CEES

Centre for Ecological and Evolutionary Synthesis

Department of Biosciences
Faculty of Mathematics and Natural Sciences

The mountain nyala in changing landscapes: behavioral ecology, habitat suitability modeling and land use land cover change

PhD dissertation defense

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June 21, 2024

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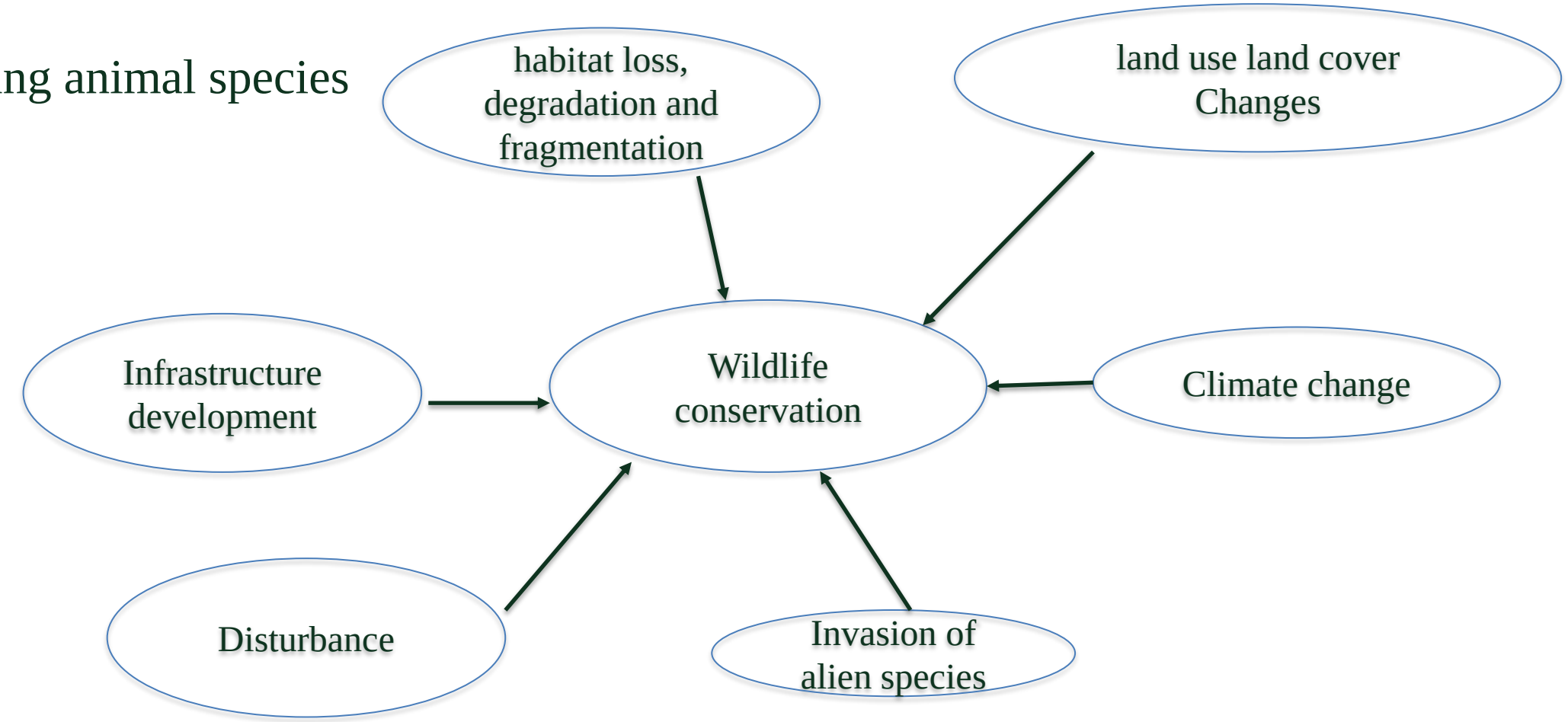
Norwegian Centre of Excellence

Outline

- Introduction
- Objectives
- Study species
- Papers I - IV
- Implications for conservation and management

INTRODUCTION

- Threats facing animal species



Swaisgood (2002). Anim. Conserv.

INTRODUCTION

Animal behaviour in conservation

- understanding the behaviors of an animal species contribute to its conservation

Examples:

- group size dynamics, sexual selection, social networks, sensory ecology, mating systems, antipredator strategy

Rubenstein (2010). *Advances in the Study of Behavior*
Caro and Berger (2019). Philos Trans R Soc Lond B Biol Sci.

INTRODUCTION

Habitat suitability modelling

- understanding animal distribution and habitat relationships is key to conserving threatened species.
- study of species (existing and potential habitats) using a combination of remote sensing and field data.
- conservation effort can be focused and will assist in policy making

Lecis and Norris (2003). *Biol. Conserv.*
Franklin, J. (2010).

INTRODUCTION

Land use land cover change (LULC)

- Understanding the spatiotemporal change and drivers of LULC
  - conservation planning,
  - land use planning,
  - policy development
  - environmental restoration programs.

- LULC change dynamics and driving factors of the change could not be uniform

Dibaba et al., (2020). *Land*

Outline

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OBJECTIVES

1. To examine the effects of human activities on the activity budget and determine the extent of home range size
2. To investigate the environmental factors affecting group size
3. To map the potential suitable habitat and identify environmental factors
4. To examine the dynamics of land use land cover change and identify the main drivers

Outline

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STUDY SPECIES

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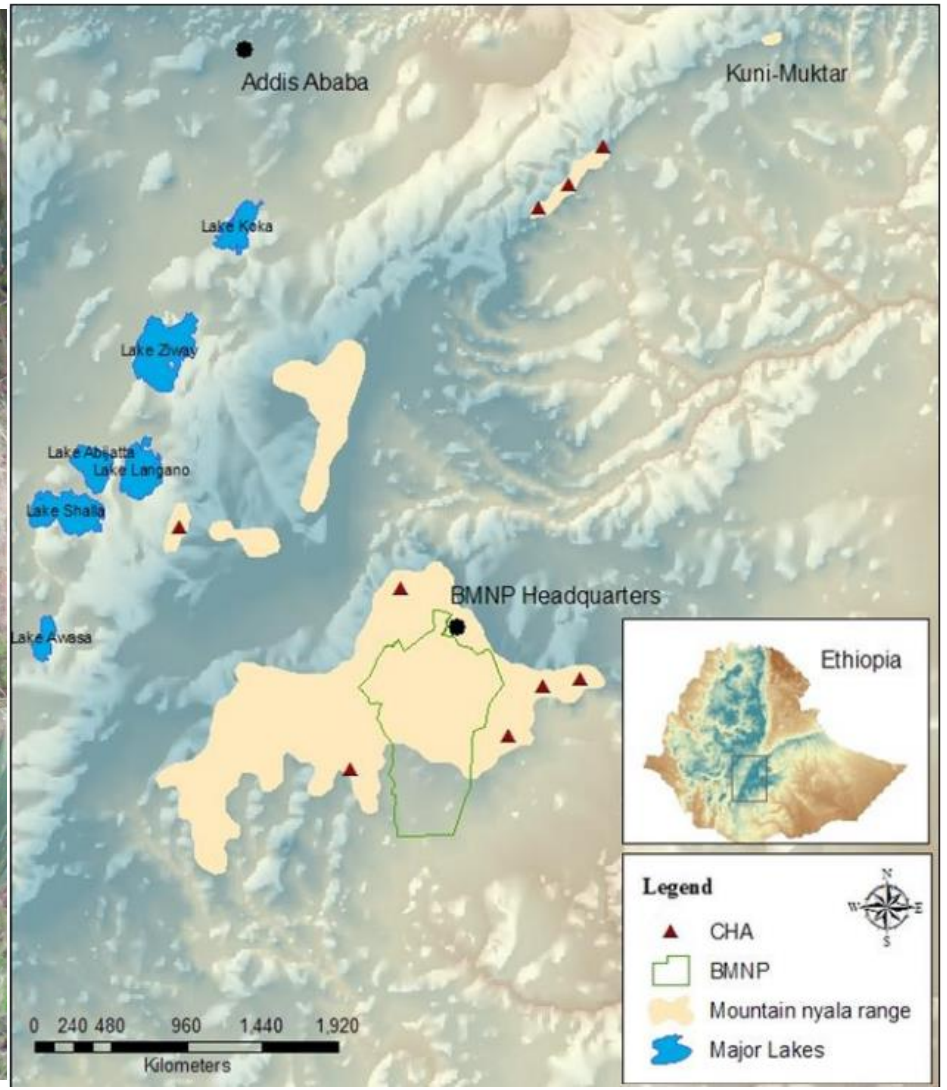
Nyala Insurance s.c

