

Workshop Biodiversity and Land Use - A Comparative Approach -



26th - 29th September 2016
Linde (Germany)





Biodiversity and land use – a comparative approach, Linde, 26th-29th September 2016

Workshop
“Biodiversity and land use – a comparative approach”
Linde, 26th -29th September 2016

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Systematic Zoology Division
Albrecht Daniel Thaer-Institute of
Agricultural – and Horticultural Sciences
Faculty of Life Sciences
Humboldt-Universität zu Berlin
Unter den Linden 6, 10099 Berlin

Zwillenberg-Tietz Stiftung
Forschungsstation Linde
Brunnenweg 2
14715 Märkisch Luch /OT Linde

Links:

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U. Zeller, N. Starik & T. Göttert

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Biodiversity and land use – a comparative approach, Linde, 26th-29th September 2016

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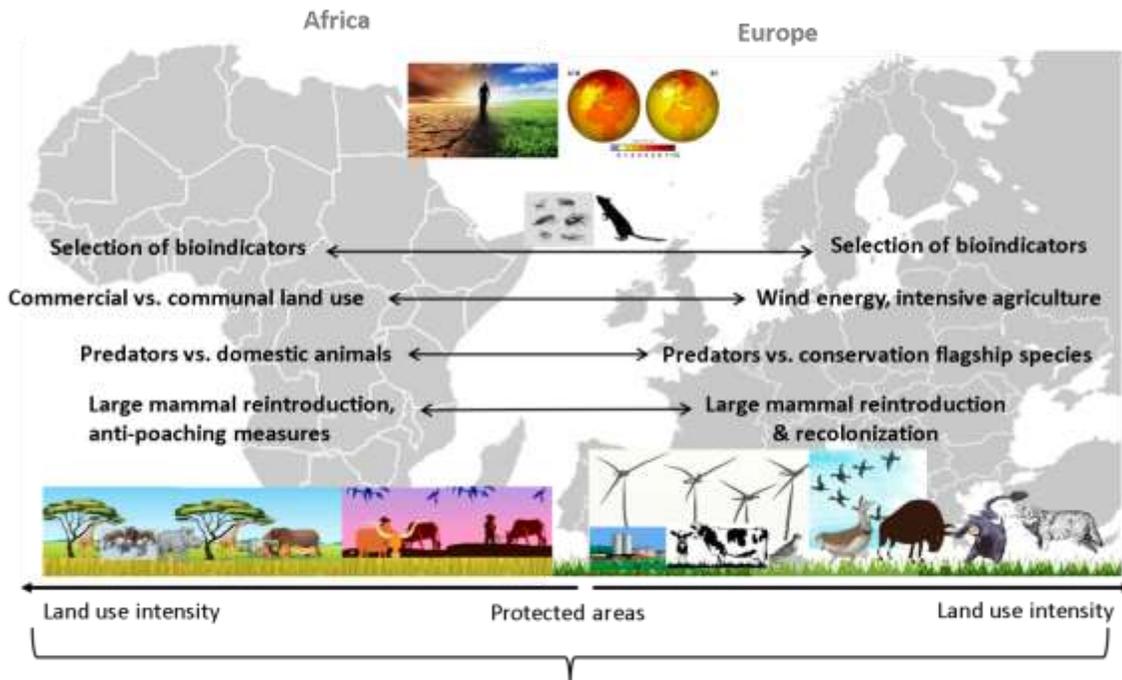




Preface

Owing to the global impact of land use practices and climatic change on biodiversity and ecosystem stability, holistic approaches on a trans-national or even global scale are needed. This kick-off workshop introduces a concept that addresses the spatiotemporal dynamics between land use and biodiversity on the basis of comparative investigations, including case scenarios under different ecological conditions. Special focus is on the comparison of grassland ecosystems in temperate Europe and southern Africa. The comparative approach deals with the central question, whether different ecosystems respond to disturbances according to generally applicable rules or (and to what extent) certain ecosystems are especially capable to buffer human induced disturbances. The comparative framework addresses practical implications arising from the currently debated trade-off between biodiversity conservation and the provision of ecosystem services using the example of protected areas and the mitigation of edge effects, land use contrasts, and human wildlife conflicts in a trans-national context. It may lead to a reassessment of the significance of arid and semiarid ecosystems, which may provide especially important case scenarios for other areas, where aridity is supposed to increase as a result of climatic change in the near future.

Biodiversity and Land Use – A comparative Approach



Comparative investigations and synthesis of results from different case studies on a transnational scale → situation-specific characteristics and universally applicable rules



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Among others, we aim at exploring protected area networks, sustainable land use strategies and climate change from an ecological, economic and sociocultural perspective, as illustrated by case studies from different parts of the world.

The workshop will include the following key aspects:

- Bioindicators as useful tools for an assessment of ecosystem functions
- Land use contrasts and edge effects at the borders of protected areas
- Human-Wildlife Conflicts
- Evaluating the potential of alternative production systems (e.g. improved varieties) for small scale subsistence agriculture of communities in buffer zones
- Traditional / current wildlife migration systems
- Wildlife reintroductions and their implications for protected area management
- Biological and cultural response mechanisms to different land use systems under different ecological conditions

Biodiversity and land use – a comparative approach

Priority areas & fields of research

- 1) Westhavelland Nature Park**
 - Bioindicators
 - Environmental compatibility of wind farms
 - Predator-prey relationships (carnivores vs. ground breeding birds)
- 2) Lower Oder Valley International Park**
 - Migration of large terrestrial mammals
 - Reintroduction of megaherbivores
 - Predator-prey relationships (carnivores vs. domestic animals)
- 3) Etosha National Park**
 - Bioindicators
 - Reintroduction of megaherbivores
 - Predator-prey relationships (carnivores vs. domestic animals)
 - Socio-cultural dimensions
- 4) Great Limpopo Transfrontierpark**
 - Migration of large terrestrial mammals
 - Reintroduction of megaherbivores
 - Anti poaching measures
 - Socio-cultural dimensions

- Creation of a communication platform for PhD students working in priority areas
- Mutual discussions about projects and concepts among experts and academics from various countries
- Identification of region-specific and situation-specific characteristics of edge effects, land use contrasts and Human Wildlife Interactions
- Identification of globally applicable characteristics of edge effects, land use contrasts and Human Wildlife Interactions



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We envisage contributions from a broad community of participants representing different members of an already established international academic network with special focus on Sub-Saharan Africa. Academics from Germany, Israel, Namibia, Mozambique, Tanzania, and Brazil will actively participate. Furthermore, an important aspect of this workshop is to create a communication platform for PhD students from Germany, Namibia and Mozambique, who are already working (or starting their PhD projects) under the umbrella of the workshops' general theme.

We would like to express our thanks to all participants for their contributions. In particular, we wish to thank Humboldt-Universität zu Berlin and Zwillingberg-Tietz Stiftung.

