MSc and PhD Topics offered

in the School of Life Sciences and Bioengineering

NM-AIST, Arusha, Tanzania

Potential Projects

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Biodiversity Conservation and Ecosystem Management

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Topic1:

Using livestock grazing to improve under-used rangeland in the Chala ecosystem

INTRODUCTION

The Chala ecosystem is composed of savanna fauna and flora. However, only few wild herbivore species and individuals are using the natural plant resources. Hence, particularly grasses remain in low quality and unpalatable species dominate. Grasses can benefit from grazing as well as dung input, enhancing the carrying capacity of a grazing system, while overgrazing can lead to a permanent decline and degradation of the rangeland. Both wild grazers and domestic grazers such as cattle and sheep can create so-called "grazing lawns" (areas of highly nutritious grass species of high productivity) when the grazing pressure is at an optimum. We claim that Chala is under-used by wild grazers and does not represent an attractive feeding site for wildlife in its current state. Hence, the rangeland quality of Chala can improve greatly under well-managed moderate cattle grazing in selected areas.

AIM OF THIS PROJECT

This project aims at identifying grass resources (species composition, productivity, biomass) under varying grazing pressure at the Chala ecosystem, Rombo area, Kilimanjaro Region. Experiments with cattle herds will be conducted and small-scale enclosures will be set up to understand differences in regrowth of the grass resources after varying grazing pressure. The outcome of the project will provide tools for the Chala management to enhance the attractivtiy of the rangeland ecosystem for wildlife species to colonize and settle in the area.

METHODS

The project will contain in total 3 months of field work (setting up exclosures, following / guiding cattle herds, harvesting grass biomass, determining grass species, quantifying dung input…). Data analyses will be conducted using basic statistical tests (ANOVA, t-test, Chi-Square tests). Recommended statistical software for data analyses is R, SPSS or PAST.

SKILLS TO BE LEARNED

The student will learn field assessment techniques of quantifying vegetation and basic experimental setup skills. Further, the student will learn to discuss management options through livestock grazing and provide applied suggestions for future sustainable resource use. The student will also learn how to analyse data statistically and how to write up and publish scientific research results.

Topic2:

Wild mammalian species biodiversity along an elevation and land use gradient in the Mt Kilimanjaro ecosystem

INTRODUCTION

The Mt Kilimanjaro ecosystem contains various vegetation zones, including rainforests, savanna systems and alpine regions. Further, the lower slopes are strongly used by humans as coffee, banana or maize plantations. Little is known about how wildlife species distribution changes with elevation and across a range of different land use / land cover types. As there is a large variety of habitats along the Kilimanjaro we expect to find a high mammalian species diversity- To address wildlife distribution has so far been rather difficult as the terrain is steep, not easily accessible and animals are rather shy.

AIM OF THIS PROJECT

This project aims at assessing wild mammalian biodiversity along an elevation and land use gradient in the Mt Kilimanjaro ecosystem. We will compare wildlife diversity in natural vs human-impacted systems (e.g., maize vs savanna, home gardens vs lower montane forest). Further, we assess how the wild animal species are distributed across an elevation gradient (from 1800 masl to ca 4000 masl).

METHODS

The project will contain in total 3 months of field work. We will use camera traps along 20 different locations along Mt Kilimanjaro (inside and outside the protected area). Camera trap pictures will be complemented with systematic tracks and sign recording around each trap location. Photographs and signs will be analysed according to species presence, activity, and frequency of occurrence. Data analyses will be conducted using basic statistical tests (ANOVA, t-test, Chi-Square tests). Recommended statistical software for data analyses is R, SPSS or PAST.

SKILLS TO BE LEARNED

The student will learn field assessment techniques of identifying wildlife tracks and signs. Further, the student will learn to set up camera traps and to download and analyse camera trap data. The student will also learn how to analyse data statistically and how to write up and publish scientific research results. A certain physical fitness is required to conduct this project.

<u>**Topic3:**</u>

Wildlife livestock overlap and its ecological consequences in the Saadani ecosystem

INTRODUCTION

Uncontrolled cattle numbers have been reported to compete with and pressure wildlife species in the Saadani ecosystem. Whilst establishing the National Park local authorities have identified overgrazing as a high threat to its ecosystem. Prior to being incorporated into the National Park, parts of Saadani have been utilized for intensive cattle ranching for almost five decades. This led to low wild animal numbers and highly bush-encroached areas. While wildlife populations slowly started recolonizing the former livestock areas little is known about their habitat use patterns as well as that of livestock, including seasonal and long-term movement, which will provide more information on potential conflict sites and areas of high utilization.

AIM OF THIS PROJECT

The aim of this study is to investigate and identify the seasonal and long-term movement and interaction patterns of herbivorous wildlife and livestock. We will quantify the overlap of livestock and wildlife and assess the biomass and productivity of herbaceous plant resources. Further, we will identify and map livestock and wildlife conflict hotspots and model future habitat overlap and conflict for feed under land use and climate change scenarios.