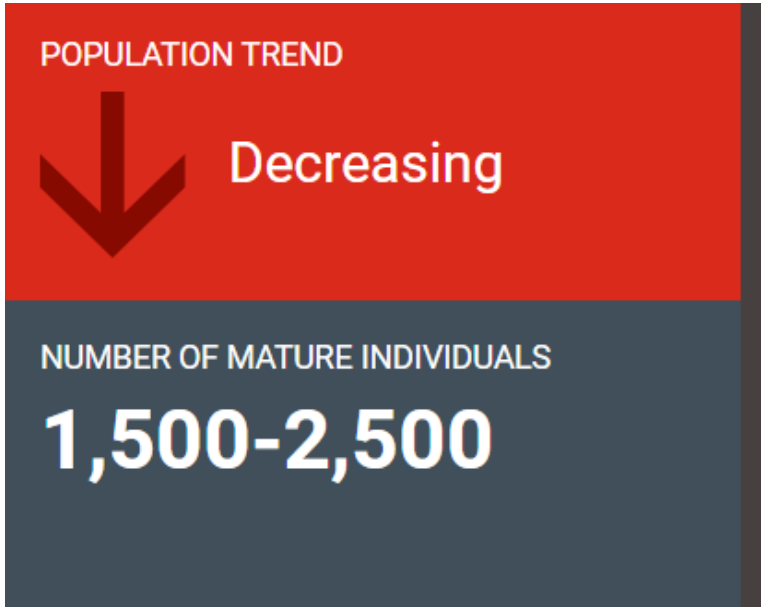
BALE MOUNTAINS
NATIONAL PARK
ETHIOPIA

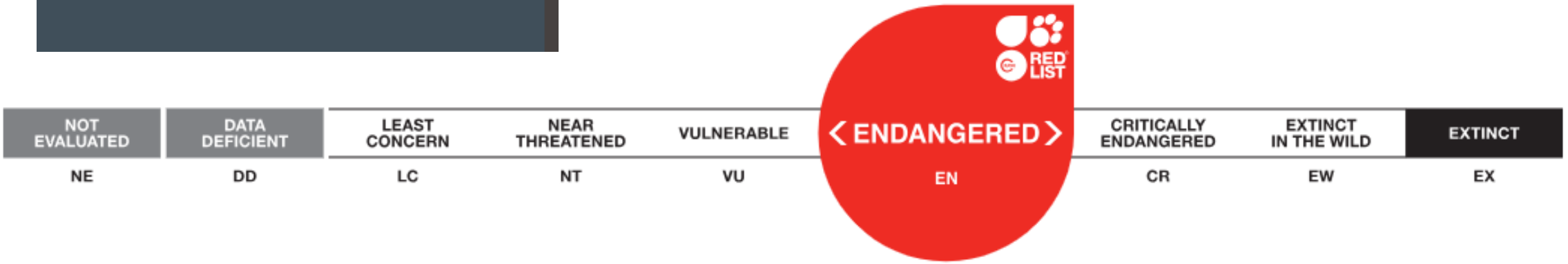
STUDY SPECIES



STUDY SPECIES-conservation threats

STUDY SPECIES





STUDY SPECIES

❑ Previous researches on the species

- ❖ Ecology and conservation of mountain nyala (*Tragelaphus buxtoni*: Lydekker, 1910) in Bale Mountains National Park, Ethiopia (Mamo, 2007)
- ❖ Habitat quality and foraging ecology of mountain nyala (Tragelaphus buxtoni) in the Munessa forest and the Bale Mountains National Park, Southeastern Ethiopia (Tadesse, 2012)
- ❖ Landscape genetics and behavioural ecology of mountain nyala (Tragelaphus buxtoni) in the Southern highlands of Ethiopia (Atickem, 2013)
- ❖ Habitat use, diet and conservation of mountain nyala and Menelik's bushbuck in Arsi Mountains National park, Ethiopia (Girma , 2016)

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- Introduction
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PAPERS

Paper I

Global Ecology and Conservation 32 (2021) e01900

Contents lists available at ScienceDirect

Global Ecology and Conservation

journal homepage: www.elsevier.com/locate/gecco

Check for updates

Human activities increase vigilance, movement and home range size of the endangered mountain nyala (*Tragelaphus buxtoni*) at the cost of foraging and resting

Ejigu Alemayehu Worku [a,*], Anagaw Atickem [b], Jakob Bro-Jørgensen [c], Afework Bekele [b], Paul Evangelista [d], Nils Chr. Stenseth [a]

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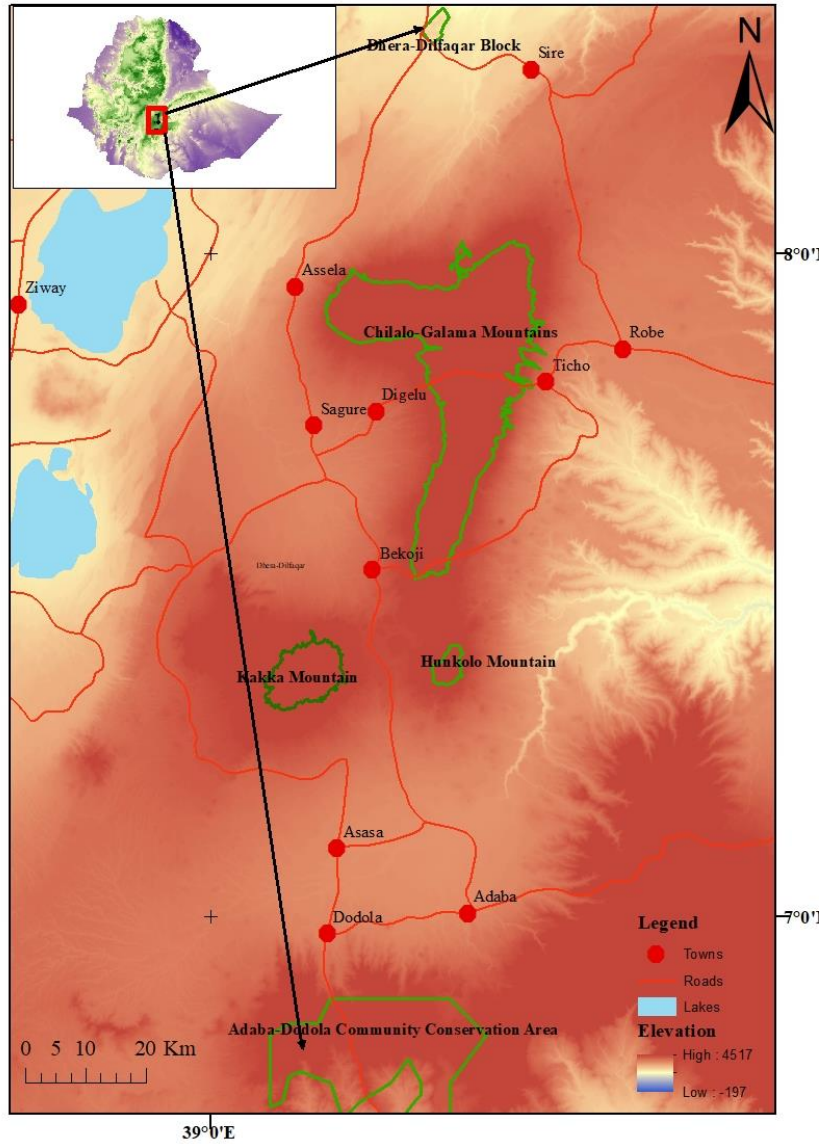
[d] *Natural Resource Ecology Laboratory, Colorado State University, B254 NESB, Fort Collins, CO 80523, USA*

PAPERS

Paper I: Objectives

- investigate the impact of intensified human activities on the activity budgets
- home range size of mountain nyala, including seasonal variations.



