotspot known globally as the only breeding site for the endemic, endangered Clarke's Weaver, and supports local community livelihoods. The site, a mosaic of forest, woodland, farmland, abandoned farmland, grassland and thicket – has been experiencing environmental degradation attributed to expansion of farming activities; extractive use of trees for charcoal making and production of house construction materials; and climate change. Detailed Ecosystem Services Assessment was carried out guided by the Toolkit for Ecosystem Services Site-based Assessment (TESSA) for estimating the value of ecosystem services provided by Dakatcha Woodland in 2021 and in two future scenarios- (*Business As Usual and Conservation Scenerio*). The study results indicate that Dakatcha Woodland stores approximately 12 Million Tons of Carbon supporting Climate regulation. The value of goods harvested (wild goods, water and cultivated crops) was worth KSh.1.8 Billion. Dakatcha woodland had multiple cultural values including ecotourism potential to generate KSh.107 million annually. The total value of Dakatcha Woodland ecosystem services was estimated at KSh.2.5 billion Kenya Shillings in 2021, and KSh.4.3 billion and 3.9 billion in the Business As Usual and Conservation Scenarios, respectively. This assessment recommends promoting the conservation scenario that balances socio-economic development with biodiversity conservation. For this to be achieved, there is a need for investment in awareness creation and infrastructure development.

Keywords: Biodiversity hotspot, carbon, community livelihoods, Dakatcha woodland, ecosystem service assessment

Posters

01 Hippopotamus (*Hippopotamus amphibius*) suitable habitat analysis in the Pendjari biosphere reserve using remote sensing and GIS tools

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Abstract

The common hippopotamus (*Hippopotamus amphibius*

) is less widely distributed and typically occurs at low densities in West Africa. Although found in many West African countries, overall population sizes tend to be small, either because of less available habitat or high human population density. Thus, habitat loss and conflict with agricultural development and farming are major problems for the species conservation in many countries, such as Benin. Our project aims to carry out habitat suitability analysis for hippopotamus in the Pendjari Biosphere Reserve. Mixed methods approaches based on remote sensing and GIS were employed to map the suitable habitat sites for hippopotamus in the Pendjari Biosphere Reserve. The ENVI 4.7 software was used to classify land use/land cover and ArcGIS 10.4.1 to produce thematic maps based on various criteria. Our results indicated that the suitable habitats for hippopotamus including savannah grasslands, shrublands and woodlands savannah, cover 91,90% (4640,99 km²) of the overall land cover whereas the remaining 8,1% is unsuitable as a habitat. In areas where hippos compete with other herbivores, the grass productivity of the suitable habitats needs to be assessed to determine the local carrying capacity for hippos.

Keywords: Hippopotamus benefit, suitable habitat, Positive perception, grassland, Savannah

02 Climate change vulnerability assessment of communities adjacent to Diani Chale Marine Reserve, Kwale County, Kenya

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Abstract

Kenya has been in the frontline in the conservation of marine resources through establishment of Marine Protected Areas (MPAs) and Joint Co-managed Marine Areas (JCMMA). The focus of the study was Diani-Chale Marine Reserve (DCMR) and adjacent areas. Though established as an MPA in 1995, management of DCMR has not been operationalized to date, and the study lays a foundation for the establishment of a climate-smart co-management plan. The reserve's marine ecosystems are the lifeline of the communities in the area, providing tangible and intangible benefits to the community, in the form of fisheries, wood products, tourism and shoreline protection. The study aimed to comprehensively assess the vulnerability of communities adjacent to the Diani Chale Marine Reserve to climate change impacts, recognizing the intricate interplay between ecological, socio-economic, and marine resource-use. The research integrated rapid appraisal

approaches to evaluate vulnerability from multiple dimensions – socio-economic and environmental stressors. Socio-economic indicators, including income levels, education, and access to savings and credits were utilized to gauge community adaptive capacity. Qualitative data was derived from focus group discussions and interviews. A vulnerability index was developed using the weighted mean method. Findings reveal that communities adjacent to the marine reserve are exposed to climate-related risks, particularly those linked to drought, rising temperatures and changes in rainy seasons. The overall average vulnerability index of the community is 0.49 implying a moderately vulnerable community. Vulnerability indices also show a significant difference between gender and across age groups, ($p>0.05$). These results demonstrate that socio-economic constraints hinder adaptive capacity, highlighting the need for targeted interventions that are gender-sensitive and age-specific. Such efforts should focus on education, capacity building and alternative income generating activities as well as marine resource conservation initiatives to bridge the gap between the changing natural environment, ecological systems and communities.

Key words: Marine protected areas, joint co-managed marine areas, climate change, vulnerability, DCMR, Kenya

03 Morphometric characterization of Swallowtail butterfly, *Papilio nireus* Linnaeus, 1758 (*Lepidoptera: Papilionidae*) on wild citrus in Kenya

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Abstract

African blue-banded swallowtail butterfly, *Papilio nireus* Linnaeus, 1758 is a common species with a wide range of distribution in Sub-Saharan Africa. Its morphology, when reared on wild citrus species (Rutaceae), *Clausena anisata* and *Toddalia asiatica*, is studied in Taita Hills, Kenya for the first time. The morphological characters of various developmental stages are described. The effects of the host plants on the size of the eggs, length of larval instars, pupae, and adult tibia are illustrated.

Keywords Morphology, developmental stages, Swallowtail butterfly, wild citrus, Sub-Saharan Africa

04 Role of management planning in protected areas management - A case study of Lake Elementeita Wildlife Sanctuary

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Abstract

Protected areas play a major role in conserving species and ecosystems that help us confront environmental and societal challenges such as climate change, food and water security. In mid 2014 some 15.4% of the terrestrial surface of the Earth and 3.4% of the global ocean area, which includes 8.4% of marine areas under national jurisdiction, had been officially recognized as protected areas (UNEP-WCMC 2014). Protected areas in Africa occupy slightly over 2 million sq Km or 7% of the continent's 30 million sq Km. In Kenya, about 8% of the total land mass is protected area for wildlife conservation. The Kenya Wildlife Service is mandated to formulate management plans for protected areas under its jurisdiction. Management plans prescribe actions intended to maintain the ecological integrity of the protected areas.

They are important instruments in which all the ingredients for active management are described. Management planning is provided for in the Wildlife Conservation and Management Act (WCMA), 2013. The Wildlife Act states that no development shall be approved in a protected area without an approved management plan. This necessitates that for the organization to undertake developments in the protected areas or to lease out sites for development a management plan should be in place to guide such developments. Lake Elementaita Wildlife Sanctuary is a site that is internationally recognized due to its exceptional conservation values. Lake Elementaita is part of the formation of the Great Gregory Rift Valley, listed together with lakes Nakuru and Bogoria as the Kenya Lakes System in the Great Rift Valley World Heritage Site by UNESCO in 2011, it is a Ramsar site Number 1498 (05-09-2005), IBA KE046 (1999) and a National Wildlife Sanctuary (2010). The management planning process for Lake Elementaita Wildlife Sanctuary Ecosystem started way back in 2010 and has since stalled twice. Last year, Kenya Wildlife Service revived the plan development and this year in the month of August, the plan was finally completed and validated. The plan area comprises the Ramsar designated site and it is envisaged that by conserving the site, the site will maintain the values for which it was designated. The management plan identified key species of conservation concerns such as the Great White Pelicans-CMS, Appendix I, lesser flamingo- IUCN, Near Threatened (NT), CITES, Appendix II, CMS Appendix II and the Nubian, IUCN, Appendix 1. Despite its international status, the site faces the following threats; poaching, fires, climate effect, invasive species, diseases, illegal logging, charcoal burning and human encroachment among others. The management plan incorporated activities that had been recommended during operationalization of the site, last year (2022). With the operationalization of the site and implementation of activities meant to address the above threats, the waterfowls have returned back to Lake Elementaita and there is increased visitation to the site. The Chinese visitors have become popular with the site. Many researchers have also developed interest in the site. With the fencing of the Sanctuary and the established KWS outpost at the site, Illegal activities have been controlled. Lake Elementaita has become the gem that it was meant to be.