Berlin, September 2016

Prof. Dr. Ulrich Zeller, Dr. Thomas Götttert & Nicole Starik





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Programme



Biodiversity and land use – a comparative approach, Linde, 26th-29th September 2016

Monday, 26th September 2016

Arrival

17.00h **U. Zeller** (Germany): Welcoming notes and introduction to the research station Linde

Come together and refreshments

18:30h *Dinner*

Tuesday, 27th September 2016

09.00h **U. Zeller** (Germany): Biodiversity and land use – a comparative approach: an introduction to the concept

09.45h **T. Göttert** (Germany): Human-wildlife conflicts on a global scale –implications for comparative approaches: The example of carnivore-livestock interactions

10.30h **T. Rottstock** (Germany): Comparative study of interrelations between grazing systems of domestic cattle and agrobiodiversity in Europe and southern Africa - Concept of a proposed dissertation

11.00h *Coffee and Tea*



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- 11.30h **D. Saltz** (Israel): The value of reintroductions as a conservation tool: ungulates in Israel
- 12.15h **V. Macandza** (Mozambique): Resource dependence of reintroduced large herbivores in the Maputo Special Reserve, Mozambique
- 13.00h *Lunch break*
- 14.00h **N. Starik** (Germany): Bats and rodents as bioindicators for land use change – a useful tool for transregional application
- 14.45h **R. Platen** (Germany): Assessing the effects of energy cropping by carabid beetles (Col.: Carabidae) as bioindicators
- 15.30h *Coffee and Tea*
- 16.00h **F. Itanna** (Namibia): Coping strategies to combat food insecurity and loss of biodiversity in Namibia
- 16.45h **O. Mbango** (Namibia): Assessing Lucerne establishment, yield potential and impacts on biodiversity in semi-arid environment of Namibia
- 18.00h *Dinner*



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Wednesday, 28th September 2016

- 9.00h **M. Velte** (Germany): Introducing EAGERLearn. Creating an East African German Transdisciplinary University Network for research-based learning on urban-rural transformations
- 9.45h **M. Willkomm** (Germany): Land use dynamics of urban and peri-urban agriculture in Sub-Saharan Africa: a case study from Kenya (research concept)
- 10.30h **P. Msigula** (Tanzania): Effects of land use on wildlife movement and protected areas biodiversity in Eastern Arc Mountains and Ruvuma landscape, Tanzania
- 11.15h *Coffee and Tea*
- 11.45h **D. Roque** (Mozambique): Fauna diversity assessment along a gradient of forest cover and forest use regimes
- 12.30h **C. Fiderer** (Germany): Ranging behavior and movement patterns of red foxes (*Vulpes vulpes*) and raccoons (*Procyon lotor*) in the Special Protection Area "Mittlere Havelniederung", Brandenburg, Germany
- 13.15h *Lunch break*
- 14.30h **B. Coutinho** (Brazil): The challenge of integrating biodiversity and socioeconomics geodatabases as subsidies for decision makers for biological conservation and human well-being: some case studies in the Amazon, Cerrado and Atlantic Forest in Brazil
- 15.15h **F. Alpers** (Namibia): Protected area improved management through the application and practice of Traditional Knowledge by Indigenous People, case study of the KhwePeople's TK inside the Bwabwata National Park in Namibia



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- 16.00h *Coffee and Tea*
- 16.30h **E. de Oliveira** (Mozambique): Community resilience in conservation areas – Limpopo National Park (Case study)
- 17.15h **T. Jeremias** (Mozambique): Social and economic integration of people living in conservation areas in Mozambique (LNP case) - challenges and key principles
- 18.30h *Barbeque*

Thursday, 29th September 2016

- 9.00h Excursion to the Special Protection Area “Rietzer See”
- 12.30h *Lunch*
- Departure



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Abstracts of presentations



Biodiversity and land use – a comparative approach, Linde, 26th-29th September 2016

Biodiversity and land use – a comparative approach: an introduction to the concept

U. Zeller, N. Starik, T. Göttert, Germany

We introduce a concept that addresses the complex interrelations between land use and biodiversity by applying an organismic and comparative approach with special focus on grassland ecosystems in southern Africa and temperate Europe. While the natural savannas of southern Africa evolved several million years ago, tertiary grasslands in Europe emerged as cultivated land as a result of intensifying agriculture only a few hundred years ago. African grasslands are characterized by high original megafaunal species diversity. European ecosystems have been tremendously formed by humans and the species diversity of original megafauna is much smaller. Similar to the situation in southern Africa today, large herbivores also created a cyclic habitat mosaic in Europe during the last interglacial. The depleted herbivore community in Europe during the early Holocene was not anymore able to maintain this cyclic succession. This resulted in a uniform and dense vegetation type – a process that can be currently witnessed in Africa in terms of bush encroachment.

The comparative approach considers further strong natural and cultural linkages between Europe and Africa, such as i) a low geographical proximity between continents throughout continental drift, ii) the Afro-Palaearctic bird migration system, iii) the amount of exotic animals killed in ancient Rome, and iv) the global dispersal and distribution of cattle.

The approach is based on the assumption that comparative investigations of response patterns under different ecological conditions lead to a better understanding of the common mechanisms between land use and biodiversity. It deals with the central question, whether ecosystems respond in a similar way to disturbances. Biodiversity response patterns in relatively undisturbed savanna ecosystems might be a valuable reference for Europe, e.g. in terms of increasing aridity in Europe in the future.

The comparative approach requires a careful selection of primary taxa. Special focus is on the applicability of terrestrial small mammals as ecological indicators. Own preparatory work in Europe and southern Africa suggests comparable levels of species diversity and abundance within small mammal communities, as well as similar response patterns towards increasing land use intensities. The concept also includes human wildlife interactions. The emergence of top predators in Europe reveals the value of the experience from Africa, where pastoralists manage to coexist with large predators since more than 10,000 years. Another focus is on the reintroduction of megaherbivores, including own preparatory work in southern Africa. The question is, whether reintroductions in Europe favor ecosystem services or rather result in the creation of artificial “enclosures”. Thereby, the concept leads to a careful consideration of the term “wilderness”.

By applying this comparative approach, we aim to differentiate between region-specific characteristics and universally applicable rules to gain a better understanding of the complex interrelations between land use and biodiversity.