PAPERS

Paper I: Methods

- Two study groups

Adaba-Dodola Community Conservation Area

Arsi Mountains National Park

PAPERS

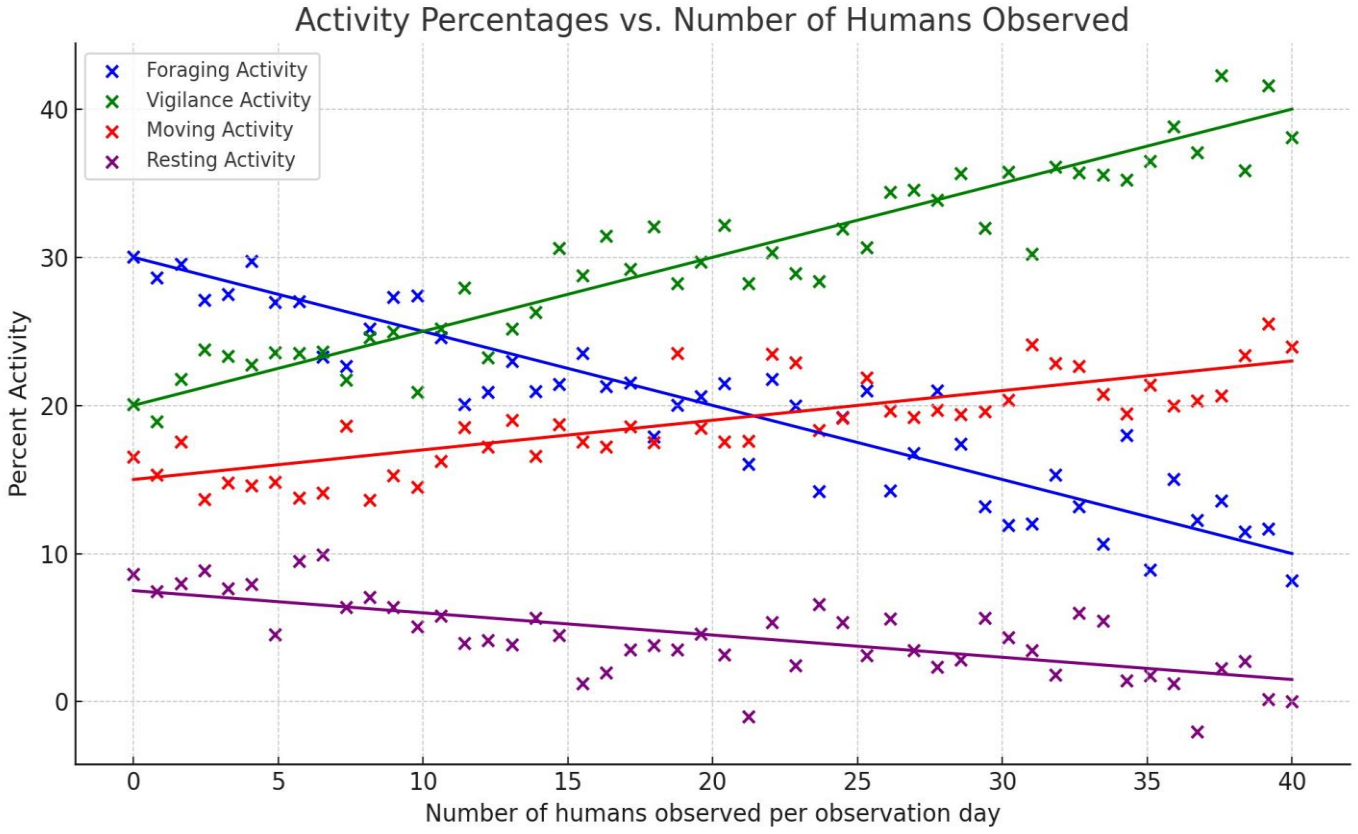
Paper I: Methods

- Scan sampling (Altmann, 1974) used to assess different behavioural activities at 15 minutes interval
  - foraging,
  - vigilant,
  - moving,
  - resting and
  - others
- GPS positions of the group reordered
  - to determine home range (from the minimum convex polygon and kernel estimate methods).

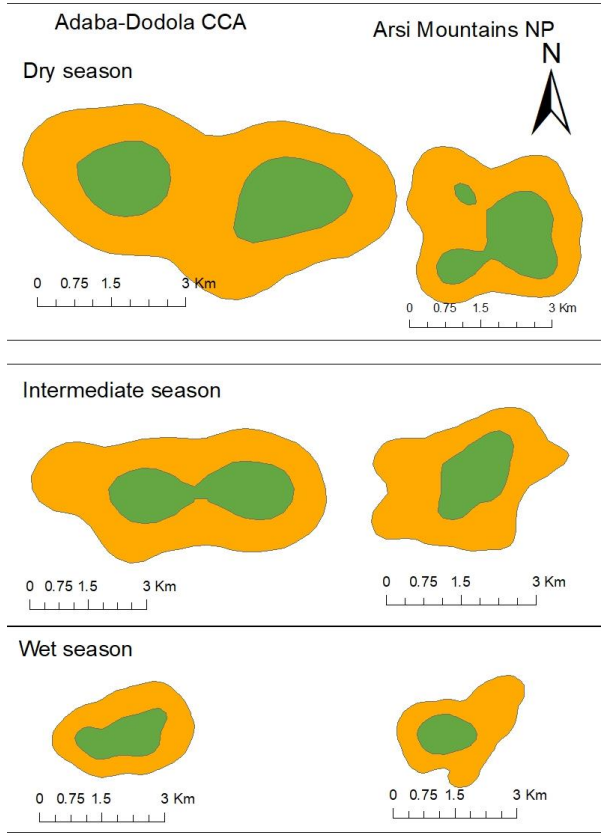
PAPERS

Paper I: Results

a) Activity budget



b) Home range



PAPERS

Paper I: summary

- Increased vigilance and movement in human-disturbed areas reduce time for foraging and resting
- The larger home range in disturbed areas suggests that nyala must cover more ground to meet their needs due to reduced forage availability caused by human activities

PAPERS

Paper II

Global Ecology and Conservation 46 (2023) e02546

Contents lists available at ScienceDirect

Global Ecology and Conservation

journal homepage: www.elsevier.com/locate/gecco

Check for updates

Group size dynamics of the endangered mountain nyala (*Tragelaphus buxtoni*) in protected areas of the Arsi and Ahmar Mountains, Ethiopia

Ejigu Alemayehu Worku [a,*], Jakob Bro-Jørgensen [b], Paul H. Evangelista [c], Afework Bekele [d], Anagaw Atickem [d], Nils Chr. Stenseth [a]