METHODS

The project will contain in total 3 months of field work. Along walking transects and with camera traps we will assess wildlife distribution inside and outside the western border of Saadani. Further, using a Global Positioning System (GPS) we will localize and follow the daily movement of cattle herds. Photographs and sightings will be analysed according to species presence and activity inside, at the border, and outside of the Saadani NP boundary. Data analyses will be conducted using basic statistical tests (ANOVA, t-test, Chi-Square tests). Recommended statistical software for data analyses is R, SPSS or PAST.

SKILLS TO BE LEARNED

The student will learn field assessment techniques of identifying wildlife tracks and signs. Further, the student will learn to set up and download camera trap data. The student will also learn how to analyse data statistically and how to write up and publish scientific research results.

Assessing the current distribution of the invasive plant species *Prosopis juliflora* and predicting its future spread in Tanzania

INTRODUCTION

Prosopis juliflora is an aggressively spreading plant species that has led to rangeland degradation and livelihood reductions in many parts of eastern Africa. While it is a high threat to local native vegetation in Kenya and Ethiopia, not much is known about its distribution and spread into rangelands, natural and agricultural sites. This study will involve intensive travels throughout Tanzania and assessing of grey and published literature on *Prosopis juliflora*. The thesis will also include modelling of future spread of this invasive species.

AIM OF THIS PROJECT

The aim of this study is to identify the current distribution and potential future spread of this highly invasive species. We will quantify the abundance of plant individuals in particular spots, assess the time since establishment and the speed as well as the vectors of its spread. Using this information, we will model potential spread scenarios under varying land use and climate change.

METHODS

The project will contain field work in Tanzania, with extensive travel to understand the distribution of Prosopis juliflora. Vegetation assessment of plant species, distribution, population structure as well as soil properties and water availability will be conducted. Rainfall and temperature data, and land use maps will be collected across the country in the areas of current and potential spread. Data analyses will be conducted using basic statistical tests (ANOVA, t-test, Chi-Square tests). Further, modelling will include activities in NetLogo, R or other modelling software.

SKILLS TO BE LEARNED

The student will learn vegetation field assessment techniques and receiving data from unpublished reports, literature and interviews with pastoralists. The student will also learn how to analyse data statistically and in models and how to write up and publish scientific research results.

Topic 5:

Using the abundance of phreatophytes to understand how land use patterns have changed a river catchment system in northern Tanzania

INTRODUCTION

The Kikuletwa River in northern Tanzania has undergone a closure, i.e., its water sources have disappeared in recent years. Little is known about when and where the water has gone and the exact location where the water had been flowing before. Phreatophytes, i.e., plants that use ground table water to strive, can indicate where water has been and is currently flowing. In a strongly agriculturally used environment, this knowledge is important for water access and a future sustainable water use. We will use vegetation mapping to understand former and current land use as well as water flow patterns in the Kikuletwa catchment in Tanzania.

METHODS

The project will contain field work in Tanzania, with vegetation assessment of various plant species and their distribution with respect to the riverine area. Further, land use maps will be created and – where available - used. The project is embedded in a PhD project, which will use water flow models to understand the watershed characteristics and historical change.

SKILLS TO BE LEARNED

The student will learn vegetation field assessment techniques and interpreting land use maps and water flow regimes. The student will also learn how to analyse data statistically and how to write up and publish scientific research results.

Herbivores foraging on woody vegetation (=browsers) might be the winners of the future
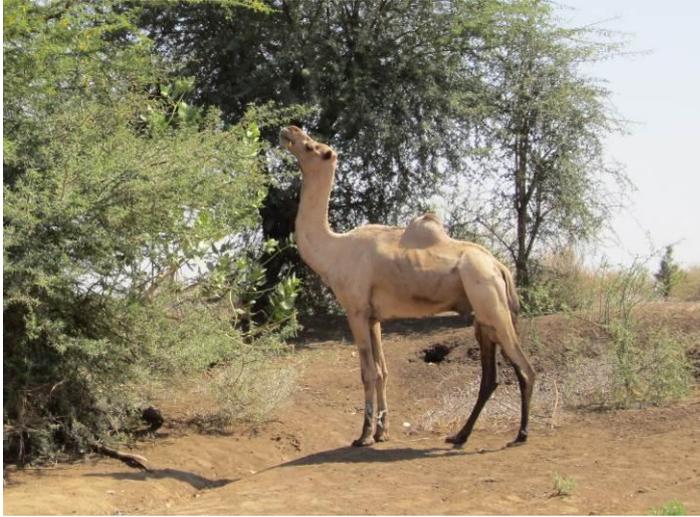
INTRODUCTION

Across the world, rangelands and savanna systems undergo a rapid woody vegetation encroachment. The herbaceous vegetation is being outcompeted, which will mean that grazing herbivores might be lost from the system. Hence, the abundance of grazing species should be positively correlated to open areas while the abundance of browsing species should be higher in increasing tree cover. Livestock and wildlife species will be more strongly composed of browsing species, compared to previous years.