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**Human-wildlife conflicts on a global scale – implications for comparative approaches:
The example of carnivore-livestock interactions**

T. Göttert, U. Zeller, Germany

Owing to human population growth, increasing livestock numbers, intensifying agricultural practices and habitat degradation on the one hand and ecotourism and an increasing awareness of the importance of nature conservation on the other hand, carnivore-livestock conflicts are a global phenomenon. Comparative approaches are needed to identify management practices for conflict situations on a trans-national or even global scale. This presentation deals with case studies on carnivore-livestock conflicts from various parts of the world, including the countries represented by the participants of our workshop. The goal is to introduce the comparative and organismic approach by using the example of carnivore-livestock conflicts in order to differentiate between case-specificity and common applicability of the underlying ecological processes and the resulting management strategies. Different methods to reduce such conflicts (e.g. lethal control, artificial and natural barriers, livestock husbandry practices, guarding livestock, waste management systems, resettlement of humans) will be discussed. The basic assumption is that mitigation strategies towards carnivore-livestock conflicts from regions, which represent relatively undisturbed ecosystems, might provide important information for similar studies in regions, where the ecosystems have been extremely transformed. In Europe, for example, we are currently witnessing large carnivores, such as wolves (*Canis lupus*), recolonizing areas, where these species were formerly extinct. The emergence of top predators in Europe forces wildlife managers to develop appropriate strategies. The experience from other regions is of great importance to address one and the same phenomenon, the conflict between large carnivores and livestock, under different ecological conditions and detect generally applicable practices to achieve the coexistence of ecologically highly relevant faunal elements, as well as human well-being.



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Comparative study of interrelations between grazing systems of domestic cattle and agrobiodiversity in Europe and southern Africa - Concept of a proposed dissertation

T. Rottstock, U. Zeller, Germany

As part of a dissertation at Humboldt-Universität zu Berlin, a comparative study of the interactions between grazing domestic cattle and agricultural biodiversity in Europe and southern Africa is planned. Since the beginning of agriculture, the different land use systems have diverse impacts on the biodiversity of agroecosystems. The influence of human activity on the naturally occurring megafauna in southern Africa was not as high as in Europe. Next to obvious differences, significant similarities in the influence on ecosystems by their agricultural use can be found at a closer look. Since domestic cattle breeds on both continents have a common origin and then developed independently under different ecological conditions, they are especially capable to function as the theoretical framework of the comparative analysis. The objective of the proposed study is to achieve a better understanding of the interactions between agricultural land use systems and agrobiodiversity, and to enable advice for sustainable management strategies, due to a comparative study of grazing systems of domestic cattle in Europe and southern Africa. Therefore, grazing management, region-specific conditions of cattle farming and the handling of existing human-wildlife conflicts shall be comparatively analyzed within selected case studies in Germany (Odertal, Havelland) and in Namibia (communal land, private land).



The value of reintroductions as a conservation tool: ungulates in Israel

D. Saltz, Israel

Relative to other conservation-oriented endeavors reintroductions are both hi-risk and hi-cost. Reintroductions can be justified on the basis of both the intrinsic value and the pragmatist philosophical approaches in conservation; however, the latter requires “hard evidence”. I review the conservation benefits obtained from the ungulate reintroduction program in Israel. These benefits can be divided into three types:

(1) Reintroductions can be viewed as part of ecosystem restoration. We have demonstrated that several of the reintroduced species fulfill key functions in the ecosystem that in their absence would lead to a significant decline in biodiversity. These functions could not be compensated for by other extant species, including ungulates.

(2) Reintroduced species are often both umbrella and flagship. Thus, their successful establishment and needs for future range expansion can be used to secure land for conservation. Successfully reintroduced populations also offer an excellent opportunity to study habitat selection and range expansion. We used these attributes to project the reintroduced populations’ range expansion and prioritize areas for conservation. We then used this evidence to prevent land development and secure areas for conservation.

(3) The contribution that reintroduction programs can make to the sciences of general and applied ecology has been previously outlined. In Israel studies of reintroduced populations demonstrated the validity of population growth-projection models, the impact of age structure and sex ratio in small populations on their dynamics, the susceptibility of social organisms to conspecific disruption, potential impact of global change, and the impact of the founder effect on genetics.



Resource dependence of reintroduced large herbivores in the Maputo Special Reserve, Mozambique

V. Macandza, Mozambique

The populations of large herbivores in the Maputo Special Reserve (MSR), Mozambique declined severely during the civil war that affected the country during 16 years (1976 – 1992). Illegal poaching after the war also contributed to the shrinking of the populations. Large herbivores are being reintroduced to restore ecological function and increase the tourism potential of the reserve, including a total of 351 zebra and 109 wildebeest reintroduced in the reserve since 2010. In this study we estimated ecological carrying capacity for grazing herbivores and assessed resource use by the reintroduced animals. The carrying capacity was estimated using the method that combines rangeland ecological condition, mean annual rainfall, accessibility and occurrence of fires. The condition of the rangeland was estimated using the ecological index method. The use of food resources by zebra and wildebeest was assessed by documenting grazed and ungrazed grass species and counting the number of bites taken on grass species within quadrats placed on sites where the animals were located feeding, to estimate grass species acceptability and contribution to the diet. It is estimated that MSR can support 14076.9 grazing units. Zebra and wildebeest showed high acceptance index for the grass species most available in the grassland such as *Trachypogon spicatus* and *Digitaria eriantha*. Highest acceptance values were also recorded for grass species retaining a higher proportion of green leaves. Night five percent of the diet of both zebra and wildebeest are made up by five grass species, respectively, with the most widely available *Trachypogon spicatus* and *Digitaria eriantha* making up more than 70% of the diet. High acceptability and dietary contribution by the most abundant and widespread grass species suggests that the reintroduced animals have adapted to the resources of the new habitat.



Bats and rodents as bioindicators for land use change – a useful tool for transregional application

N. Starik, U. Zeller, Germany

The use of bioindicators to evaluate impacts from land use on biodiversity is increasingly becoming a key element in developing strategies for a sustainable management of agro-ecosystems. However, various definitions of the term “bioindicator” exist in the scientific literature and several taxa have been highlighted in different contexts.

The main aim of this presentation is to demonstrate the potential of bats and rodents as ecological indicators to track changes in habitats caused by different forms of land use. Due to their dependence upon insects and vegetation parameters and their obvious ecological importance, these two groups seem especially suitable to reflect habitat quality and ecosystem integrity.

In this presentation, original research studies from Germany and Namibia, as well as results from other research projects in different geographical regions, will be discussed.

In most studies a positive relationship between species diversity and/or abundance and certain habitat parameters/land use types could be found for both, bats and rodents. However, it turns out that species richness alone cannot sufficiently provide a precise picture and that species turnover and composition are essential parameters that should be additionally considered and investigated to understand the influence of anthropogenic changes on biodiversity. Owing to specific organismic features of bats and rodents, these two groups turn out to be able to capture complex ecological interrelations. Moreover, certain species or species groups (guilds) seem to be able to reflect specific habitat features with a greater degree of precision than others. Therefore, this presentation also aims at exploring relationships between sensitivity and ecological and life history traits (e.g. feeding strategy). Understanding which organismic traits are related to sensitivity is essential, as sensitivity to habitat change is important in determining a species's ability to survive in dynamic environments.