[a] *Centre for Ecological and Evolutionary Synthesis (CEES), Department of Biosciences, University of Oslo, PO Box 1066, Blindern, 0316 Oslo, Norway*
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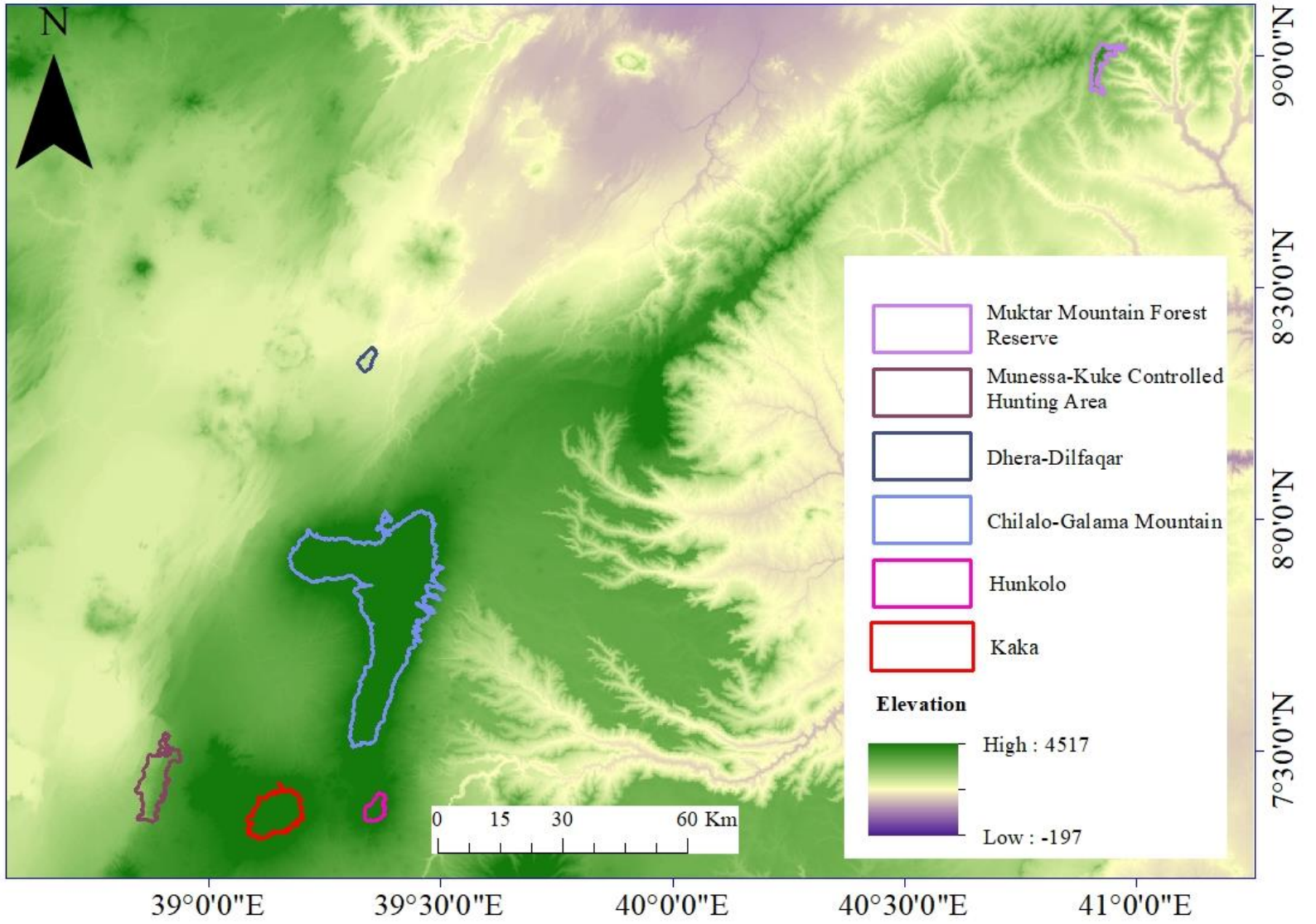
PAPERS

Paper II: Objective

- Examine the environmental factors influence group size of mountain nyala



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Paper II: Methods

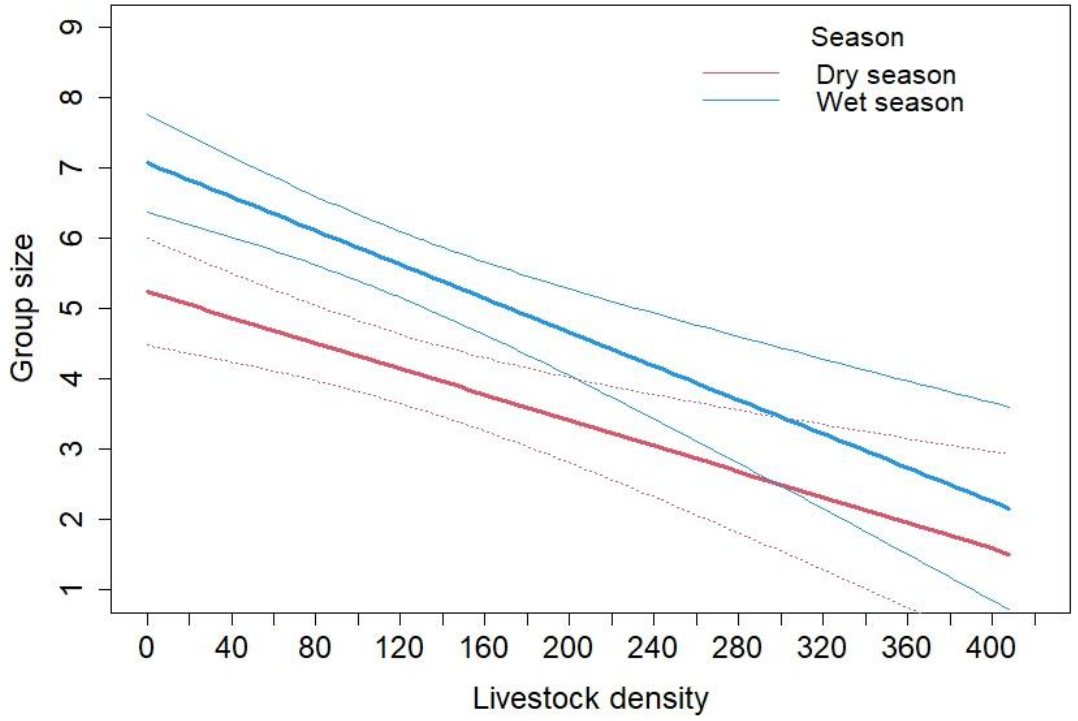
- Surveyed 36 transects in the three study sites

- Predictor variables
  1) topography (i.e., elevation and slope),
  2) ecological variables (i.e., land cover type, normalized difference vegetation index and visibility),
  3) livestock density, and
  4) Seasonality

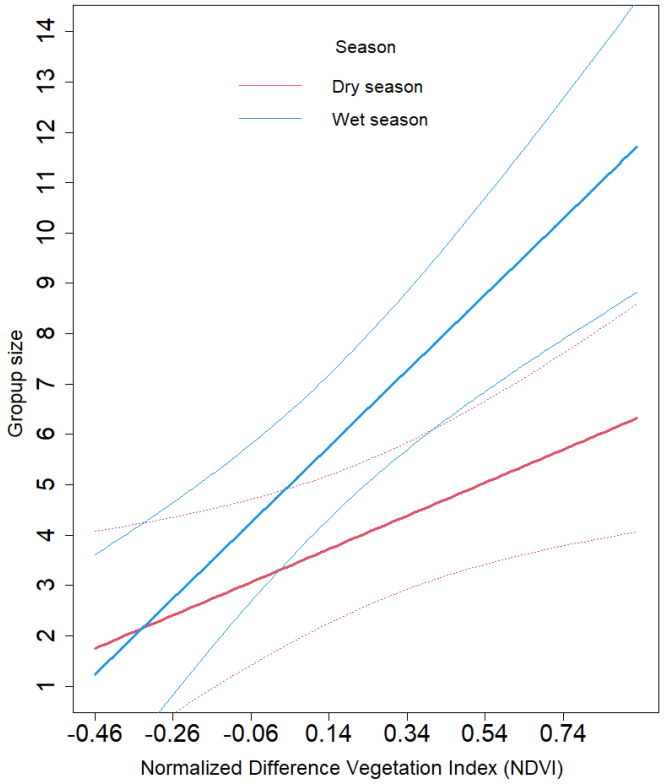
PAPERS

Paper II: Results

- Livestock negatively affects group size



- Resource availability positively affects group size



PAPERS

Paper II: Summary

- Livestock density, habitat visibility and food quality and availability (using NDVI as an index).
- Larger group sizes observed in areas with high NDVI