05 Using SCR models to estimate the Population and survival of the African Lion (*Panthera leo melanochaita*) within the Meru National Park (MNP), Kenya in relation to lion translocation as a management tool.

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Abstract

The African lion (*Panthera leo*) is estimated to have experienced a dramatic decline in population and range over the last century. Moreover, the greatest declines are likely occurring in remote wilderness areas where it is particularly challenging to acquire reliable lion population estimates. We therefore used spatial capture recapture (SCR) data collected in the Meru Conservation Area (MCA) between 2016 to 2019 to estimate lion abundance and density in an effort to ultimately understand how different factors influence the survival of lions and develop a Population Viability Analysis of lions within the MCA. More specifically, we assessed how different demographic, environmental, and management factors (such as translocation

of lions as a human-lion conflict management tool), affect lion survival within the MCA. Our research aims to get an in-depth understanding of the population structure and survival of lions within the MCA, while highlighting the value of robust capture recapture models in order to demonstrate how rigorous field methods combined with robust analyses can produce reliable population estimates within remote wilderness conservation areas such as the MCA.

Keywords: Demography, population, Spatial Capture-Recapture (SCR), translocation.

06 Application of space technology solutions in wildlife conservation in Kenya

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Abstract

The challenges facing wildlife conservation in Kenya are many and varied. They include ecological and wetlands degradation, climate change, forest depletion, tourism market volatility, land cover/land use change, human wildlife conflict brought by human population explosion and land fragmentation in areas where communities coexist with wildlife. These challenges call for ecological monitoring to reveal the hidden truth, the behaviors, relationships and patterns among the existing things. Ecological monitoring is critical in the management of wildlife populations for conservation reasons. Modern management dictates that prudent decisions be based on scientific information. This scientific information can be gathered by using Earth observation. Data gathering takes time, effort, resources and sometimes data is rarely available in the quality required. Incomplete and inaccurate data can be dangerous in making decisions. Different space technology techniques can be used to remotely gather data for wildlife conservation. Some of the techniques applied in Kenya include wildlife collaring for monitoring wildlife movements, location and behavior; camera traps to gather data with little or no interference. Others include video GPS in aerial wildlife census to enhance quality of wildlife census in terms of accuracy in numbers since video GPS creates location-based video that allow Scientists to verify the numbers afterwards. Another technology is the use of Unmanned Aerial Vehicle which has cost saving potential in data gathering and monitoring of protected areas. UAV helps to reduce illegal wildlife activities such as poaching and illegal hunting. The use of big data is a technology that involves the use of community in quantitative data gathering using smartphones to facilitate wildlife management. The best technology is often the one you already have, know how to use, can maintain and can afford. Lastly the use of GIS and Remote Sensing in data gathering remotely and data analysis.

Key words: Space technology solutions; wildlife collaring; Camera traps; Unmanned Aerial Vehicle; Big data; GIS and Remote Sensing

07 Status of the Ishaqbini Hirola Sanctuary 2012 – 2023

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Abstract

Ishaqbini Hirola Community Conservancy was formed in 2007 by the communities of Hara, Korisa, Kotile and Abalatiro locations. Ishaqbini's aim is the conservation and protection of the world's most critically endangered Hirola antelope, *Beatragus hunteri* and to improve the livelihoods of the local communities. The conservancy covers approximately 68,000

hectares of community land where wildlife conservation is promoted as a land-use alongside traditional pastoralist livelihoods. The global population of hirola is estimated to be less than 500 individuals, all of which are found in Kenya. When Ishaqbini was first established, observations and data gathered by conservancy rangers and Northern Rangelands Trust (NRT), highlighted the vulnerability of the hirola population to poaching and predation. As a result, Ishaqbini and NRT with the support of KWS established a 2,700-hectare predator-proof fenced hirola Sanctuary in 2012 with the aim of providing a secure breeding population of hirola in the absence of predation, poaching and competition with livestock. The population of hirola in the Sanctuary increased from an initial 48 animals in 2012 to approximately 140 by the end of 2020, an average annual growth rate of 15%, and representing between 25-30% of the global population. In 2016, Ishaqbini faced severe drought, resulting in deaths of hirola as efforts to supplement feed were not successful. In late 2020, Ishaqbini faced another severe drought. In early 2021, a decision was made to release hirola from the sanctuary, which had reached carrying capacity. Approximately 70 hirola were released into the wider conservancy, 5 of which were collared; within 9 months of release, 3 of the 5 collared hirola (60%) had been killed by predators. The 2021 drought led to further deaths of wildlife, however, by the end of 2021 hirola were successfully feeding on supplemental feed and no further deaths occurred. The estimated hirola population in the sanctuary in 2023 is 45-50 animals.

Keywords: Community, conservancy, Hirola antelope, Hirola Sanctuary, population recovery, breeding population, global population, drought, supplementary feeding, predation/poaching.

08 The Coexistence Co-op: reducing the threat of poisoning through community-based trainings

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Abstract

The use of poisons, typically highly toxic pesticides, to kill wildlife is a global problem. Human-wildlife conflict is widespread and often is a root cause of wildlife poisoning. In Africa's pastoral areas conflict between livestock farmers and large predators results in retaliatory poisoning when lions, hyenas, or leopards kill livestock. Remaining carcasses are laced with pesticide to kill predators, but endangered vultures and eagles are the most impacted. Since 2018 the Coexistence Co-op, a collaboration between raptor and lion NGOs in northern Kenya, has undertaken a training and conflict management programme to reduce livestock losses to carnivores and the resultant use of poisons to kill carnivores. Our community training programme relies on a two-fold approach: 1) improving livestock husbandry and building predator-proof bomas (livestock corrals), and 2) education about the dangers of using poisons to kill wildlife. We conduct 1-day trainings involving 15 people that are hands-on and quality-focused. We have conducted 350 trainings involving over 4800 people who have built 818 new predator-proof bomas. These bomas, built and financed by trainees, have been 92% effective in reducing nighttime carnivore attacks. Trainees have intervened 52 times to prevent the poisoning of 208 animals including lions, vultures, hyenas, hippos and dogs. The most significant changes in human behavior have been: 1) building predator-proof bomas, 2) proper disposal of suspected poisoned carcasses, and 3) increased knowledge about human safety and use of protective gear when handling pesticides. Our approach strengthens community capacity, as well as ownership and responsibility towards the husbandry of their livestock and the health of their environment.