As most habitats in different geographical regions will host species of both groups, a trans-regional application of bats and rodents as ecological indicators to demonstrate the effects of different land use types on biodiversity, especially at functional diversity, could be of great value to derive management measures for a sustainable use of land in different parts of the world.



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Assessing the effects of energy cropping by carabid beetles (Col.: Carabidae) as bioindicators

R. Platen, Michael Glemnitz, Germany

We developed an indicator system for the assessment of the effects of energy cropping based on carabid beetle data, collected from 2005-2013 in the course of the joint research project "Development and Comparison of Optimized Cultivation Systems for the Agricultural Production of Energy Crops under different Site Conditions in Germany" (EVA). We used carabid beetles as bioindicators because their biology and ecology is well known and they react very sensitive to perturbations in ecosystems. To date, no comprehensive approach has been made for agro-ecosystems in practice. Our goal was an easy way (traffic light system) to evaluate the effects of energy cropping in a synoptic summary. The approach was to assess the effects of energy cropping with three thematic focuses: Alpha-diversity, the habitat suitability of energy crops for carabid beetles (expressed by the proportions of habitat preferences, body mass distribution, and functional aspects, such as the proportions of wing morphs, reproduction phases, food availability, potential pest regulation ability, etc. With a multivariate GLM we identified the geo-climatic region as a variable which caused significant differences between Alpha-diversity and a number of ecological and functional parameters. Consequently, we made the assessment separately for the four different regions investigated. We analyzed 10 different crop species groups (CSGs) that combined the single energy crops; where maize was cropped as a reference which was investigated in all the four regions; to different parameters of the three thematic focuses. The results turned out to be very region-specific. In the East German plain- and heatherland, the numbers of species, individuals, the overall biomass and the species diversity was the highest in the fields with new energy crops, whereas in the other three regions, where no new energy crops were investigated, the highest values were scattered over different CSGs. The diversity values in all the four regions are predominantly the lowest in maize and millet. In all the CSGs in the northern regions carabid beetles with preferences to agrarian land and dry, open land found convenient habitat conditions, in the Thuringia basin this was true for species with preference to agrarian land, while at the Alpine upland this holds for greenland species. In all the regions, except for the Thuringian basin, where heavier carabids dominated in all the different CSGs, the other three regions were dominated by moderately heavy species. All in all, we have not found a general pattern of positive and negative assessment parameters and conclude that the integration of energy crops into a region-specific crop rotation will maintain diverse and balanced carabid beetle coenoses that differ in species composition depending on the particular crop species.



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Coping strategies to combat food insecurity and loss of biodiversity in Namibia

F. Itanna, Namibia

Namibia is a country in southern Africa with a semi-arid to arid environment endowed with a vast ecological diversity. Land use classes range from barren sandy salt flats to coastal water of Atlantic Ocean with a rich biodiversity; and restricted acacia dominated forestlands with poor to medium soil fertility status and more. During the rainy period, the prevalence of unique seasonal wetlands offers an opportunity for changes in biodiversity, particularly in northern landscapes.

While extreme heat, predominantly impoverished sandy soils, erratic and low rainfall are the major natural causes limiting biodiversity; mining, overgrazing, poor soil management and related practices are major human induced causes. The overall effect of these natural and anthropogenic causes is low crop production and insufficient food supply particularly to the farming community.

Recent studies on adaptation to flood and drought spells through judicious utilization of seasonal wetlands has demonstrated that the situation can be reversed fairly well. Efforts are also underway to investigate how conservation agriculture could dramatically change the status of biodiversity and food security. Improving the quality and management of rangelands, reclamation of abandoned mining sites, utilization of indigenous vegetable resources that are well adapted to the adverse environmental conditions such as drought, salinity, and alkalinity are among several strategic options that can alleviate food security in Namibia.



Assessing Lucerne establishment, yield potential and impacts on biodiversity in semi-arid environment of Namibia

O. Mbango, Namibia

Namibia has a semi-arid climate, with average annual rainfall of about 270 mm. Livestock production relies primarily on natural rangelands. Associated with these semi-arid rangelands are below average rainfall, high temperatures, and frequent droughts experienced on a cyclical basis. In the face of such persistent combined effects and further environmental degradation due to climatic change, natural pastures are no longer able to support the desired level of livestock production. Consequently, more alternative pasture species suited to dryland conditions are required to maximize forage production in dry environments.

Lucerne (*Medicago sativa*, L.) is a leguminous, perennial, drought tolerant species that is characterized by its deep taproot system. Despite all these attributes, Lucerne cultivation in Namibia is limited. The main aim of the study was to assess the establishment potential of Lucerne as forage crop for livestock production in northern Namibia and determine whether introduction of Lucerne in this semi-arid rangeland is environmentally sustainable. To do this, Lucerne was established in a field experiment at the University of Namibia farm, Ogongo Campus. The effect of four planting dates and irrigation intensities on the establishment, growth of seedling and dry matter (DM) yield of Lucerne was examined. Lucerne establishment was successful across all sowing dates. This resulted in mean (DM) yields at first harvest ranging from 0.07 t DM/ha to 2.3 t DM/ha and cumulative total (DM) yields of 0.3 t DM/ha to 9.2 t DM/ha for 3 consecutive cuts. High DM production was maximized when Lucerne was sown in March and delayed sowing from April to May reduced the yield in the establishment season by 92.46 kg DM/ha/day.

Preliminary results from a study aimed at investigating on how growing Lucerne at field scale could impact abundance and species composition of small mammal communities indicates that the highest overall abundance was found in the Lucerne fields compared to the semi-natural habitat, and other conventional field's crop. The results presented in this study could provide insight of Lucerne establishment potential in northern Namibia to further refinement best management practices for dryland Lucerne crops and also investigate whether introduction of this practice at field scale is environmentally sustainable.



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Introducing EAGERLearn. Creating an East African German transdisciplinary university network for research-based learning on urban-rural transformations

M. Velte, Germany

The presentation provides an insight into the efforts to build up a transdisciplinary network between the University of Nairobi, Karatina University in Kenya, the University of Daressalaam in Tanzania and the Humboldt-Universität zu Berlin in the context of the Erasmus+ Programme. Beginning with the initial idea, the process of application and how to finally getting started is described. Central goals of the network are the establishment and extension of international cooperation on a long term and the support and qualification of young academic teaching staff and future scientists based on transdisciplinary and intercultural research-based learning. With members belonging to the disciplines of Economic and Transport Geography, Applied Geoinformation Sciences, Agricultural Sciences and African Humanities (History, Ethnology, Literature and Languages), the focus of research is set on mobility and transport, land use change and urbanization and regional economics and commodity chains in Kenya, Tanzania as well as Germany.