PAPERS

Paper III

RESEARCH ARTICLE

Ecology and Evolution Open Access WILEY

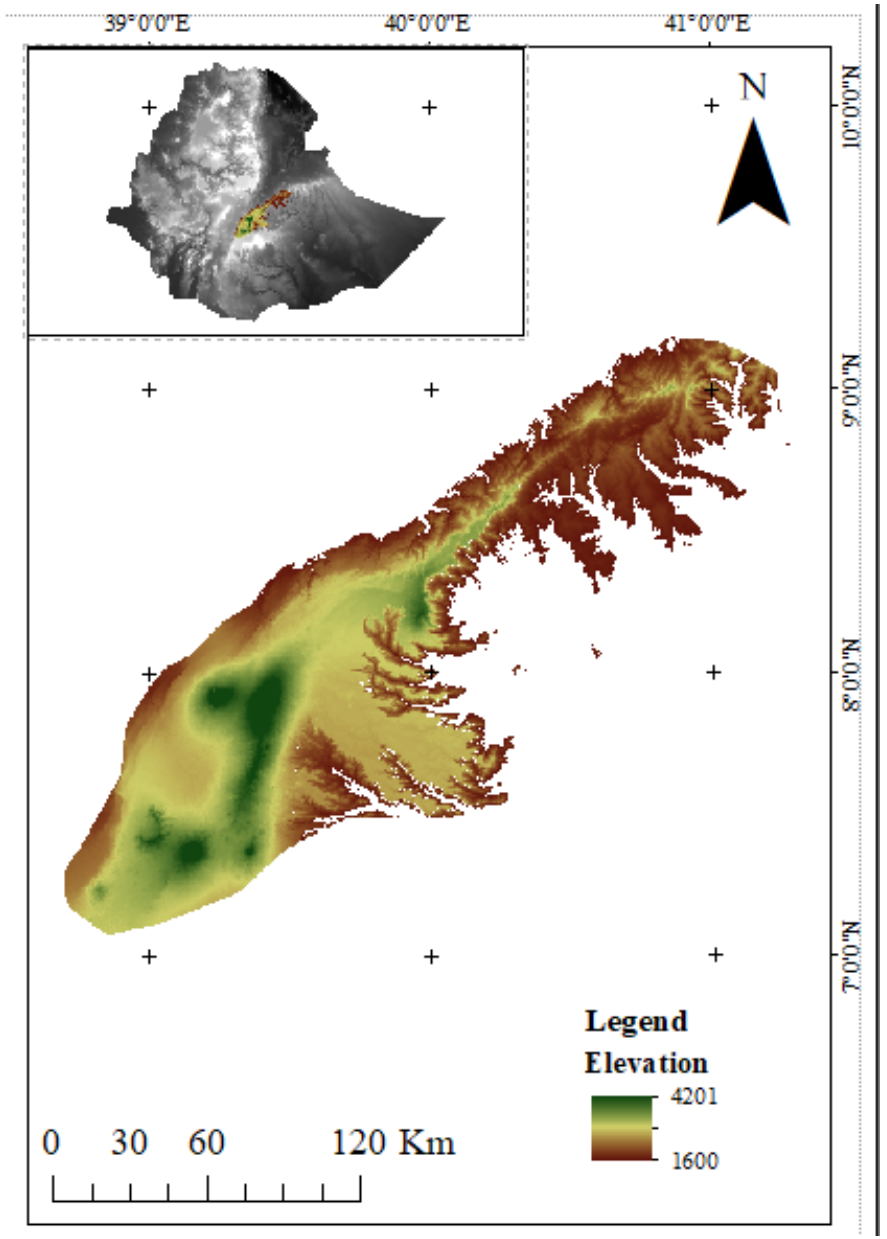
Modeling habitat suitability for the lesser-known populations of endangered mountain nyala (*Tragelaphus buxtoni*) in the Arsi and Ahmar Mountains, Ethiopia

Ejigu Alemayehu Worku[1] | Paul H. Evangelista[2] | Anagaw Atickem[3] | Afework Bekele[3] | Jakob Bro-Jørgensen[4] | Nils Chr. Stenseth[1]

PAPERS

Paper III: **Objectives**

- ❖ map suitable habitat for mountain nyala
- ❖ identify key environmental conditions that are associated with the current distribution



PAPERS

Paper III: **Methods**

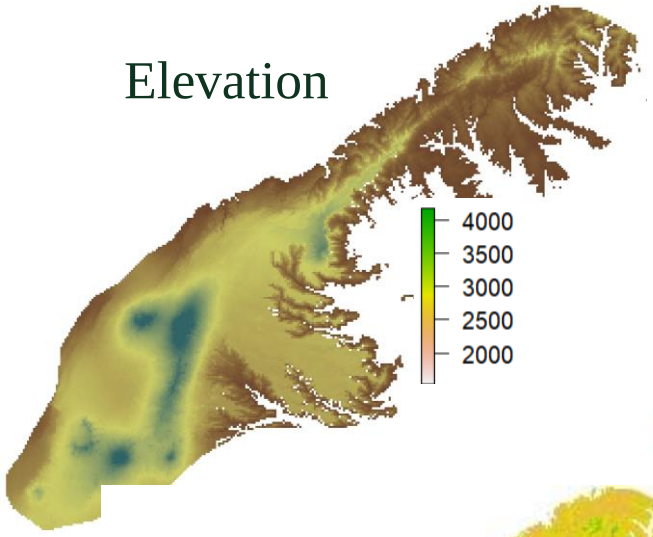
- 196 transects established and 1710 plots surveyed (presence points)