09 Evidence of widespread declines in Kenya's raptor populations over a 40-year period

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Abstract

Kenya's wildlife has been declining substantially for decades, due to rapid human population growth and its associated impacts on natural habitats. Predators and scavengers are particularly sensitive to anthropogenic pressures, and their changing status has corresponding impacts on the ecosystem services they provide. To estimate rates of change in Kenya's raptor populations we compared linear encounter rates (individuals 100 km^{-1}) recorded during road surveys conducted in 1970–1977 and 2003–2020. Encounter rates for 19 out of 22 species had fallen, by a median of 70% among species showing a significant or near-significant change. No species had increased significantly. Declines occurred among all vulture and large eagle species, and were especially pronounced among once-common small and medium-sized raptors. Our findings demonstrate the importance of protected areas (PAs) for Kenya's remaining raptor populations. Median encounter rate for vultures and large eagles had dropped by 23% within PAs and by 76% in unprotected areas. Smaller species showed divergent trends in relation to PA status, their median encounter rate increasing by 104% within PAs while declining by 85% elsewhere. Based on projected declines over three generation lengths, 45% of the species examined would qualify as nationally Endangered or Critically Endangered. Key threats include electrocution/collision with energy infrastructure, deliberate and incidental poisoning, persecution and impacts associated with habitat degradation. Kenya's raptor declines could be reversed through enhanced management of PAs, mitigation of specific threats and the implementation of species recovery plans; all requiring steadfast government commitment and close collaboration with conservation stakeholders.

10 Population dynamics and conservation of the critically endangered pancake tortoise (*Malacochersus tornieri*) in Northern Kenya

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Abstract

The pancake tortoise (*Malacochersus tornieri*) is a critically endangered species with few individuals remaining worldwide. This is attributed to habitat degradation, illegal pet trade and negative cultural beliefs that pose a significant threat to their survival. The current known range is in the arid regions of East Africa, primarily in Kenya and Tanzania. In 2019, we discovered a population of 7 pancake tortoises on Lewa – Borana Landscape (LBL) which prompted further investigation of their existence within their adjoining areas and Northern Kenya conservancies. Since this species inhabits specific rock crevices, we modelled the rock geomorphologies to identify their prime habitats of kopjes of Precambrian bedrock with *Acacia-Commiphora* bushland and thickets. This acted as a guide where we systematically searched their physical presence in these specific rock crevices using spotlights and retrieval sticks. The majority were adults (81.7%) and the sex ratio was skewed towards females. The average plastron and carapace length were 137.86 mm and 140.18 mm for males and females respectively. The average weights of adults, sub adults, juveniles and hatchlings were 369 g, 419 g, 381 g, 343 g respectively. We also examined their physical characteristics, including oral cavity and integuments to determine their health status. Scute anomalies were documented to monitor shell condition and cloacal swabs were taken for future genetic diversity and pathogen analysis. The results indicated the presence of a healthy population of 186 individuals in the region mostly occurring within low altitude ranging from 894 m to 1689 m including the community conservancies in the region. The study reinforces the pivotal role of the pancake tortoise within the unique rocky ecosystems of Northern Kenyan. It also emphasizes the gravity of the threats it faces, particularly habitat degradation and illegal trade. We recommend further studies in the greater parts of northern Kenya to further understand the pancake tortoise population, their genetic diversity, dispersal and their evolutionary history.

Keywords: Genetic diversity, contiguous areas, habitat degradation

11 The effect of habitat type on population distribution and abundance of Rothschild's giraffe (*Giraffa Camelopardalis rothschildi*) in Ruma National Park and Mwea National Reserve in Kenya

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Abstract

The Rothschild's giraffe is currently listed as vulnerable by the International Union for Conservation of Nature (IUCN) largely due to the loss of its habitat caused by human activities. This study examined the effect of habitat type on population structure and distribution of Rothschild's giraffe in the Ruma National Park (RNP) and Mwea National Reserve (MNR) in Kenya. The study employed road transects to collect data on the number, age class and sex distribution in three habitat types; open, medium and closed. Data was collected along three road transects of equal lengths measuring 14.2 km in each site (RNP and MNR) for comparison. A driving speed of 20 km per hour was maintained along each transect for standardization of survey effort and maximum giraffe detection rate. Photographic capture of the coat patterns of the right side of all the giraffes sighted within 500 m from the transect was done for identification of age classes. The field visits were replicated 12 times for each transect giving 36 replications for each site spread equally through wet and dry seasons from March 2017 to November 2018. The effect of habitat type on population structure and distribution was analysed using ANOVA and Tukey HSD to test for significant differences. The results show that habitat type had a highly significant effect on the distribution of giraffes in Ruma, ($F_{22,1720}$= 106.2, P<0.001, n = 1723,) and significant effect in MNR, ($F_{22, 480}$= 9.939, df=22 P<0.05, n=482). T-test was used to compare the mean population size of giraffe across the wet and dry seasons. The dry season shows a contrasting effect on giraffe distribution between MNR and RNP, (t= 2.6071, df = 2, P<0.05) and (t=14.178, df = 2, P<0.001) respectively. The coat pattern analysis for age class identification was done using WildID software. The findings indicated that MNR had more males 57.1% to females 42.9% compared to RNP that registered more females 57.6%. Habitat type had a significant effect on the distribution of giraffes. The giraffe population showed a preference for medium habitat types. The findings are useful for the management of habitat quality for giraffe populations at the interface where conservation areas overlap with human land use.

Keywords: Giraffe conservation, population distribution, Rothschild's giraffe

12 Population status and trends of the savanna Elephant (*Loxodonta africana*) in the Aberdares forest ecosystem

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Abstract

The spatial distribution of African elephants has been diminishing owing to anthropogenic expansion. Kenya, characterized by at least 3% forest cover, may accommodate more than 20% of the elephant population. Aberdare Forest Ecosystem (AFE) encompasses Aberdare National Park (765.8 km²) and a forest reserve (1013 km²). This study used line transects to estimate elephant populations and map human threats. A total of 56 wildlife sightings (248 animals) and 314 elephant dung piles on line transects were analyzed out of 1103 recorded. There was a mean dung decay rate of 43.52 days (±1SE= 3.46), the density estimate for the Aberdares landscape was 2.3 elephants/km² (95% CI 1.61 - 3.28 elephants / km2) with a percent coefficient of variation of 18.32. This gives an overall abundance estimate of 4,019 (95% CI 2,813 – 5,741), which, based on a one-sided z-test, is not significantly lower, at the 5% level, than the estimated elephant density of 2.63 elephants / km² and abundance of 4,593 for the 2017 survey. In the 2017 survey, the Elephant density was 2.2/Km2 (CV% 12.87) or 3939 (95%CL: 3063 - 5066) elephants. Previously, there was an elephant density at 2.40/ km² or 1,840 elephants (%CV=25.05) in the Aberdare National Park (767 km²) and 2.56/ km² or 1,700 elephants (%CV= 27.76) in parts of the AFE outside the National Park (663 km²) in 2005.