EAGERLearn is a project in the making and the presentation aims to encourage to creatively engage in international science and education cooperation.

For further information, please check

<https://www.geographie.hu-berlin.de/de/abteilungen/wirtschaftsgeographie/eagerlearn>



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Land use dynamics of urban and peri-urban agriculture in Sub-Saharan Africa: a case study from Kenya (research concept)

M. Willkomm, Germany

For many urban dwellers in Sub-Saharan Africa, urban and peri-urban agriculture (PUA) plays an important role for food security and increasingly for income opportunities. Even though PUA is often seen as a less valuable activity in comparison to other urban land uses, recent studies suggest that it is becoming more and more profitable. However, PUA has to face challenges due to recent developments. In the context of an increasing internal migration and still a high natural population growth, urban growth leads to land use pressure which includes PUA as well. These processes again result in land use conflicts due to varying economic, societal and individual interests. Furthermore, recent studies assume that urban growth has influence on value chains of agricultural products cultivated in cities (e.g. commercialisation). Those two dynamics, namely the intensification of land use conflicts and the changes in value chains, lead to substantial challenges for PUA in Sub-Saharan Africa. On the basis of two medium-sized cities in Kenya (Nakuru and Nyeri) the present study (1) aims to quantify spatial and economic changes of PUA, and (2) investigates drivers and framework conditions in which these changes occur. Against this background, the project focusses on conceptual approaches of urban land use changes and (global) value chains, whereby especially the combination of both approaches enables further gain of knowledge. In this context, the study is following an innovative methodical approach in combining established methods of empirical social research for value chain analysis (mainly qualitative interviews) with remote sensing surveys for land use analysis (mainly satellite remote sensing).



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Effects of land use on wildlife movement and protected areas biodiversity in Eastern Arc Mountains and Ruvuma landscape, Tanzania

P. Msigula, Tanzania

Measures for conservation of biodiversity in Eastern Arc Mountains (EAM) and wildlife corridors connecting it with Ruvuma landscape is increasingly becoming important in the increasing human demands for land in Tanzania. Apart from sustaining lives of millions of people, the EAM forests are also a biodiversity hotspot and home to hundreds of endemic species. Conserving wildlife corridors is increasingly important for maintaining ecological and genetic connectivity in times of unprecedented habitat fragmentation. This paper presents two case studies. One is looking at the vanishing wildlife corridors due to increased demand of land for agricultural production and provides options for restoration. Another is looking at land use planning procedures and land tenure for implementation of corridor restoration options and for enabling communities bordering the EAM to reduce pressure towards the Mountains natural resources.

The corridor between the Udzungwa Mountains (part of Eastern Arc Mountains) and the Selous Game Reserve (part of Ruvuma landscape) in south-central Tanzania, a major link between western and southern wildlife communities, especially for the African elephant *Loxodonta africana*, provides an illuminating case study for vanishing wildlife corridors and restoration options. A preliminary assessment in 2005 found that connectivity was barely persisting via two remaining routes. Assessments of these two corridors conducted from 2007-2010, using a combination methods of dung surveys, habitat mapping and questionnaires. We found that both corridor routes have become closed over the last five years due to increased crop farming and livestock keeping, associated with population growth, were the main reasons for corridor blockage. However, continued attempts by elephants to cross by both routes suggest that connectivity can be restored. This entails a process of harmonizing differing land owners and uses towards a common goal. We provide recommendations for restoring lost connectivity and discuss the prospects for preventing further loss of corridors across the country. We further show land use planning procedures, land tenure and land use plans implementation challenges to guide approach for proposed corridor restoration options and of developing comprehensive village land use plans for communities bordering EAM in order to conserve the Mountains biodiversity which are under threats.



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Fauna diversity assessment along a gradient of forest cover and forest use regimes

D.V. Roque, V. Macandza, Mozambique

Forest cover is the main habitat component for terrestrial fauna, providing food, protection and shelter. Its reduction due to agriculture, logging, mining, burning and charcoal production decreases habitat quality, which changes fauna species richness, diversity, distribution and abundance. The aim of this study is to contribute to the knowledge of the distribution, abundance and diversity of fauna species in relation to the variation of forest cover and forest use regimes in landscapes progressively dominated by humans. Seventy-six transects were established in three forest cover levels (high, medium and low) and 4 forest use regimes (hunting concession, community forest, forest reserve and forest concession) in Manica province – Mozambique. Along each transect, species of mammals and reptiles were recorded based on direct observation of specimens or identification of indirect signs such as spoor, dung, animal remains and feeding signs. Seventy-three bird point counts were also established and all birds were counted, regardless of species. Alpha (α)-diversity was determined for each forest cover level and forest use regime, whereas beta (β)-diversity (species turnover, nestedness and species similarity) was determined between pairs of forest cover levels and forest use regimes. Binomial confidence intervals for proportions were computed to compare the frequency of occurrence of selected species in habitats with different forest cover and under different use regimes. Mean number of birds was compared among forest cover levels and forest use regimes using one-way ANOVA. The results show that α diversity and frequency (distribution) of species were not affected by the forest cover gradient and forest use regimes. β diversity was determined by species turnover. The similarity in the composition of fauna communities decreased as the difference in forest cover between habitats increased. The density of birds increased with the reduction of forest coverage.



Biodiversity and land use – a comparative approach, Linde, 26th-29th September 2016

Ranging behavior and movement patterns of red foxes (*Vulpes vulpes*) and raccoons (*Procyon lotor*) in the Special Protection Area “Mittlere Havelniederung”, Brandenburg

C. Fiderer, U. Zeller, Germany

Over recent decades, a general decline in ground breeding birds has been recorded all over Europe and this trend is mainly a result of agricultural intensification. However, increasing predation pressure might also play an important role in this context. Previous studies show that red fox populations (*Vulpes vulpes*) have increased rapidly since the 1980s. Moreover, there are growing populations of invasive raccoons (*Procyon lotor*) and raccoon dogs (*Nyctereutes procyonoides*) that additionally increase predation pressure on ground breeding birds. The main objective of the present study is to investigate the impact of different mammalian predators on ground breeding birds in the southern part of the Havelland, Brandenburg (Germany). Thus, home-range data and movement patterns of predators are compared with local occurrences of ground breeding birds. Since October 2015, we are collaring adult foxes, raccoons and raccoon dogs with GPS-tags in order to study their movement patterns and habitat preferences in the rural district of Potsdam-Mittelmark, near the research station Linde. Animals are captured with box traps that are set along obligatory passages such as ditches, fences, lakesides or walls, as well as close to dens and decoy places. Captured animals are transferred in a transfer cage, where they get immobilized with the Hellabrunner Mixture. Until now, more than 2,245 trap nights have been realized and four adult foxes and six adult raccoons have been equipped with GPS-collars. Preliminary results of the movement data suggest that foxes are more likely to hunt in open grassland than raccoons, which show a clear preference for water bodies. For this reason, raccoons seem to have a much higher impact on birds breeding in reed beds, while foxes seem to affect a higher predation pressure on birds that breed in open grassland. Furthermore, the studied individuals of *Vulpes vulpes* show a clear preference for human settlements during the night hours, while at daytime, most of them stay close to open areas in the forest. Movement data also suggest that female foxes are more likely to change their territories during mating season in December and January, while male foxes have strict territories and show less migratory activity. Female foxes changed their territories in December and migrated more than four kilometers to establish new territories. One adult female even moved a total distance of more than 120 kilometers during 5 days. In contrast, male foxes show high site fidelity. Data collection and trapping activities are still ongoing in order to increase sample size and to get a more precise picture of seasonal variations to derive management recommendations for sustainable land use strategies in the future. This will help to get a better understanding of the complex interrelations between ground breeding birds and mammalian carnivores in this study area in order to derive management recommendations for sustainable land use strategies in the future.