PAPERS

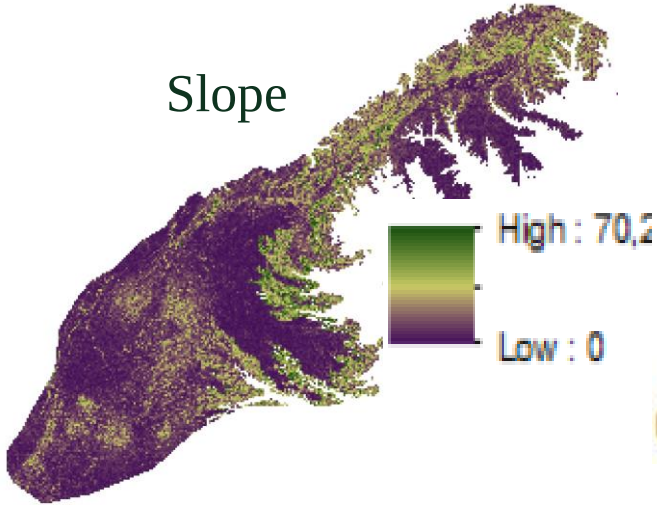
Paper III: **Methods**

Environmental variables

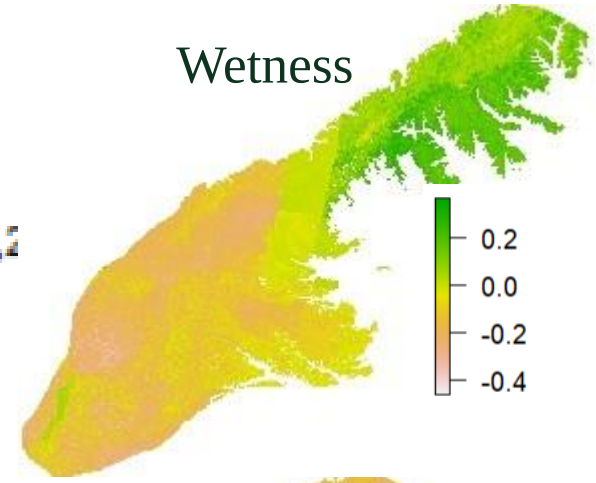
Elevation

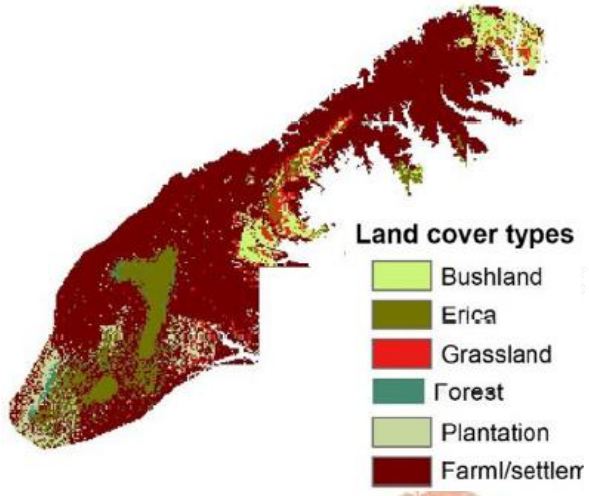


Slope

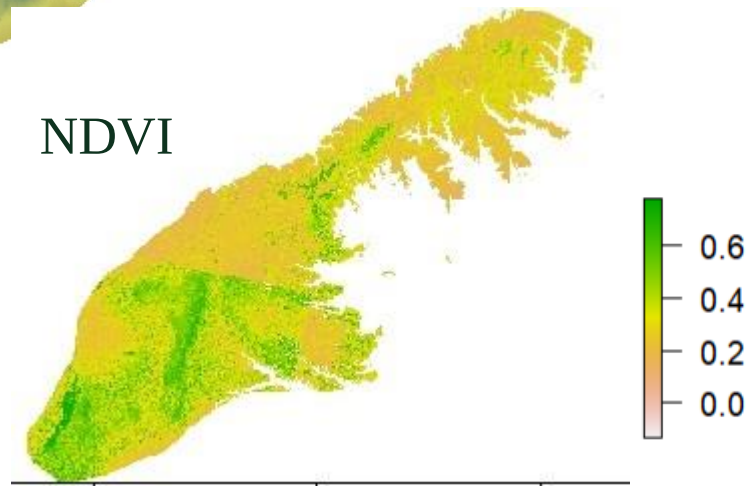


Wetness

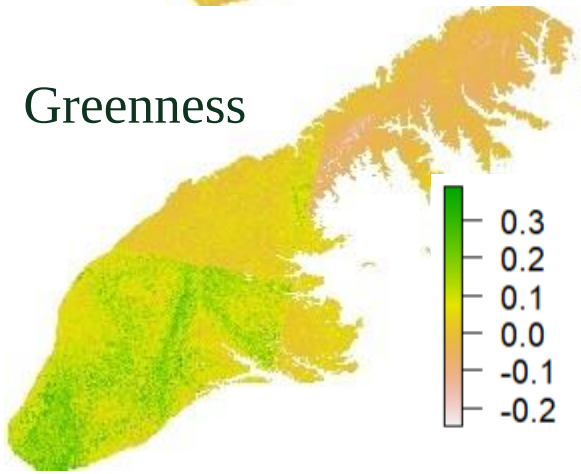




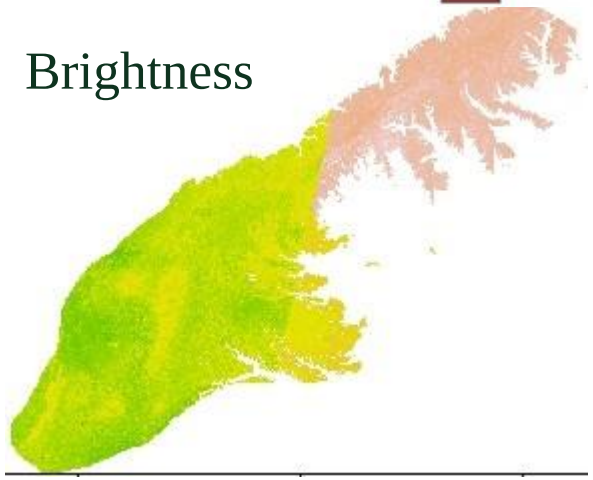
NDVI



Greenness

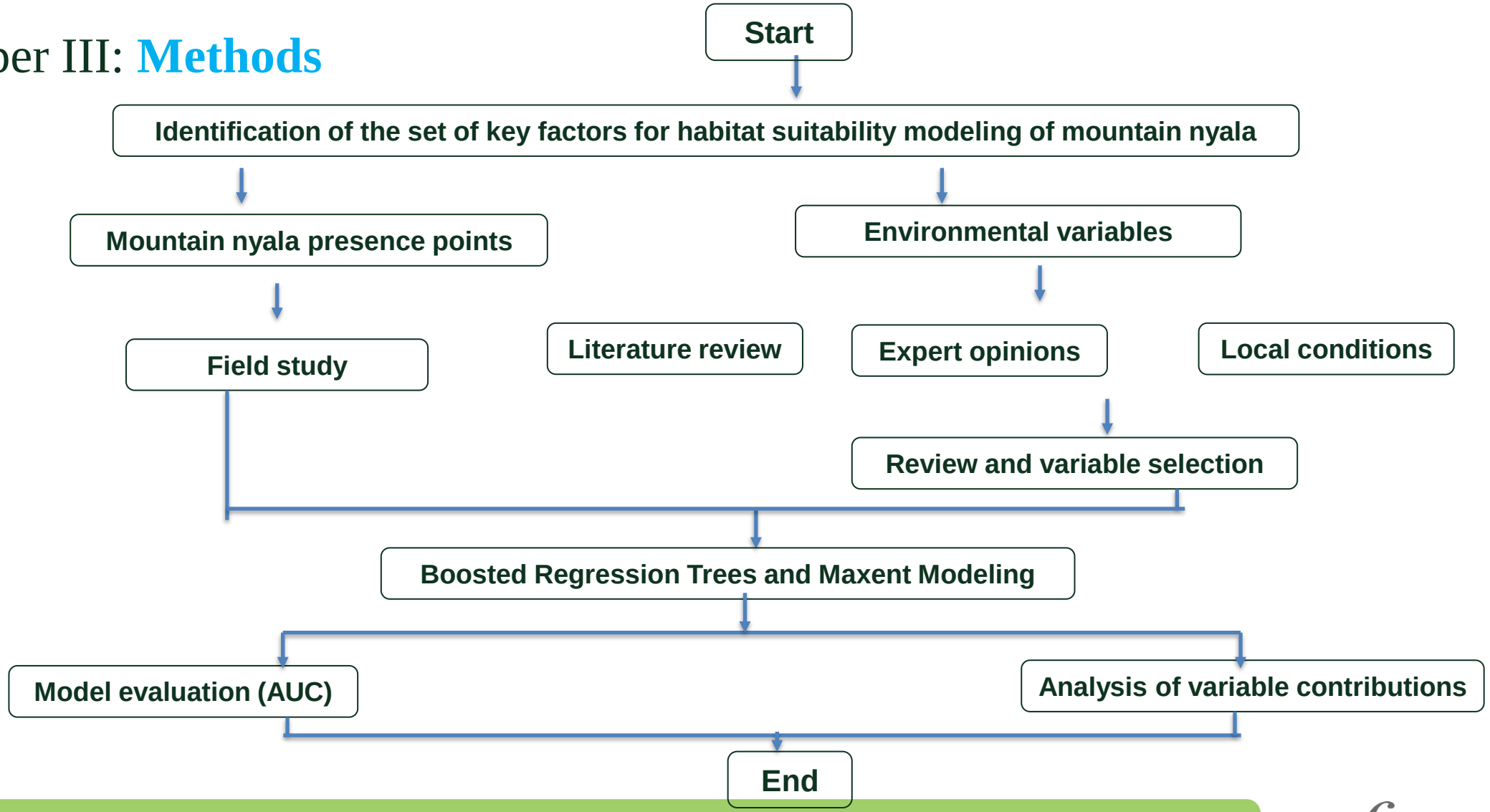


Brightness



PAPERS

Paper III: Methods



PAPERS

Paper III: **Results**

suitable habitat for mountain nyala (1864 km2)