Key words: Distribution, Ecosystem, Threats, Estimate, Density

List of Annexes

Members of the Conference Planning committee

SNO	Name	Institution
	Francis Gakuya	Wildlife Research and Training Institute
	Benard Ngoru	Wildlife Research and Training Institute
	David Manoa	Born Free
	Wycliffe Mutero	International Fund Animal Welfare
	Festus Ihwagi	Save The Elephant
	Phillista Malaki	National Museums of Kenya
	Charles Njagi	Wildlife Clubs of Kenya
	Daniel Bett	Kenya Wildlife Service
	Mark Bett	Wildlife Research and Training Institute
	Sam Weru	Conservation Asoociation of Kenya
	Albert Kimutai	Wildlife Research and Training Institute
	Nyambura Muchai	Wildlife Research and Training Institute
	Cyrus Wachira	Wildlife Research and Training Institute
	Kasaine Sankali	Kenya Wildlife Trust
	Paul Gacheru	Nature Kenya
	Kabaka Mukonyi	Wildlife Research and Training Institute
	Joseph Mukeka	Wildlife Research and Training Institute
	Judy Nyunja	Wildlife Research and Training Institute
	Peter Hongo	Wildlife Research and Training Institute
	Christine Atieno	Wildlife Research and Training Institute
	Grace Karanja	Wildlife Research and Training Institute
	Ruth Anyura	Wildlife Research and Training Institute

SNO	Name	Institution
	Stephen Karanja	Wildlife Research and Training Institute
	Grace Ndung'u	Wildlife Research and Training Institute
	Nelly Mukoko	Wildlife Research and Training Institute
	Richard Ngetich	Wildlife Research and Training Institute

Programme For The WRTI 1st Wildlife Scientific Conference In Kenya, 26th - 28th September, 2023

MONDAY, 25TH SEPTEMBER 2023: ARRIVAL OF PARTICIPANTS **TUESDAY, 26TH SEPTEMBER 2023**			
TIME	**EVENT/ ACTIVITY**		
8.00 - 9.00	Registration, exhibition and housekeeping – Kiboko Hall		
9.00 – 11.30	Opening ceremony – **Kiboko Hall**		
11.30 – 12.00	**Group Photo and Health Break**		
12.00 - 12.45	**Keynote Address 2: Kiboko Hall** Use of science for harmonized policy engagement by Lucy Waruingi		
12.45 - 14.00	**Lunch Break**		
14.00 – 16.50	**Parallel Breakout Session 1 - Kiboko Hall Sub-theme:** Changes in wildlife population trends and dynamics	**Parallel Breakout Session 1 -2-Way Hall** **Sub-theme**: Initiatives towards wildlife habitat restoration and connectivity	**Parallel Breakout Session 1 - Acacia Hall** **Sub-theme**: Approaches to enhance human-wildlife coexistence in human-dominated landscapes
16.50 - 17.15	**Health Break and End of Day One**		
WEDNESDAY, 27TH SEPTEMBER, 2023			
8.00 – 8.15	Registration, exhibition and housekeeping		
8.15 - 9.00	**Keynote Address 3 – Kiboko Hall** Infrastructure and conservation: the nexus for policy development by Dr. Ben Okita		
9.00 - 9.45	**Keynote Address 4 - Kiboko Hall** Ecological monitoring and community enterprises by Dr. David Western		
9.45 - 10.00	**Launch of National IUCN Species Specialist Group**		
10.00 -10.30	**Health break**		

TIME	EVENT/ ACTIVITY		
10.30 -13.00	**Parallel Session 2 – Kiboko Hall** **Sub-theme**: Changes in wildlife population trends and dynamics	**Parallel Session 2 – 2-Way Hall 2** **Sub-theme:** Initiatives towards wildlife habitat restoration and connectivity	**Parallel Session 2 – Acacia Hall** **Sub-themes:** Approaches to enhance human-wildlife coexistence in human-dominated landscapes, and Approaches to climate change mitigation and adaptability
13.00 - 14.00	**Lunch Break**		
14.00 - 14.45	**Keynote Address 5 - Kiboko Hall** Remote Sensing and Natural Resource Surveys for Wildlife conservation and Management by Dr. Emmanuel Nkurunziza		
14.45-16.45	**Parallel Session 3- Kiboko Hall** **Sub-theme:** Changes in wildlife population trends and dynamics	**Parallel Session 3 – 2-Way Hall** **Sub-theme**: Use of science for harmonized policy engagement	**Parallel Session 3 – Acacia Hall** **Sub-theme**: Approaches to climate change mitigation and adaptability
16.45 -17.15	**Health Break**		
17.15 - 20.00	**Networking dinner**		
THURSDAY, 28TH SEPTEMBER 2023			
8.00 - 8.15	Registration exhibition and housekeeping		
8.15 - 9.00	**Keynote Address 6 – Kiboko Hall** Regulation of wildlife research in Kenya by Prof. Walter Oyawa		
9.00 – 9.15	Role of research in the implementation of EAC Wildlife Strategy by Leo Niskanen		
9.15 - 10.00	**Parallel Session 4 – Kiboko Hall** **Sub-theme:** Addressing wildlife health challenges through One Health approach	**Parallel Session 4 – 2-Way Hall** **Sub-Theme:** Use of new technology in addressing wildlife conservation challenges	**Parallel Session 4 – Acacia Hall** **Sub-Theme:** Use of biotechnology and bio-prospecting for enhanced socio-economic benefits
10.00 -10.30	**Health Break**		
10.30 - 13.00	**Parallel Session 5- Kiboko Hall** **Sub-theme:** Addressing wildlife health challenges through One Health approach	**Parallel Session 5- 2-Way Hall** **Sub-Theme:** Use of new technology in addressing wildlife conservation challenges	**Parallel Session 5- Acacia Hall** **Sub-Themes:** Use of biotechnology and bio-prospecting for enhanced socio-economic benefits, and Use of natural capital accounting systems and payment for ecosystem service for socio-economic benefits
13.00 - 14.00	**Lunch Break**		

TIME	EVENT/ ACTIVITY		
14.00 - 15.30	**Parallel Session 6- Kiboko Hall** **Sub-theme:** Addressing wildlife health challenges through a One Health approach	**Parallel Session 6- 2-Way Hall 3** **Sub-Theme:** Use of new technology in addressing wildlife conservation challenges, and Emerging alternative wildlife utilization and enterprises	**Parallel Session - 6- Acacia Hall** **Sub-Theme:** Emerging alternative wildlife utilization and enterprises
15.30 – 16.00	**Recommendations and way forward**		
16.00 – 16.30	**Closing Ceremony**		

Daily Programme

Time	Event/Paper	Responsible	Chair
DAY ONE: TUESDAY 26th SEPTEMBER 2023			
8.00 – 9.00	Registration, exhibition and housekeeping	Organizing committee	
9.00 - 11.30	Opening ceremony - **Kiboko Hall** **Keynote Address 1** : Conservation science, management and policy; The nexus- Dr. Hellen Gichohi	Event Organizer	Master of Ceremony
11.30 – 12.00	Group Photo and Health Break		
Time	**Event/Paper**	**Presenter**	**Chair**
12.00 -12.45	**Keynote Address 2** - Use of science for harmonized policy engagement by Lucy Waruingi - **Kiboko Hall**	Lucy Waruingi	Dr. Patrick Omondi
DAY 1- PARALLEL SESSION 1- Kiboko Hall **Sub-theme:** Changes in wildlife population trends and dynamics			
Time	**Event/Paper**	**Presenter**	**Chair**
14.00-14.20	Sub-theme Keynote speaker	Prof. Joseph O. Ogutu	Bernard Ngoru
14.20– 14.35	Conservation Gains, Losses and the Future of Tana River Red Colobus and Tana River Mangabeys in the lower Tana River: Analysis of Four Decades Population Trends	Stanislaus Kivai *et al.*	
14.35- 14.50	Development of a Science-Based Integrated Metapopulation Management Plan for the Kenyan Black Rhinoceros (*Diceros bicornis michaeli*)	Cedric Khayale *et al.*	
14.50 - 15.05	A long-term study: Lion trends and dynamics in northern Kenya	Toby Otieno *et al.*	
15.05 – 15.20	Africa's wilderness under threat – the case of wild dogs (*Lycaon pictus*) in Kenya's Kajiado County	George Mboya *et al.*	
15.20 – 15.35	Anthropogenic disturbance induces opposing population	Kay E. Holekamp *et al.*	
15.35 - 15.50	Avian diversity in different forest regimes in and around North Nandi Forest, Kenya.	Mark Cheruiyot Bett *et al.*	
15.50 – 16.05	Birds in the matrix: the role of agriculture in avian conservation in the Taita Hills, Kenya	Philista Adhiambo Malaki *et al.*	
16.05 - 16.20	25 Years of Long-Term Elephant Monitoring in Samburu	David Letitiya *et al.*	
16.20 – 16.35	Long-term population and demographic trends among the Amboseli elephants.	Phyllis Lee *et al.*	
16.35 – 16.50	Q&A		

