

Crops, Trees and Birds

Biodiversity change under agricultural intensification in Uganda's farming systems

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Background

- Farming a major source of income for poor people in developing countries
- Global food demand will double by 2050
 - Rapid population growth
 - Increase in per capita food consumption – especially meat/dairy
- Higher quality standards in food trade
 - more intensive production methods
 - more sustainable production methods (?)²

Conflicting goals

- Most biodiversity rich areas have high potential for agricultural production
 - Agricultural expansion and intensification reduce biodiversity through replacement of natural habitats with more permanent and homogenous areas with crops or pastures
- Mounting conflict between biodiversity, food production, and poverty goals

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Policy questions

- Which land use strategies will conserve most biodiversity of a particular type in a particular region?
 - Biodiversity-friendly farming (extensive, organic, wildlife corridors, etc.)
 - Land sparing farming (input-intensive, high-value)
- How may we minimize biodiversity – food production trade-offs?

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Research Objectives

1. Provide information on patterns and trends in wild biodiversity (birds and trees) in Uganda's farming systems
2. Examine the effects of agricultural intensification on the abundance and species richness of birds and trees
 - a. Examine the importance to birds of native and exotic trees (In focus today)
 - b. Examine the importance to birds of cropping patterns and crop diversity

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METHODS

Combining agricultural geography (land use analysis) with botany and ornithology

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Forest cover & crop land in Uganda

Southern Uganda

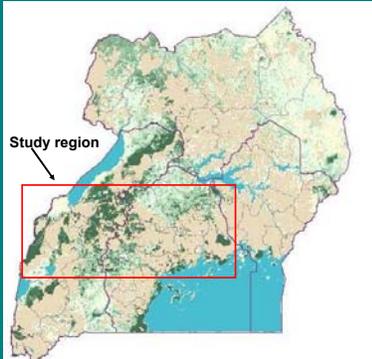
Tropical forest or moist savannah

...giving way to crop land

High and increasing population densities

Mostly small and poor farmers

Banana-based farming systems



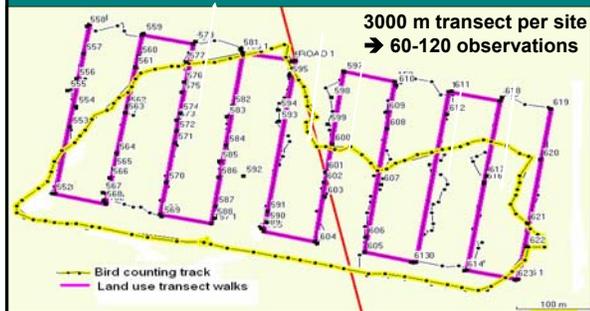
Study sites

- 14 bird monitoring sites in central and western Uganda
 - 9 small-scale farming systems
 - transect walks
 - 4 large-scale farming systems
 - complete mapping

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Bird counting track

Land use and tree cover transects



Summary of variables

- Agricultural land use
 - Cultivation intensity (crop / crop + fallow)
 - Fallow vegetation, natural veg, crop types
- Tree cover and species richness
 - Canopy cover, species origin, human use
- Bird abundance and species richness
 - Categorisation (habitat, threat, pollinators)
 - Time series data since 1986

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Selected Results

Patterns and (suggested) relationships among agricultural land use, trees and birds

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Cultivation intensity & tree cover

Farming system	Cultivation intensity (%)	Canopy Exotic (%)	Canopy Native (%)
L. Scale Sugar	100	0.06	0.06
L. Scale Tea	100	0.22	0.25
Small scale	98	2.9	5.2
	82	3.1	2.7
	73	2.5	4.6
	72	1.8	0.9
	63	0.9	3.1
	61	2.4	6.3
	51	1.9	1.0
26	0.2	12.6	

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Bird species richness in relation to farming system and cultivation intensity

Farming system	Cultivation intensity (% range)	Average number of bird species *
Large scale	Very high (100)	43
Small scale	High (73-98)	104
	Medium (61-72)	102
	Low (26-51)	143

* Jack 1 estimate of λ , based on Timed Species Counts

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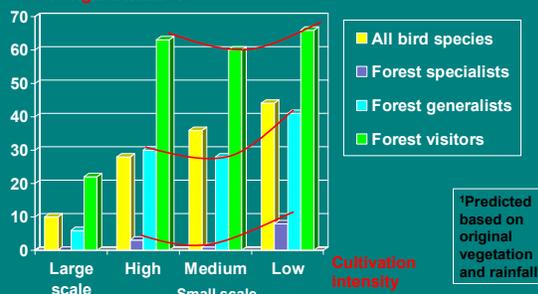
Bird species richness by category and farming system (scale)