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The challenge of integrating biodiversity and socioeconomic geodatabases as subsidies for decision makers for biological conservation and human well-being: some case studies in the Amazon, Cerrado and Atlantic Forest in Brazil

B. Coutinho, Rodrigo Medeiros, Thais Kasecker, Brazil

The manager, legislator or policy performer ideally makes decisions based on the greatest certainty possible in a given time. The scientist, to influence this decision-making has to deal with the uncertainties to reduce them and finally communicate them to public managers, entrepreneurs and civil society. However, decisions on biodiversity and the environment often have an interdisciplinary character and need to also take into account socio-economic aspects. Thus, it becomes desirable that environmental databases can interact with socioeconomic databases.

With the development of geo-technologies, scientific research and policies to access information; there is an increase of geospatial databases available for various themes and scales. Since the 2000s, in Brazil there is a significant increase in the efforts for the collection and availability of environmental and socio-economic monitoring data at the federal, state and municipal level. From basic cartography of reference, cataloging species and geobiophysical mappings to the monitoring of habitat loss and socioeconomic indicators at various scales; new bases have emerged or improved, and today have a direct effect on strategic public policies such as reducing deforestation, conservation of endangered species and maintenance of ecosystem services. Nevertheless, there are still gaps in relation to these bases, especially with respect to integration and accessibility. In this sense, it is important to understand the assumptions and limitations of scales and spatial resolutions of these materials and select what is most relevant to the issue. This is not a simple task and involves not only the knowledge of the sources but mainly the development of hypotheses, the construction of indicator systems and models capable of subsidize the answers. In this context, the challenge that arises is to develop knowledge; make it available to the public and turn it into tools for participatory management on the use of the territory.

In this article are presented results of three studies conducted by CI-Brazil and partners in continental and national scales, in which there is an effort to integrate geodata on biodiversity, ecosystem services and socio-economic with a focus on diagnostics and prognostics for supporting the development of public policies and investments to environmental conservation and human well-being.



Mapping Essential Natural Capital in Amazonia

The first case study was conducted by Conservation International (and Amazon countries offices) with the aim of mapping the most important areas for biodiversity and ecosystem services as a way of supporting multiple partners work throughout the Amazon.

Were collected existing data and new spatial analysis were performed to identify important areas for biodiversity, freshwater, non-timber forest products, climate mitigation and adaptation.

Products from these analyses include maps and spatial datasets that can be used by decision makers to identify the most important places to conserve and sustainably manage. The maps could be used by governments in prioritization of areas for environmental protection or restoration, as a guiding tool to avoid developing projects in sensitive areas or to guide private sector financing for conservation.

Among important results; highlights are that are currently unprotected 50% of the areas considered as priorities for conservation by national governments, 43% of the areas of greatest endemism, 50% of the most important areas for freshwater and 50% of essential natural capital mapped.

On the other hand, protected areas and indigenous lands cover 46% of the study area and collectively account for 54% of total carbon stock. While these protected areas deforestation rates from 2010-2014 were 0.08%-year in the remainder of the Amazon were 0.24%-year.

Considering limitations for decision making at the regional or local level with continental data, the lack of some data for modeling and the need to incorporate new information; This project is being conducted at national scales with official data from governments which may contribute to its usability.

Ecosystem Profile Cerrado Biodiversity Hotspot

The purpose of the ecosystem profile is to provide an overview of biodiversity conservation, analyze priorities for action and identify ways to strengthen the constituency for conservation. In addition to laying out a strategic framework for CEPF's grant-making, it also sets out a broader agenda for the hotspot for use by all parties that might embrace the cause.

Preparation of the profile benefitted from critical analyses and recommendations from more than 170 people of 130 institutions, including community and indigenous leaders, non-governmental organizations, private sector, government authorities, researchers and a Senior Advisory Group who participated in five workshops held in 2015. Preparation also involved a detailed survey of relevant literature and documents as well as analysis of past experience.



The Cerrado (2 million km², in central Brazil) has a wide variety of vegetation types including grasslands, scrublands, dry forests and riparian woodlands. The fine-textured mosaic in the heart of South America provides links among the “open” formations of the Caatinga, Pantanal and Chaco, as well as connecting the Amazon rainforest with the Atlantic Forest.

There are 980 officially recognized threatened species in the Cerrado. Since its rainy tropical climate has a long dry season between May and October, many plant species that are wild relatives of commercial crops have resistance to heat and drought, genetic characteristics that are strategic in the current context of global climate change.

The analysis generated a database with more than 10.000 occurrence points for species that trigger one or more KBA (Key Biodiversity Areas) criteria. KBAs were identified for each group of KBA trigger species, before a grouping analysis was undertaken to remove spatial overlaps. This resulted in a final list of 761 KBAs in Brazil plus one area in Bolivia and three in Paraguay.

In order to make conservation outcomes as relevant as possible to policy makers, the KBA concept was broadened to include consideration of socioeconomics aspects and ecosystem services of individual sites, especially hydrological services.

Corridors are large-scale spatial units required for the maintenance of ecological and evolutionary processes. The corridors were defined based on clusters of KBAs of high relative biological importance considering criteria of vulnerability and irreplaceability. Analysis also took into account connectivity among remnants of native vegetation and distribution of protected areas.

The 13 corridors encompass a total area of 723.000 km², of which 689.700 km² (95%) are within the hotspot. This means that one-third of the hotspot is located within conservation corridors considered highly important for biodiversity conservation and provision of ecosystem services.

To guide CEPF’s own investments, species outcomes in the Cerrado were prioritized according to three criteria: level of threat, existence of National Action Plans and relative importance of the hotspot for conservation of the species. Of the 218 species of flora and fauna classified as

Critically Endangered, only nine are globally threatened and thus eligible for CEPF investment: two plants, four birds, two insects and one amphibian.