Methods: Dekstop study in Hohenheim, literature reviews, use of unpublished data, GIS mapping, data analyses.

METHODS

The project will contain a desktop study at NM-AIST. Literature reviews and unpublished data as well as grey literature will be used and analysed. Further, GIS will be used to map browser distributions and woody cover. Statistical analyses will be conducted on the trend of browsing animal numbers over time and regressing browser numbers against woody vegetation cover in example sites.

SKILLS TO BE LEARNED

The student will learn literature review and data analysis techniques and interpreting land use maps and animal distribution maps. The student will also learn how to write up and publish scientific research results.

Other potential topics:

7. **Invasive species spread in Ngorongoro Crater, Tanzania, and their impact on tourism and wildlife**

8. **Perception of pastoralists towards wildlife – would a shift in movement patterns and herding strategies help resolving conflicts?**

9. **Successional ecosystem functions and services in a restoration site**

10. **Assessing species diversity and richness on NM-AIST campus using inaturalist – using a citizen scientists approach**

11. **Revamping NM-AIST botanical garden: which species are most desirable to plant and conserve?**

Further topics can come from the student's side and will be discussed

Potential Projects

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Potential MSc and PhD topics
- Edible Insects of Tanzania: Diversity and their nutritional quality.
- Functional foods for health promotion and diseases prevention.
- Exploitation of bioactive compounds from indigenous food plants and edible/inedible wild mushrooms.
- Developing a model formula for complementary feeding in Tanzania.
- Food safety/foodborne pathogens

Potential Projects

Prof. Thadeo M. C. Tarimo

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1. Allopathy effect of exotic (weed) such as *Mexican poppy (Argemone mericana), Datura to the survival of associated (native) plant in ANAPA*
    a. Investigate possibility of potential medicinal and botanical values of exotic species around ANAPA
2. Development of innovative approaches and used of indigeneous knowledge system in the management of *Quelea quelea aethiopica* in Tanzania for humans and poultry industry
    a. Tanzania as other Sub-saharan Africa experiences a serious shortage of protein food. The nutritional content of quelea is high, with a greater calorific value than dried mammalian meat and around five times the protein found in staple cereals. Local communities in various areas such as Kondoa and Ngudu collect several tons chicks and also sprayed quelea from a large colonies for human consumption (Mushi and Tarimo 2016). They use several methods but the most common and easiest method of harvesting quelea is the collection of nestlings from breeding colonies, which is most productive just before they fledge. Other approaches include using sticks to beat roosts after sunset, use of elastic strips from inner car tubes to smash through massing birds and basket trapping

b. These are potential alternative a control method that can be cost effective as it is no cost on the communities and provides an important food supplement in drought areas.

c. In Kondoa, Tanzania, communities use traps woven from star grass *Cynodon nlemfuensis* to catch hundreds of quelea a day (Mushi and Tarimo 2016)

d. Although rural people traditionally and notably collect, eat and sell quelea, even after spraying operations, yet there no large commercial markets. I believe that mass trapping and selling quelea for food is an important economic activity. Thus there is a need to promote it commercially for both local and international markets such as Japan

3. Devopment of Bioassay for for bird resistant sorghum for quelea repellency Sorghum has the potential to reduce grain deficit in Africa, but it is highly vulnerable to the Quelea quelea. Bird-resistant crop varieties, when incorporatedinto current control methods, may reduce quelea damage. Farmers have selected brown sorghum containing tannin as a means of reducing damage. Therefore it is essential to look for bird resitant sorghum which are nutrition acceptable by humans However, it is not only less preferred by birds but also by humans. Studies in the USA and Zimbabwe have shown ARK 3048 and is bird resistant are available and yet they are nutritional better than the brown sorghums

4. *Aviary evaluation* of Ark-1097 sorghum variety for bird repellency.