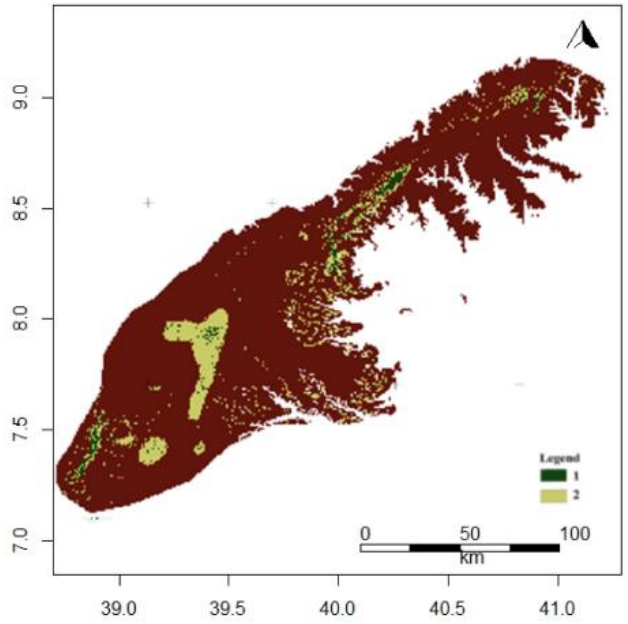
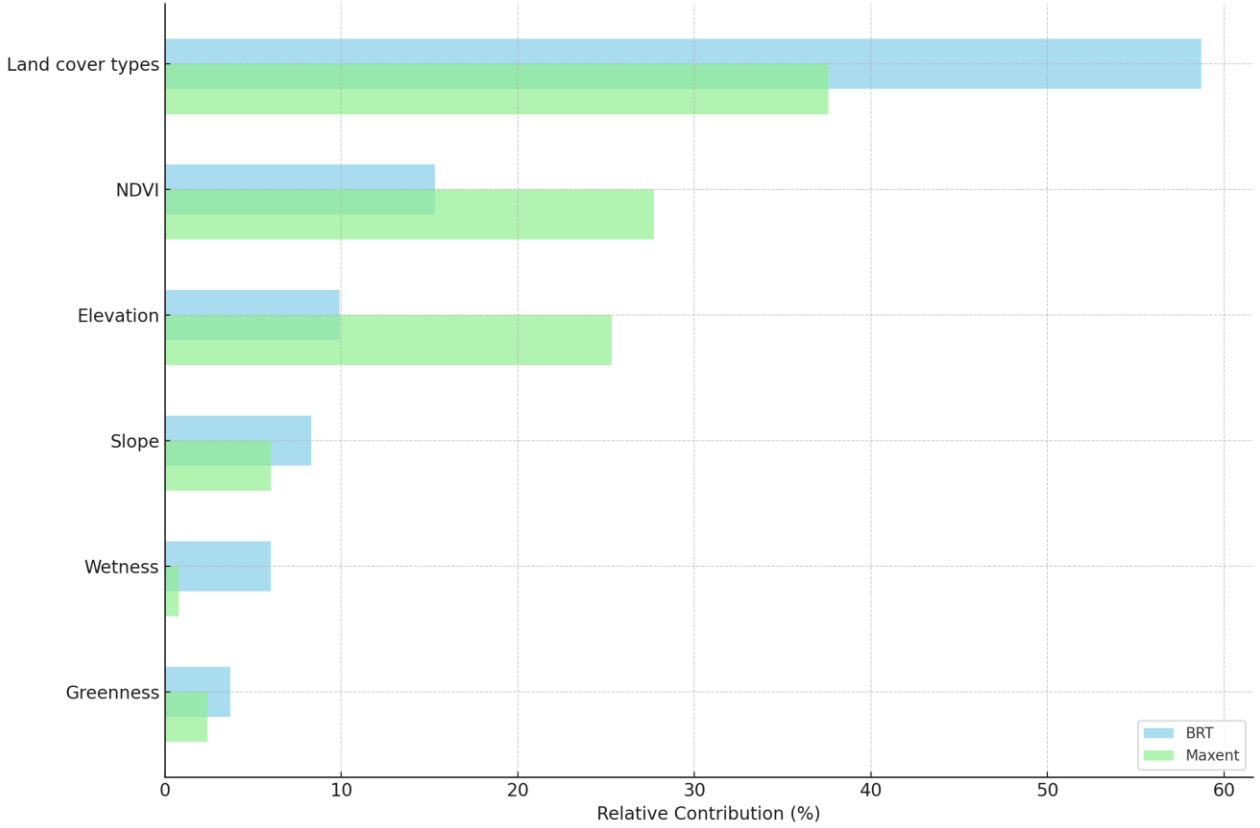


FIGURE 5 Predicted habitat suitability for mountain nyala (*Tragelaphus buxtoni*) in the Arsi and Ahmar Mountains, Ethiopia, based on an ensemble of the Boosted Regression Tree (BRT) and Maxent models. (Areas for which one model predicted suitable habitat are shown in dark green, areas for which both models predicted suitable habitat are shown in light green).

Environmental variables associated with the current distribution



PAPERS

Paper III: **Summary**

- Most suitable habitats regions with montane forest and grassland at relatively high elevations
- The model estimated a small proportion of the landscape (1864 km²)
- Land cover type, normalized vegetation index (NDVI), elevation, and slope identified the most influential environmental variable

PAPERS

Paper IV

Land use and land cover changes in the Arsi Mountains and its surrounding areas, Ethiopia: driving forces and implications for wildlife conservation