The criteria used to prioritize KBAs were biological priority, level of threat, alignment with national priorities, civil society capacity, percentage cover of original vegetation and ecosystem services, especially water. There were 109 KBAs of “Very High” relative conservation importance, equivalent to roughly 10% of the hotspot.



To select priority corridors, the six criteria used were weighted average of relative priority rankings for KBAs in the corridor, conservation investment gaps, opportunities to work with civil society, potential for leverage to sustain or amplify CEPF investments, urgency of conservation actions and natural vegetation cover. The result was four priority corridors representing 16% of the Cerrado Hotspot.

Based on this study and through public consultation, it was developed CEPF investment strategy for the Cerrado for the next 5 years: - Promote the adoption of best practices in agriculture in the priority corridors; - Support the creation/ expansion and effective management of protected areas in the priority corridors; - Promote and strengthen supply chains associated with the sustainable use of natural resources and ecological restoration in the hotspot; - Support the protection of threatened species in the hotspot; - Support the implementation of tools to integrate and to share data on monitoring to better inform decision-making processes in the hotspot; - Strengthen the capacity of civil society organizations to promote better management of territories and of natural resources and to support other investment priorities in the hotspot and - Coordinate the implementation of the investment strategy of the CEPF in the hotspot through a Regional Implementation Team (RIT).

“Bolsa Verde Program” Sample Monitoring of Social-environmental Conditionalities: understanding the transformative power of a social programme for environmental conservation.

Facing the context of poverty eradication as one of the major global challenges and indispensable condition for sustainable development, the Brazilian government has made significant efforts since 2003 to overcome the extreme poverty of the population throughout the national territory through the integration and coordination of policies, programs and actions aimed at income security, access to public services and productive inclusion.

Currently, Brazil has a rural population of about 30 million inhabitants (15% of total); and of these, 7.5 million are extremely poor (families with monthly per capita income \leq US\$22.00).

In this context, the Green Grant Program contributes supplementary income transfer to the Bolsa Família Program (broad) for extractive poor families living in legally demarcated areas and protected by the government (sustainable use protected areas, land reform settlements, riverine territories, indigenous and other traditional communities). In October 2015 the program benefited about 75,000 families. The goal of the program is to encourage the conservation of ecosystems (maintenance and sustainable use) and promote citizenship, improving living conditions and raising the income of the population in extreme poverty involved in agro-extractive activities and conservation of natural resources in priority areas of the program.



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This work of CI-Brasil with Rural Federal University of Rio de Janeiro seeks to better understand how the program has contributed to improving environmental conservation and the living conditions of the beneficiary families in the areas where they live. The central question is: Economic benefits can be translated into improved living conditions and environmental quality?

The first challenge is to build a system of indicators able to reflect the results, benefits and losses of the program in environmental, social and economic dimensions. Were listed 105 indicators for analyzes 5 dimensions: - age structure, school attendance and migration; - work and income; - production infrastructure and social organization; - environmental conservation and - opinion of the impact of the program. Another challenge is to build representative sample and conduct field work in a country with continental dimensions, for stratified sampling were used three territorial limits: management agencies; biomes and the national territory.

Overall, from the analyzes, the benefit received from the program resulted in improvements to the beneficiary families related to the average increase in income of 42%; greater presence in schools among children and adolescents; greater acquisition of school supplies and materials for personal hygiene; food security and increase of the agro-extractive production.

Also families had knowledge about environmental conservation and restrictions of the instruments of management of territories.

For the program were identified key challenges related to the expansion of the offer of assistance and technical training for agro-extractive production, as well as mapping and encouraging the development of productive chains.

Upcoming challenges of monitoring are related to the improvement of the availability of produced geoinformation, integration with environmental and socioeconomic data from other research institutions, the diffusion of the methodology to other national and international programs and the creation of an International Network of Social and Environmental Protection of traditional communities.



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Final Considerations

The three studies presented are intended to provide an idea of a body of research on topics and scales articulated for better understanding of biodiversity and ecosystem services, for the purpose of nature conservation in the light of social development.

It highlights the importance of territories not included in the National System of Conservation Units but which play a key role in the chain of protected areas according to the characteristics of social organization and agro-extractive production. Moreover, it highlights the importance of identifying and understanding of these areas to the direction of public policies for environmental and social protection.

Finally, the intention is to bring to discussion how the organization, systematization and integration of geodatabases on biodiversity and socio-economic, as well as the availability of the produced geoinformation, has the potential to open new lines of scientific research and popular participation for developing better dialogue with decision makers; which must take into account in their decisions a strong economy with social justice and equity, in a healthy environment.



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Protected area improved management through the application and practice of Traditional Knowledge by Indigenous People, case study of the Khwe People's TK inside the Bwabwata National Park in Namibia

F. Alpers, Namibia

Indigenous people in Africa hold and daily practice some of the most sophisticated knowledge systems about biodiversity and ecosystems, but this knowledge is eroding fast partly to changing lifestyles and non-recognition by conservationists, land use planners and development practitioners. This presentation presents some challenges and comes forth with a local solution to improved protected area management and derived benefits, both social and ecological benefits.

Finding local solutions, through the application of realistic and alternative approaches to challenges relating to fair access to natural resources, practice of indigenous knowledge systems, which should lead to long-term social and ecological benefits and improved land management. This is especially relevant in the appreciation of integrated land use approaches and the promotion of traditional livelihood practice in and around protected areas.

Bwabwata National Park (BNP) in north east Namibia is home to 5,300 Khwe San, a rare and unique occurrence where almost as many people as elephants reside in a national park. Despite their longstanding presence in this territory and on this land, the Khwe are vulnerable to exclusion through modernisation, also resulting from a traditional hunting ban their rich environmental knowledge is fast eroding. The Khwe San have extraordinary knowledge and have for centuries managed their ecological systems by applying their rich traditional knowledge, which sustained their resource base and today find themselves in an ecological rich and wildlife abundant landscape.

The BNP is being managed by applying an integrated park management approach between the Namibian Ministry of Environment and Tourism and the Kyaramacan Association, representing all the residents residing inside the BNP. This far sighted strategy allows for improved protected area management and partial access by the community to natural resources. Traditional knowledge systems can be valuable resources in creating livelihoods, while at the same time affirming indigenous identities and culture, and securing access and increased benefits.



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This approach pilots innovative land use and conservation approaches, such as; human wildlife conflict, access and benefits to resources, food security and conservation in a transfrontier conservation area approach. Taking into account the social / cultural impact and exploring the ecosystem services potential to secure expanded benefits and extended livelihood opportunities.

The solution:

TEKOA, a social and ecological restoration process. The establishment of a “globally valid strategy” through the local solution finding approach, a training centre - where the elders teach and coach the youth and others, called TEKOA (Teach Each-other Knowledge Of All) or the Traditional Environmental Knowledge Outreach Academy.