Time	Event/Paper	Responsible	Chair
DAY 1- PARALLEL SESSION 1 – 2-Way Hall **Sub-theme:** Initiatives towards wildlife habitat restoration and connectivity			
Time	**Event/Paper**	**Presenter**	**Chair**
14.00 – 14.20	Sub-theme Keynote Speaker	Dr. Paul Matiku	Dr. Fred Omengo
14.20 – 14.35	A spatial planning framework for informing integrated biodiversity and ecosystem service conservation and restoration	Gibbon Gwili *et al.*	
14.35 – 14.50	Infrastructure and wildlife mortality: current research and future directions	Fredrick Lala *et al.*	
14.50 – 15.05	Can market-based mechanisms enhance connectivity of landscapes? Lessons from Kasigau Corridor, Southern Kenya.	Geoffrey Mwangi and Tom Kiptenai	
15.05 - 15.20	Distribution and seasonal movements of savannah elephants, (*Loxodonta Africana)* around Lake Jipe, a function of foraging resources	Muteti Zacharia Mutinda *et al.*	
15.20 – 15.35	How anthropogenic features and threats contribute to shape cheetah, (*Acinonyx jubatus)* activities and connectivity	Cherie Schroff	
15.35 -15.50	Implementing community-based corridors to enhance wildlife connectivity	Benjamin Loloju *et al.*	
15.50 -16.05	Key biodiversity areas: preserving wildlife diversity for a sustainable future	Paul Gacheru *et al.*	
16.05 - 16.20	Rangeland restoration for a refugee species:re-establishment of grass cover using large scale multi-site experiments in African Savanna	Ali Abdullahi *et al.*	
16.20 – 16.35	Socio-economic and environment sustainability outcomes of the competing land use systems in northern Tanzania.	Lucas Yamat *et al.*	
16.35 – 16.50	Q&A		
DAY 1- PARALLEL SESSION 1 - Acacia Hall **Sub-theme:** Approaches to enhance human-wildlife coexistence in human-dominated landscapes			
Time	**Event/Paper**	Presenter	Chair
14.00 – 14.20	Sub-theme Keynote speaker	Prof. Noah Sitati	Dr. Festus Ihwagi
14.20 – 14.35	Building a landscape of resilience: large carnivore governance and management implications of farmers' attitudes and livestock husbandry practices in a multicultural setting within Meru National Park, Kenya	Kennedy Kariuki *et al.*	
14.35 - 14.50	Amboseli Trust for Elephants HECx Program – Learning how to coexist by understanding elephant behaviour.	Lydia Tiller *et al.*	
14.50 – 15.05	Appraisal of the government and private compensation schemes for human wildlife conflict in Kenya	Sarah M. Omusula *et al.*	
15.05 – 15.20	Assessing the drivers of attitude, tolerance and perception of local communities on elephants and human wildlife conflicts around Meru conservation area.	Newton Simiyu *et al.*	
15.20 – 15.35	Behavior of rescued and rehabilitated elephant calves with an eye toward release success.	Colman Lesowapir *et al.*	

Time	Event/Paper	Responsible	Chair
15.35 – 15.50	Capabilities, opportunities, and motivations for poaching reticulated giraffe in central-northern Kenya.	Symon Masiaine *et al.*	
15.50 - 16.05	Community engagement in vulture conservation in the southern rangelands of Kenya	Paul Gacheru *et al.*	
1605-1620	Ewaso Lions – a story of community-led conservation	Jeneria Lekilelei *et al.*	
16.20 – 16.35	Human-lion coexistence: Lessons learned from predator-proof bomas project in Amboseli-West Kilimanjaro ecosystem, Kenya and Tanzania	David Manoa *et al.*	
16.50 – 17.05	Q&A		
DAY TWO: WEDNESDAY 27th SEPTEMBER 2023			
8.00 - 8.30	Registration		Chair
8.30 – 9.15	**Keynote Address 3** - Infrastructure and conservation: the nexus for policy development - **Kiboko Hall**	Dr. Ben Okita	Sam Weru
9.15 – 10.00	**Keynote Address 4** - Ecological monitoring and community enterprises - **Kiboko Hall**	Dr. David Western	
DAY 2- PARALLEL SESSION 2 – Kiboko Hall **Sub-theme:** Changes in wildlife population trends and dynamics			
Time	**Event/Paper**	**Presenter**	**Chair**
10.30 – 10.45	Modelling distribution of Kirk's dik dik (*Madoqua kirkii*) in the Greater Tsavo Ecosystem.	Fredrick Lala *et al.*	Dr. David Manoa
10.45 – 11.00	Leopards' density and putative co-occurrence with spotted hyaena in the Maasai Mara ecosystem, Kenya	Elena Chelysheva *et al.*	
11.00 – 11.15	Ecological factors influencing large herbivore distribution (LHD) in Ruma National Park of Homa Bay County, Kenya	Luke Lukaria *et al.*	
11.15 – 11.30	Interaction between African leopards (*Panthera pardus pardus*) and olive baboons (*Papio anubis*) in Laikipia, Kenya.	Laiyon Lenguya *et al.*	
11.30 – 11.45	Dynamics of herbivore distribution and habitat selection in the Greater Serengeti Ecosystem, Tanzania	Hamza K Kija *et al.*	
11.45 – 12.00	A general age and sex-structured model of wildlife population dynamics illustrated by the Mara-Serengeti topi population	Joseph O. Ogutu *et al.*	
12.00 – 12.15	Distribution and abundance of migrant birds and endangered mammals within Naivasha Wildlife Sanctuary, Kenya	Peter Maina *et al.*	
12.15 – 12.30	Past outcomes and future directions for African elephant translocations	Lydia Tiller *et al.*	
12.30 – 12'45	Pathways to human-giraffe conflict and coexistence in eastern Kenya	Ali Abdullahi *et al.*	
12.45 – 13.00	Q&A		