(% of total no. of species found in Uganda)

Bird Category	Level of specialisation	Large scale systems	Small scale systems
Forest/Tree Birds	Specialists (Hi)	0	5
	Generalists (Me)	8	34
	Visitors (Low)	27	58
Grassland	(All levels)	21	23
Aerial feeders	(All levels)	24	49
Threatened	(All species)	1	6
Pollinators	(Sunbirds)	11	31 ¹⁴

Loss of bird species (by spec. category) in relation to cultivation intensity

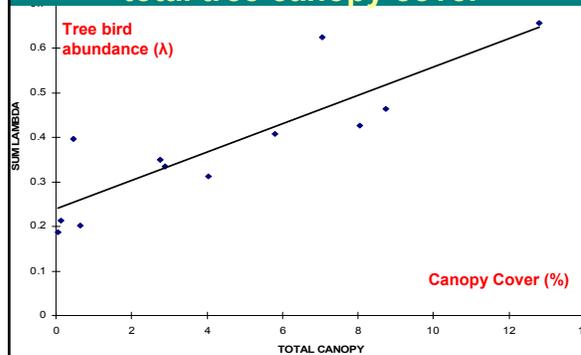
% of original numbers¹



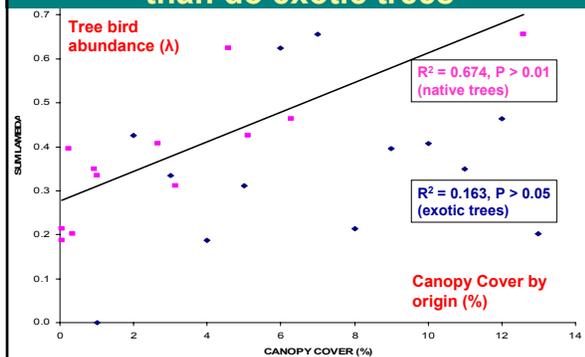
¹Predicted based on original vegetation and rainfall

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Tree bird abundance in relation to total tree canopy cover



Native trees support more tree birds than do exotic trees



Conclusions

- Plantations are bad for trees and birds
- Biodiversity impact of intensification in small scale systems appears bigger in extreme ends of intensity gradient
- Losers: specialised and threatened birds
 - Need for protected areas
- 'Winners': less specialised species
 - aerial feeders, forest visitors

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Uncertainties

- **Validity of results due to low number of observations (sites), especially at the low end of intensity gradient**
 - What happens to birds and trees between low and medium intensities in small-scale systems?
 - Are there really *more* bird and tree species in small-scale systems with high compared to medium cultivation intensity, and if so, why?
 - 'U' shaped tree cover curve?
 - Which bird species immigrate and which disappear?
- **Role of spatial patterns in vegetation cover?**¹⁹

Follow-up research, 2004 - 07

- **Project by British Trust of Ornithology, Makerere University, DIIS, NatureUganda**
- **20 new sites along small-scale intensity gradient**
- **Surveys of insects (plus birds & trees)**
- **Crop yield estimates**
 - Biodiversity – production trade-offs (test of model by Rhys Green *et al.*)
- **Farm management – e.g. organics**

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Additional Slides

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Land use variables

- **Scale of farming**
 - smallholder or commercial plantation
- **Cultivation intensity (crop / crop + fallow)**
- **Fallow age and vegetation type**
- **Cropping pattern (% mixed)**
- **Crop diversity (total no. of crops)**
- **Natural vegetation (%)**
- **Approximate habitat extent**
- **Distance to forest/swamp (but not in models)**₂

Woody vegetation survey

- **Plots at 50m intervals on LU transect**
 - Number of species
 - Number of stems (by diameter class)
 - Canopy cover (%)
 - Origin (native or exotic)
 - Human use: medicines, timber, etc.

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Bird survey

- **Species categorisation**
 - Habitat specialisation (focus on tree birds)
 - Conservation status (IUCN Red Data Listed)
 - Ecosystem service (pollinators)
- **Species richness (Jack 1, Chao 2)**
- **Bird abundance, by species and category**
 - Timed Species Counts → encounter rates (λ)
- **Predictions (compared with actual observations)**
- **Trends over time (in λ , by category)**

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Birds and Agricultural Change

- **Agricultural land use change is the major threat to globally threatened and near-threatened bird species**
- **90% of these birds are found in developing countries**
- **... and most in areas of high human population densities**

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