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Community Resilience in Conservation Areas – Limpopo National Park (Case study)

E. de Oliveira, Mozambique

With establishment of conservation areas, communities that are living within and surrounding area are losing their livelihoods, and becoming vulnerable. This is also happening in Limpopo National Park (LNP), where the communities since 2001 seen their rights regarding the use of natural resources limited, and no other options to compensate these limitations. Although the communities are represented in the park management structure, they are not active players, especially for decision-making. It was in this context that in 2006, the Government of Mozambique, with some cooperation partners, decided to initiate a resettlement of the communities that are living in the park. This process was called "voluntary resettlement", however the way that the process is being taken; it is involuntary resettlement, the engagement at the beginning was only with community leaders not with all affected people. This situation affected the relationship between the communities and the local leader. The resettlement was started in 2006, eight years before only three communities out of eight were resettled. For resettled communities, this process has been more a source of problems than a solution. The resettlement in the LNP is not ensuring the continuity of socio-economic and cultures conditions for the resettled communities. That is opposite of the Mozambican resettlement guidelines.

The establishment of LNP and all processes related, exposed the communities within and around the park in constant changes in its socio-economic and cultural environment. Whereas these processes are dynamic these communities will be constantly exposed to these changes, so it is urgent for these communities to become resilient. For this reason, I am proposing to carry out a survey with the main objective of creating a resilient model for the communities that are living in and around the Limpopo National Park.



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Social and economic integration of people living in conservation areas in Mozambique (LNP case) - challenges and key principles

J. Jeremias, Mozambique

The search for land to satisfy the interests of big companies and facilities, as well as to address issues related to food security at the global level, has increased and is creating pressure on man and the environment. To ease this pressure and the environmental crisis the world has indicated the conservation of biodiversity through the creation of protected areas as essential to the preservation of natural resources, minimizing the problems arising from the environmental crisis', and promoting the quality of life society (olivato and junior; 2008).

On the basis of these agreements, in Mozambique have been identified seven areas for the creation of cross-border parks. In these areas live in poor communities that have the land and natural resources for their survival base. Different studies, as Massingarela 2015 has shown that because of the creation of conservation areas, access to land and natural resources to communities is reduced, implying a change of their livelihoods.

The Limpopo National Park, in Mozambican is no exception to this phenomenon. The rate of investment in conservation is greater than the speed of adaptation to shock the communities face the restrictions on resource access as a result of conservation areas, which makes them vulnerable to any external shock.

To minimize the vulnerability of these communities an involvement of all actors in the socio economic integration is necessary, through investments in a process of transformation of people to have new survival skills meet the new living ways, through appropriate educational systems, training in vocational skills, and development of fair markets. Only the transformation is that will allow the engagement of community members for active participation in the processes of decision-making, exploitation and use of opportunities, investment and job creation and employability of them. This socio economic integration strategy must be ensured by a permanent communication mechanism at all levels and with a flow of information in real time.



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List of participants

Alpers, Friedrich

Integrated Rural Development and Conservation
Buffalo Camp
Bwabwata National Park
Namibia

Coutinho, Bruno, Dr.

Conservation International Brazil & Universidade Federal Rural do Rio de Janeiro
Av.Rio Branco, 131
20.040-006
Rio de Janeiro
Brazil

de Oliveira, Esperança Rui Colua, MSc

Rua Save 414
Tchumene 1
1114 Matola
Mozambique

Fiderer, Christian, MSc

FG Spezielle Zoologie
Lebenswissenschaftliche Fakultät
Humboldt-Universität zu Berlin
Unter den Linden 6, 10099 Berlin
Germany

Götttert, Thomas, Dr.

FG Spezielle Zoologie
Lebenswissenschaftliche Fakultät
Humboldt-Universität zu Berlin
Unter den Linden 6, 10099 Berlin
Germany



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Itanna, Fisseha, Prof. Dr.
Crop Science Department
Faculty of Agriculture and Natural Resources
University of Namibia
Namibia

Jeremias, Teodósio
Comité Ecuménico para o Desenvolvimento Social (CEDES)
171 Maguiguana Ave
Maputo
Mozambique

Leitner, Peter
Project Manager
Parque Nacional do Limpopo / Limpopo National Park
PNL Head Quarters, Massingir
Mozambique

Msigula, Proches, H., Dr.
Department of Engineering Science and Technology
Sokoine University of Agriculture (SUA)
P.O. Box 3003, Morogoro
Tanzania

Macandza, Valerio, Prof. Dr.
Department of Forestry Engineering
Faculty of Agronomy and Forestry Engineering
Universidade Eduardo Mondlane
Mozambique

Mbango, Oscar, MSc
Department of Animal Science
Faculty of Agriculture and Natural Resources
University of Namibia
Namibia



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Pistreich, Machla, RAIN

Zwillenberg-Tietz Stiftung
Richard-Strauss-Straße 4
14193 Berlin
Germany

Platen, Ralph, Dr.

Institut für Landnutzungssysteme
Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF) e. V.
Eberswalder Straße 84
15374 Müncheberg
Germany

Roque, Dionisio Virgilio, MSc

Campus de Lhanguene
Av. de Moçambique
Maputo
Mozambique

Rottstock, Thomas, MSc

FG Spezielle Zoologie
Lebenswissenschaftliche Fakultät
Humboldt-Universität zu Berlin
Unter den Linden 6, 10099 Berlin
Germany

Saltz, David, Prof. Dr.

The Swiss Institute for Dryland Environmental and Energy Research
The Jacob Blaustein Institutes for Desert Research
Ben-Gurion University of the Negev
8499000 Midreshet Ben-Gurion
Israel



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Starik, Nicole, Dipl.-Biol.

FG Spezielle Zoologie
Lebenswissenschaftliche Fakultät
Humboldt-Universität zu Berlin
Unter den Linden 6, 10099 Berlin
Germany

Velte, Maria, Dipl.-Geogr.

Humboldt-Universität zu Berlin
Geographisches Institut
Abteilung für Wirtschaftsgeographie
10099 Berlin, Unter den Linden 6
Sitz: Berlin, Rudower Chaussee 16
Germany

Wicke, Marcus, Dr.

Zwillenberg-Tietz Stiftung
Forschungsstation Linde
Brunnenweg 2, 14715 Märkisch Luch (OT Linde)
Germany

Willkomm, Maximilian, MSc

Arbeitsgruppe Anthropogeographie - Stadt und Regionalentwicklung
Geographisches Institut
Universität zu Köln
Albertus-Magnus-Platz
50923 Köln
Germany

Zeller, Ulrich, Prof. Dr.

FG Spezielle Zoologie
Lebenswissenschaftliche Fakultät
Humboldt-Universität zu Berlin
Unter den Linden 6, 10099 Berlin
Germany