Time	Event/Paper	Responsible	Chair
DAY 2- PARALLEL SESSION 2 - 2-Way Hall			
Sub-theme: Initiatives towards wildlife habitat restoration and connectivity			
Time	**Event/Paper**	**Presenter**	**Chair**
10.30 - 10.45	Status, conservation threats and restoration of the Tarangire-Manyara (Kwakuchinja) wildlife corridor in Tanzania	Julius Keyyu *et al.*	Dr. Judy Nyunja
10.45 – 11.00	The extent and impacts of invasive species on Wildlife habitat productivity	Peter Maina *et al.*	
11.00 – 11.15	The impact of cattle foraging on habitats by Kenyan plains zebra (*Equus guagga*) and Grevy's zebra (*E. grevyi*)	Daniel Rubenstein *et al.*	
11.15 – 11.30	The influence of elephants foraging on tree species regeneration and abundance in Arabuko-Sokoke Forest, Kenya	Lynn Njuguna *et al.*	
11.30 – 11.45	The role of environmental, structural and anthropogenic variables on underpass use by African savanna elephants (*Loxodonta africana*) in the Tsavo Conservation Area.	Michael Koskei *et al.*	
11.45 – 12.00	Tracking carbon allocation to unravel how mutualism and its breakdown affect tree dynamics in Laikipia, Kenya	Elizabeth Pringle *et al.*	
12.00 – 12.15	Transfrontier elephant movements in the Kidepo ecosystem: evidence for connectivity across Uganda, Kenya and South Sudan	Purity Milgo *et al.*	
12.15 – 12.30	Understanding the foraging behavior and dispersal patterns of red colobus monkey (*Priocolobus rufomitratus*, Peters 1879) populations in natural and agro-ecosystems forests in Tana River Primate National Reserve, Tana River County Kenya	Rose Abae *et al.*	
12.30 -12.45	Young male elephants – dispersal and exploration in Amboseli	Vicki Fishlock *et al.*	
12.45 – 13.00	Q&A		
DAY 2- PARALLEL SESSION 2 – Acacia Hall			
Sub-theme: Approaches to enhance human-wildlife coexistence in human-dominated landscapes			
Time	**Event/Paper**	**Presenter**	**Chair**
10.30 – 10.45	Impact of drought and development on the effectiveness of beehive fences as elephant deterrents over nine years.	King, L. E *et al.*	Fredrick Lala
10.45 – 11.00	Late Holocene human interactions with the landscape in Eastern Africa	Stephen Rucina *et al.*	
11.00 – 11.15	Nature and extent of human- hippopotamus conflict in Busega District, North- Western Tanzania	Richard Lyamuya *et al.*	
11.15 – 11.30	The effectiveness of bomas with wire-fencing and lights at deterring livestock depredation and its influence on pastoralists' attitudes towards carnivore conservation.	Ambrose Letoluai *et al.*	
11.30 – 11.45	The Elephant Queen: can a nature documentary improve tolerance for elephants?	Harry Williams *et al.*	
11.45 – 12.00	Q&A		
Sub-theme: Approaches to climate change mitigation and adaptability			
12.00 – 12.15	Are they the key to coral reef resilience? A temporal study from Kenya	Said Hashim Omar *et al.*	

Time	Event/Paper	Responsible	Chair
12.15 – 12.30	Assessing the Aberdare fire incidence in Kenya: causes, impacts, and multi-stakeholder-based approaches for effective mitigation	Jared Asenwa Lumbasi *et al.*	
12.30 – 12.45	Assessment of vegetation changes in Kilombe Caldera, Baringo County Kenya; Inferences from micro botanical remains and current vegetation	Rebecca Muthoni *et al.*	
12.45 – 13.00	Q&A		
			Chair
14.00 – 14.45	**Keynote Address 5** - Remote Sensing and Natural Resource Surveys for Wildlife conservation and Management- **Kiboko Hall**	Dr. Emmanuel Nkurunziza	Dr. Joseph Mukeka
DAY 2- PARALLEL SESSION 3 – Kiboko Hall **Sub-theme:** Changes in wildlife population trends and dynamics			
Time	**Event/Paper**	**Presenter**	**Chair**
14.45 – 15.00	Population distribution and abundance of the Common hippopotamus, *Hippopotamus amphibius* in Lakes Naivasha and Nakuru, Kenya	Joseph Edebe *et al.*	Dr. Joseph Mukeka
15.00 – 15.15	Rural socioeconomic trends, and not ecological competition with livestock, as a main driver of wildlife declines in East Africa.	Lucas Yamat *et al.*	
15.15 – 15.30	Spatially-explicit future landscape scenarios for population growth of the African elephant	Sospeter Kiambi, *et al.*	
15.30 – 15.45	Temporal dynamics in observations of rare antelope endemic to Shimba Hills National Reserve, Kenya.	Benard Ochieng *et al.*	
15.45 – 16.00	The social structure and demographic status of the lion population in Meru National Park, Kenya.	Alois Mweu *et al.*	
16.00 – 16.15	Wildlife and livestock in the Samburu and Buffalo Springs National Reserves: insights from 17 years of monitoring	Giacomo D'Ammando *et al.*	
16.15 - 16.30	Lion (*Panthera leo*) monitoring and community conservation within the greater Mara ecosystem	Kasaine Sankan *et al.*	
16.30 - 16.45	Q&A		
DAY 2- PARALLEL SESSION 3 - 2-Way Hall **Sub-theme**: Use of science for harmonized policy engagement			
Time	**Event/Paper**	**Presenter**	**Chair**
14.45 – 15.00	Assessment of management effectiveness of the greater Mara and Mara Triangle conservation area: the case of Masai Mara national reserve, Siana, Oloisukut, and Ikinyei conservancies	Judith Nyunja	
15.00- 15.15	Comparative analysis of wildlife governance approaches in African countries	Frida D. Obare *et al.*	
15.15 – 15.30	Evidenced-based decision support for guiding biodiversity conservation strategies associated with urban growth and infrastructural development in East Africa.	Anthony Macharia *et al.*	
15.30 – 15.45	Mainstreaming of birds conservation into energy sector-lessons in engaging in energy issues in Kenya	Paul Gacheru *et al.*	
15.45 – 16.00	Morally contested conservation: Use of science for effective and inclusive policy implementation	Betty Rono *et al.*	