5. *Assessment of Environmental impacts* of the control of quelea with organophosphate in Tanzania wetlands especially Lake Victoria, Manyara and Momela lakes

   a. *Spraying with avicides s to kill red-billed quelea (Quelea quelea) may affect non-target organisms and leave hazardous contaminants in the environment. There ois a need to continue monitoring their impact on especially within wetlands where we annually dump a lot of fenithion*
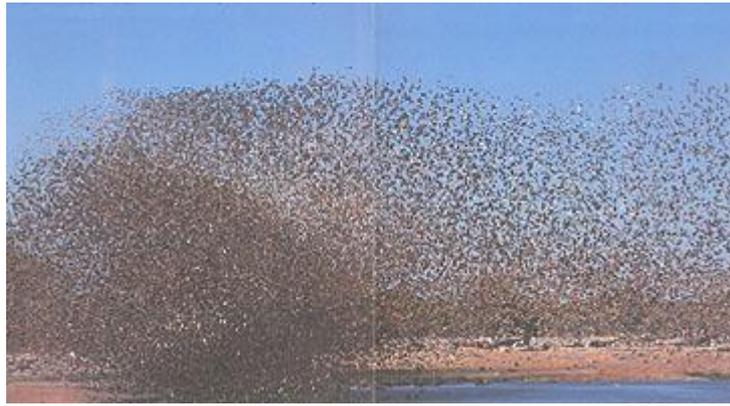
The gregarious behavior of Quelea

6. Impacts of agrochemical and other contaminants to the ecology of Momella lakes.
   Studies have shown that there are several un-identified chemicals within the soil and water segments from the Momella lakes

7. Assessment of the effects of fire on biodiversity especially grasslands open plains (habitats)
   a. To monitor vegetation changes due to frequent destructive (hot) fires initiated from outside the Park

8. Population dynamics and breeding success of *Maccoa* ducks in Momella Lakes: Nlote that Momella Lakes are the only breeding sites for *Maccoa* ducks in Tanzania

9. Assessment of Flamingo (Lesser & Greater) feeding ecology in Momella and Lake Manyara lakes: There have been frequent massive deaths of flamingoes in Manyara Momella Lakes due to toxins

10. Impacts of climate change on diversity and distribution of wildlife, pathogens and vectors

    a. To model climate changes as a factor in disease dynamics: Effects of fire on vegetation dynamics (species composition, regeneration etc.) Hot dry season fires as well as cool early burning fires can affect the natural vegetation dynamics

11. Impact of human socio economic activities around the KINAPA: Increased demand on Park resources due to increasing human population

12. Assessment of human wildlife conflicts including livestock depredation, crop damage and community attitudes and perceptions on wildlife conservation: There is an increasing public outcry on damage of crops and predation of livestock by wildlife

13. The behavior and population dynamics of lion, wild dogs, hyenas and leopards within and around Nkomazi/Mikumi NPs: Behavior and current status of large carnivores in KNP is unknown

14. Asses species abundances, distribution and potential dynamics with changing climate within and aroumnd KINAPA Studies done elsewhere have shown that climate change impact on biodiversity and that species respond to these impacts differently and in different situations

15. Insects altitudinal diversity as a bio-indicator of climate changes Investigate Insect species diversity and abundance within and around KINAPA. A cost effective method for assessing climate change dynamics It's potential to tourist attraction

16. Assessment of tourism potentials of the mountain and its environs Information is needed to balance tourism development and conservation

17. Assessment of the status and viability of migratory routes, buffer zones and dispersal areas: Buffer zones and migratory routes are rapidly been impacted by human activities, so data are needed to validate the viability of migratory routes, buffer zones and dispersal areas

18. Magnitude and consequences of human-wildlife conflicts:
    a. Mikumi is surrounded by 19 villages with ever increasing human-wildlife conflicts. A study to quantify the magnitude of the problem and determine the root causes and mitigation options is recommended

19. Assessment of demographic and population status of the lion population within Lake Manyara National Park: General observation suggests that male lions are scarcely sighted in the park in recent times. Females on heat often sighted for several days without any male around.

20. Long term impact of highway through the Mikumi National park on animal road kills:
    a. Frequent road kills by highway traffic. Long-term data needed for informed decisions
    b. Tanapa data indicated that there were 1,172 vehicles passing through the park per day leading to significant impact of exhaust gases and noise.
    c. Emission particles are deposited on the forage along the road verge and consumed by grazers.

d. These impacts are not yet quantified. Passengers commuting through the park have a habit of throwing food stuff inside the park

21. The conservation status of traditional wildlife corridors around protected areas such as Mikumi:
    a. The following corridor used to connect wildlife from one protected area to another: Mikumi-Twatwatwa –Wami-Mbiki and Mikumi-Rubeho-Udzungwa-Ruaha. Current status and viability of these corridors are not known.

22. Assessment of visitor satisfaction from tourist attractions and services in some National Parks
    a. Long term monitoring of the impact of Tourism facilities on park resource values
    b. Identification of new tourism attractions Study on the tourist attraction in the park need to be explored.
    c. Tourist expectation, perceptions and attitudes need to be explored
    d. Enhancing visitor service quality is a high priority for the Park

23. Assessment of the status of alien plant species and possible control measures within and around Saadan NP
    a. The impact of alien invasive plants introduced in parts used for livestock ranching on the natural vegetation
    b. There are many species of alien plants in the Park due to past human activities
    c. The information is still needed to inform decision on whether or not to eradicate the alien invasive plants