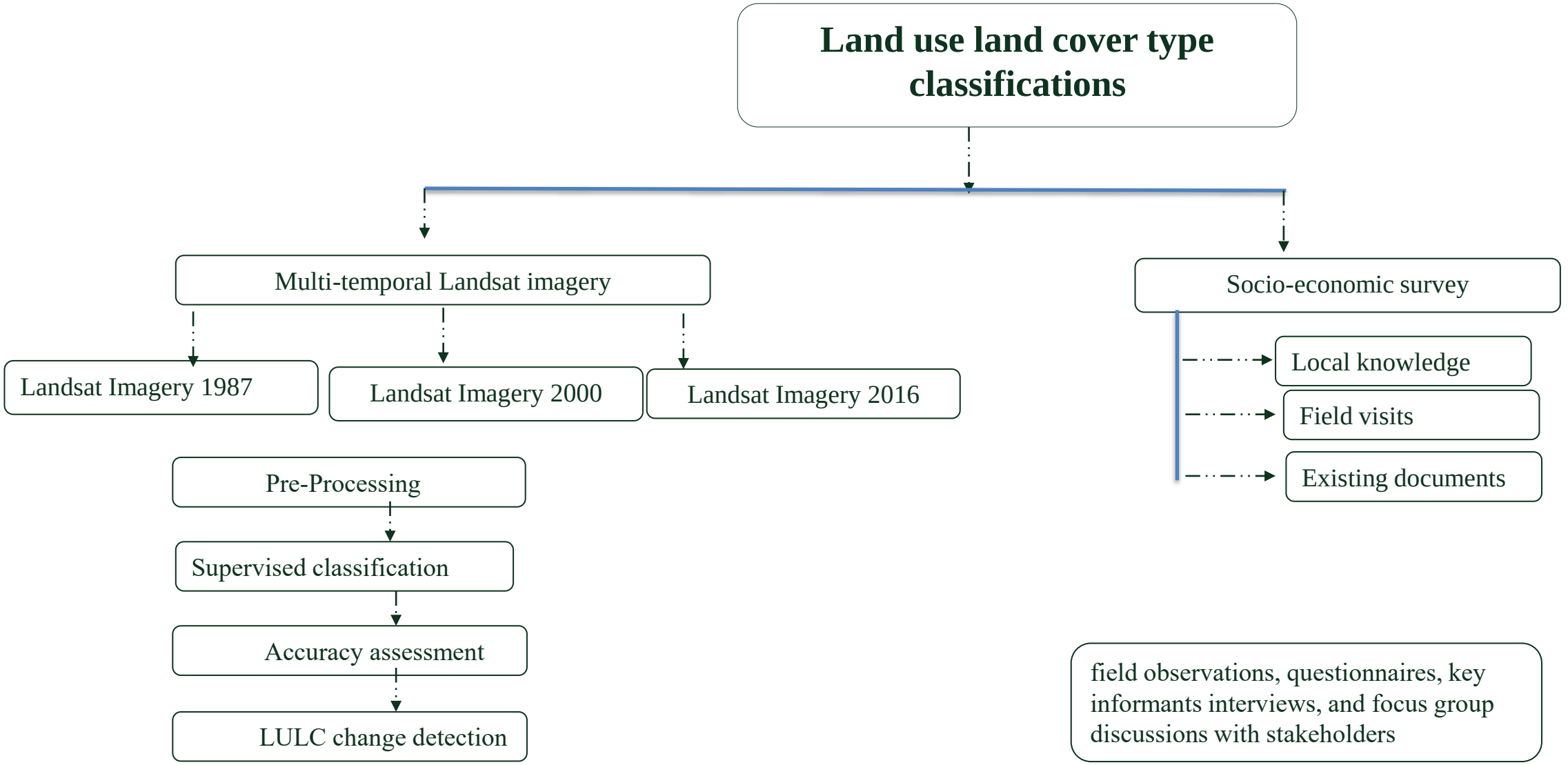
Ejigu Alemayehu Worku[1*], Anagaw Atickem[2], Jakob Bro-Jørgensen[3], Afework Bekele[2], Paul Evangelista[4] and Nils Chr. Stenseth[1]

PAPERS

Paper IV: Objective

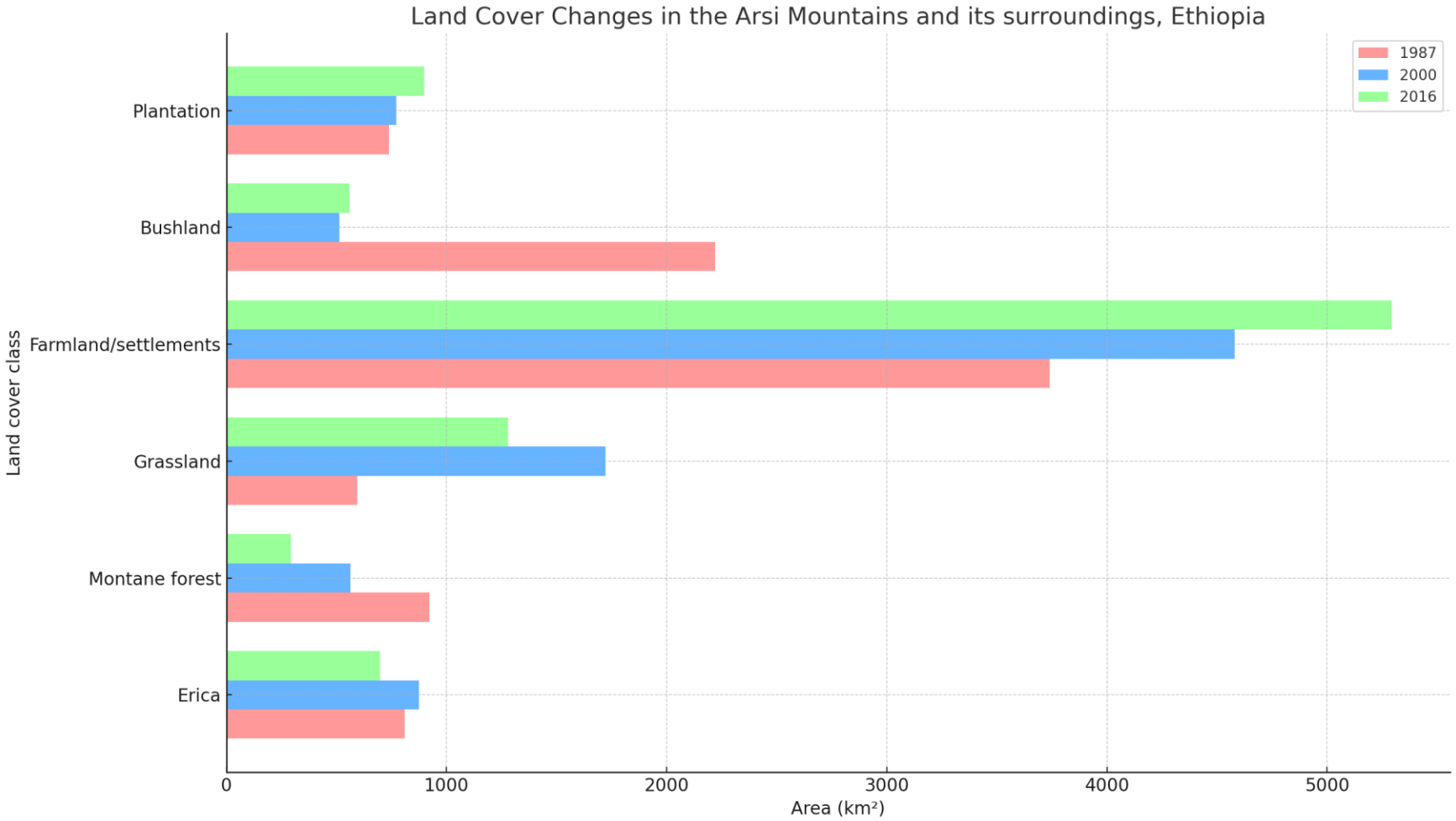
- ❑ to quantify the temporal and spatial LULC change over the last 30 years (1987-2016)
- ❑ to identify the key drivers for LULC changes

Land use land cover type classifications



PAPERS

Paper IV: **Results**



PAPERS

Paper IV: **Results**

Drivers	Percent	Rank
Livestock over grazing	26.5	1
Human settlement expansion	22.8	2
Lack of integrated institutional frameworks	19.2	3
Unsustainable use of forest products	15.3	4
Agricultural land expanison	9.2	5
Weak environmental considerations	7	6

PAPERS

Paper IV: Summary

- substantial increase in agricultural land and human settlements, resulting in habitat fragmentation. The montane forest, in particular, has seen a drastic decline
- Human settlement and agricultural expansion further exacerbate these problems, often resulting in deforestation and habitat fragmentation.
- The absence of coordinated institutional efforts lead to unsustainable land use practices

Outline

- Introduction
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- Papers I-IV
- **Implications for conservation and management**

IMPLICATIONS FOR CONSERVATION and MANAGEMENT

- Livestock overgrazing affects the behavioral activities of mountain nyala and the habitat
- The need to limit human activities
- Monitoring behavioral changes in disturbed populations
- Need for appropriate policies and programs on the sustainable use of natural resources
- Educational programs to promote effective enforcement of laws and regulations

Acknowledgments

Supervisors

- Prof. Nils Chr Stenseth
- Prof. Afework Bekele
- Dr. Paul Evangelista
- Dr. Jakob Bro-Jørgensen
- Dr. Anagaw Atickem

Others

- Ethiopian Wildlife Conservation Authority
- Oromia Forest and Wildlife Enterprise
- All my field assistants

Financial support

The Rufford Foundation
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