Time	Event/Paper	Responsible	Chair
16.00 – 16.15	The greater Mara monitoring framework: a practical model for linking scientific evidence to management and policy needs	Holly T. Dublin *et al.*	
16.15 – 16.30	Q&A		
DAY 2- PARALLEL SESSION 3 - Acacia Hall **Sub-theme:** Approaches to climate change mitigation and adaptability			
Time	**Event/Paper**	**Presenter**	**Chair**
14.45 – 15.00	Sub-theme Keynote speaker	Prof. Daniel Olago	Dr. Mohammed Said
15.00 – 15.15	Impacts of a severe drought on the Samburu elephants	David Daballen *et al.*	
15.15 - 15.30	Developing drought mitigation measures for elephants in the Tsavo ecosystem by understanding long-term elephant distribution and mortality patterns in relation to NDVI, vegetation, and rainfall.	David Kimutai *et al.*	
15.30-15.45	Effects of climate change on elephants population in Amboseli National Park in Kenya	Lynnette Mwari Kiboro *et al.*	
15.45 - 16.00	A million-year vegetation history and palaeoenvironmental record from the Lake Magadi Basin, Kenya Rift Valley	Veronica Muiruri	
16.00 – 16.15	Modeling trends and variation in rainfall, temperature, NDVI, SOI and DMI in the Greater Mara-Serengeti Ecosystem: implications for biodiversity dynamics and conservation	Joseph Ogutu *et al.*	
16.15 – 16.30	Potential impacts of climate change on wildlife protected areas, a case study of Maasai Mara National Game Reserve	Laban K. Rotich *et al.*	
16.30 – 16.45	Vulnerability assessment of *Chondrichthyan* species to fisheries in coastal Kenya: implications for conservation and management	Benedict Kiilu *et al.*	
16.30 – 16.45	Q&A		
DAY THREE: THURSDAY, 28TH SEPTEMBER 2023			
8.00 - 8.15	Registration		Chair
8.15 – 9.00	**Keynote Address 6** – Regulation of wildlife research in Kenya- **Kiboko Hall**	Prof. Walter Oyawa	Dr. Vincent Obanda
9.00 – 9.15	Role of research in the implementation of EAC Wildlife Strategy	Leo Niskanen	
DAY 3- PARALLEL SESSION 4 – Kiboko Hall **Sub-theme:** Addressing wildlife health challenges through One Health approach			
Time	**Event/Paper**	**Presenter**	**Chair**
9.15 – 9.30	Sub-theme Keynote speaker	Prof. Eddy Mogoa	Dr. David Ndeereh
9.30 – 9.45	Recurrent anthrax outbreaks in humans, livestock and wildlife in the same locality, Kenya (2014-2017)	Matthew Muturi *et al.*	
9.45 - 10.00	Evaluating temporal patterns of anthrax outbreaks in Kenya's wildlife and the control measures instituted to control and prevent anthrax events in the country	Francis Gakuya *et al.*	

Time	Event/Paper	Responsible	Chair
DAY 3- PARALLEL SESSION 4 – 2-Way Hall			
Sub-theme: Use of new technology in addressing wildlife conservation challenges			
Time	**Event/Paper**	**Presenter**	**Chair**
9.10 – 9.30	Sub-theme Keynote speaker	Dr. Jack Wall	Wycliffe Mutero
9.30 – 9.45	Compatibility of livestock and wildlife in human occupied rangelands: using traditional pastoralism to enhance conservation of lions in their wild prey in Laikipia, Kenya	Annabella Helman *et al.*	
9.45 – 10.00	Combining technologies to examine human-lion interactions across scales for improved coexistence	Lucrecia K. Aguilar *et al.*	
DAY 3- PARALLEL SESSION 4 – Acacia Hall			
Sub-theme: Use of biotechnology and bio-prospecting for enhanced socio-economic benefits			
Time	**Event/Paper**	**Presenter**	**Chair**
9.10 – 9.30	Sub-theme Keynote speaker	Prof. Marion Mutugi	Priscilla Mutungi
9.30 – 9.45	A New Gem: *Steganotaenia araliacea*, a new host plant for edible *Bunaea alcinoe* larva in Yatta plateau, Machakos, Kenya.	Alex Mutinda *et al.*	
9.45 – 10.00	Bioprospecting for Thermophilic break-down of keratin-laden biomass waste	Francis Mulaa *et al.*	
DAY 3- PARALLEL SESSION 5 – Kiboko Hall			
Sub-theme: Addressing wildlife health challenges through One Health approach			
Time	**Event/Paper**	**Presenter**	**Chair**
10.30 - 10.45	Behavior and parasitism in a wild baboon population	Mercy Akinyi *et al.*	Dr. David Ndeereh
10.45 -11.00	Evidence of co-exposure with *Brucella* spp, *Coxiella burnetti* and Rift Valley fever virus among various species of wildlife in Kenya	James Akoko *et al.*	
11.00 – 11.15	Conservation of lions in Samburu through improving domestic carnivore welfare	Solomon Lenasalia *et al.*	
11.15 – 11.30	Gastrointestinal nematodes and physiology at the Livestock-Wildlife Interface in Kenya	Alice Burton *et al.*	
11.30 – 11.45	Gastrointestinal parasite dynamics at the livestock-wildlife interface in Laikipia, Kenya	Andrew Halls *et al.*	
11.45 - 12.00	Non-invasive assessment of ovarian activity in free-ranging eastern Black Rhinoceros (*Diceros bicornis michaeli*) in Kenya	Maureen Kamau *et al.*	
12.00 - 12.15	Assessment of heavy metal contaminants in Nkenye Stream in Meru south – Kenya.	Samson Chabari *et al.*	
12.15 – 12.30	A One Health approach to engaging communities better in long term elephant conservation.	Belinda Omollo *et al.*	
12.30 – 12.45	Southern white rhino gifts to Aitong, Kenya - fly in the ointment?	Richard Kock *et al.*	
12.45 – 13.00	Q&A		

Time	Event/Paper	Responsible	Chair
DAY 3- PARALLEL SESSION 5 – 2-Way Hall **Sub-theme:** Use of new technology in addressing wildlife conservation challenges			
Time	**Event/Paper**	**Presenter**	**Chair**
10.30 – 10.45	Flooding of Lake Nakuru National Park and its effects on the resident wildlife	Peter Hongo *et al.*	Joseph Edebe
10.45 – 11.00	Hippopotamus suitable habitat analyse in the Pendjari biosphere reserve using remote sensing and GIS tools	GRM Adouke *et al.*	
11.00 – 11.15	Impacts of the Loisaba Conservancy rhino fence on the behavior of other wildlife species	Rita Orahle *et al.*	
11.15 – 11.30	Enhancing Mapping of Illegal Wildlife Trade Hotspots in Kenya: Integrating Market Survey and Confiscated Wildlife Meat Analysis	Antoinette Miyunga *et al.*	
11.30 – 11.45	Introducing a new HEC toolbox and trainer of trainers workshops to enhance human-elephant co-existence.	Ewan Brennan *et al.*	
11.45 – 12.00	Keeping watch on Olgulului Ololarashi group ranch, Amboseli, Kenya	Wycliffe Mutero *et al.*	
12.00 – 12.15	Leveraging AI and satellite to push the boundary of wildlife survey technologies	Tiejun Wang *et al.*	
12.15 – 12.30	Photo Identification as a tool to study sea turtle populations in Kenyan Marine Protected Areas	Leah Mainye *et al.*	
12.30 - 12.45	Q&A		
DAY 3- PARALLEL SESSION 5 – Acacia Hall **Sub-themes: i)** Use of biotechnology and bio-prospecting for enhanced socio-economic benefits ii) Emerging alternative wildlife utilization and enterprises			
Time	**Event/Paper**	**Presenter**	**Chair**
10.30 – 10.45	Effective access and benefit sharing systems key for wildlife conservation and livelihoods improvement.	Mukonyi Kavaka *et al.*	Priscilla Mutungi
10.45 – 11.00	Promoting a new species of Cotesia as a first biological control agent against the Mediterranean corn borer, an expanding pest	Calatayud Paul-André *et al.*	
11.00 – 11.15	The use of cryopreservation in species conservation: Nature's SAFE The Living Biobank.	Susan Walker *et al.*	
11.15 – 11.45	Community perceptions on the enhancement of avitourism activities in Arabuko Sokoke Forest in Kilifi County, Kenya.	Jairus Koki *et al.*	
11.45 – 12.00	Q&A		
Sub-theme (ii): Use of natural capital accounting systems and payment for ecosystem service for socio-economic benefits			
12.00 – 12.20	Sub-theme Keynote speaker	Bernard Opaa	
12.20 -12.35	Implementing payment for ecosystem services scheme in Kenya: The case of Lake Naivasha Basin.	Weru Sammy *et al.*	
12.35 – 12.50	Dakatcha woodland ecosystem service assessment	Paul Gacheru *et al.*	
12.50 - 13.00	Q&A		

Time	Event/Paper	Responsible	Chair
DAY 3- PARALLEL SESSION 6 - Kiboko Hall **Sub-theme:** Addressing wildlife health challenges through One Health approach			
Time	**Event/Paper**	**Presenter**	**Chair**
14.00 – 14.15	Seroprevalence of *Neospora caninum* in spotted hyena populations in areas of high and low anthropogenic activity in the Maasai Mara National Reserve, Kenya	Marsden Onsare *et al.*	Dr. Francis Gakuya
14.15 – 14.30	The physiological condition of orphaned African elephants	Jenna Parker *et al.*	
14.30 – 14.45	Variability in water quality parameters within Kenyan Rhino areas and potential toxicity from water uptake.	Fred Omengo *et al.*	
14.45 – 15.00	Using a One Health Approach to address Wildlife Disease Challenge	Marilyn Karani *et al.*	
15.00 - 15.15	Q&A		
15.30 – 16.00	Recommendations and Way forward		
16.00 – 16.30	Closing Ceremony		
DAY 3- PARALLEL SESSION 6 – 2-Way Hall **Sub-themes: i)** Use of new technology in addressing wildlife conservation challenges ii) Emerging alternative wildlife utilization and enterprises			
Time	**Event/Paper**	**Presenter**	**Chair**
14.00 – 14.15	Post-release behavior of rehabilitated and released elephant calves in Sera Rhino Sanctuary, Kenya	Lemerketo Samuel Loidialo *et al.*	Dr. Daniel Chai
14.15 – 14.30	Real-time water quality monitoring using innovative Wireless Sensor Network technology: A pilot study in Lake Nakuru, Kenya	Kipkemboi J *et al.*	
14.30-14.45	Status of animal forensics in Kenya with focus on wildlife	George E. Otianga Owiti	
14.45-15.00	Using GPS tracking data to assess elephant movement in relation to risk	Festus Ihwagi *et al.*	
15.00 – 15.15	No-Take or Regulated-Take?	Said, Hashim Omar *et al.*	
15.15 -15.30	Q&A		
15.30 – 16.00	Recommendations and Way forward		
16.00 – 16.30	Closing Ceremony		
DAY 3- PARALLEL SESSION 6 – Acacia Hall **Sub-theme:** Emerging alternative wildlife utilization and enterprises			
Time	**Event/Paper**	**Presenter**	**Chair**
14.00 -14.20	Sub-theme Keynote speaker	Dr. Daudi Sumba	Mukonyi Kavaka
14. 20 -14.35	Inventory of wild mushrooms from Central and Nairobi regions in Kenya	Susan Kabacia *et al.*	
14.35 – 14.50	Nature-based tourism in the era of climate change challenges faced by national parks in arid and semi-arid environments	Kaitano Dube *et al.*	

Time	Event/Paper	Responsible	Chair
14.50 – 15.05	Socio-economic benefits and advantages for households living in the "W" Transboundary Biosphere Reserve in Benin (WTBR): Necessity to improve the eco-development contribution of natural resources	Azizou EL-HADJ ISSA *et al.*	
15 05 – 15.20	Women's enterprise and empowerment helps to foster tolerance for elephants	Esther Serem *et al.*	
15.20 – 15.30	Q&A		
15.30 – 16.00	Recommendations and way forward		
16.00 – 16.30	Closing Ceremony		

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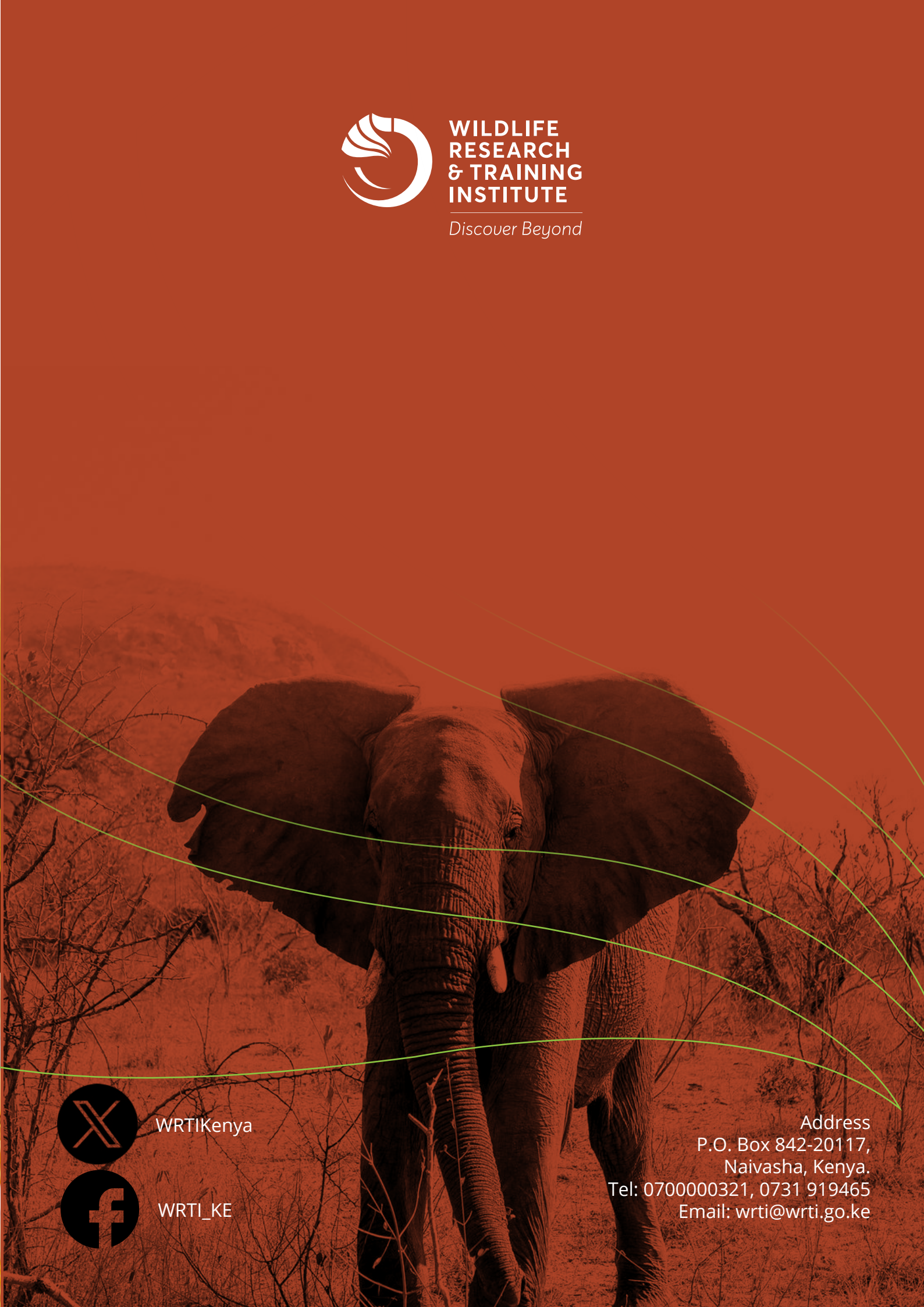

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