

Feasibility study for elephant inventory with an Unmanned Aerial Vehicle

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Introduction
Aerial survey
Results

Outline

- 1 Introduction
- 2 Aerial survey
- 3 Results

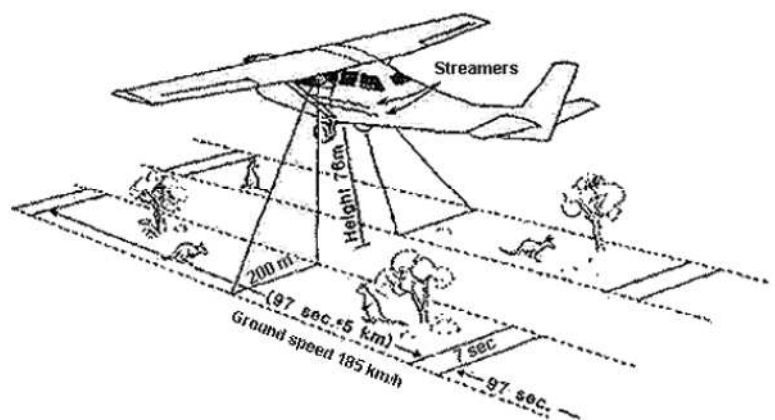


Elephant populations are **decreasing** in West-Africa.

Management requires inventory.

Inventory are achieved by sampling the total area of interest.

Fixed-width Transect (Strip) inventory is the most preconized method.



UAVs: Unmanned Aerial Vehicles^a

^aUAV: Unmanned Aerial Vehicle. UAS: Unmanned Aerial System (drone + ground control station)

"UAVs are to be understood as uninhabited and reusable motorized aerial vehicles" (Blyenburg, 1999).

These vehicles are **remotely controlled**, **semiautonomous**, **autonomous**, or have a combination of these capabilities.

The mini-UAS Gatewing X100



The mini-UAS Gatewing X100

UAV characteristics:

- ▶ 2 kg, 1m wingspan
- ▶ Electric propulsion
- ▶ Completely **autonomous flight**
- ▶ Cruise speed: 80 km/h
- ▶ Catapult launched
- ▶ Flight duration of max 45 min

The digital camera:

- ▶ Amateur camera
- ▶ **10 Gpixels¹**

¹Resolution of **3 cm** at 100m Above Ground Level

Context

Traditionnal Aerial-Based wildlife inventory have several drawbacks, as e.g.

- ▶ Price
- ▶ Risk
- ▶ Opperator dependence
- ▶ Estimation of animal density not very accurate

UAV aerial inventories show advantages:

- ▶ Quick, relatively cheap and non-risky
- ▶ Images consist in permanent documentation

Nevertheless, it remains a lot of uncertainties:

- ▶ Measurement of the inventoried surface?
- ▶ Detection of animals?
- ▶ Flights authorization?
- ▶ Operational cost?

The dawn of drone ecology



Jones 2006 : First use of UAV for wildlife assessment.



Koh 2012 : inventory of orang outang.

Introduction
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Context
Research Question

Main Research Question

- 1 Are aerial elephant inventory with UAV feasible?

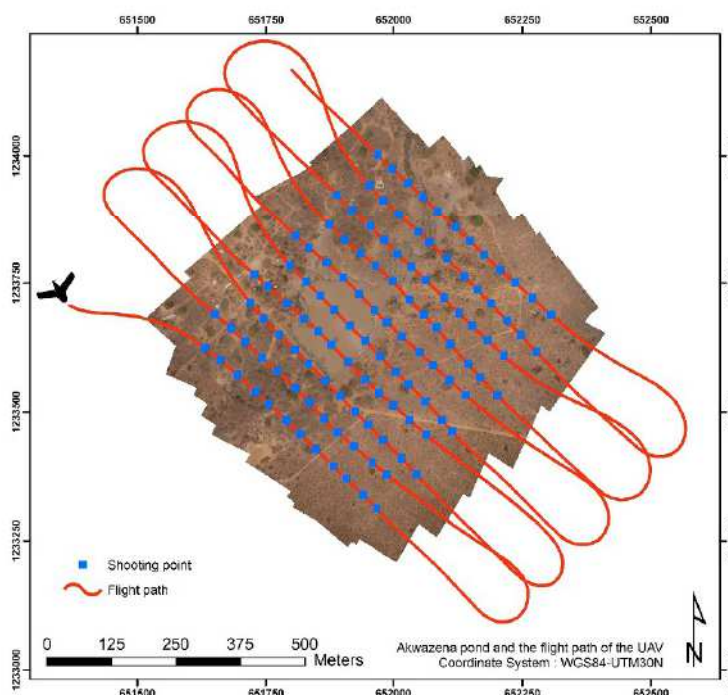
Specific Research Questions

- 1 On wich altitude should fly the UAV?
- 2 Are elephants disturbed by the presence of a mini-UAV?
- 3 Are elephants easily detectable?
- 4 How the inventoried surfaces can be measured?
- 5 Is images overlapping a necessity?
- 6 How to properly count the elephant?

We performed test flights in the **game ranch of Nazinga**, Burkina Faso



Flights above the Akwazena pond for testing the detectability et reactivity.



Strip flights along transects for testing the inventory feasibility.



J. Lisein *et al.*

Unmanned aerial inventory of elephant

It worked nicely...



J. Lisein *et al.*

Unmanned aerial inventory of elephant

Results



Sample of aerial images: Detectability





Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Specific Research Questions

- ▶ On which altitude should fly the UAV?
- ▶ Are the elephants disturbed by the presence of a mini-UAV?

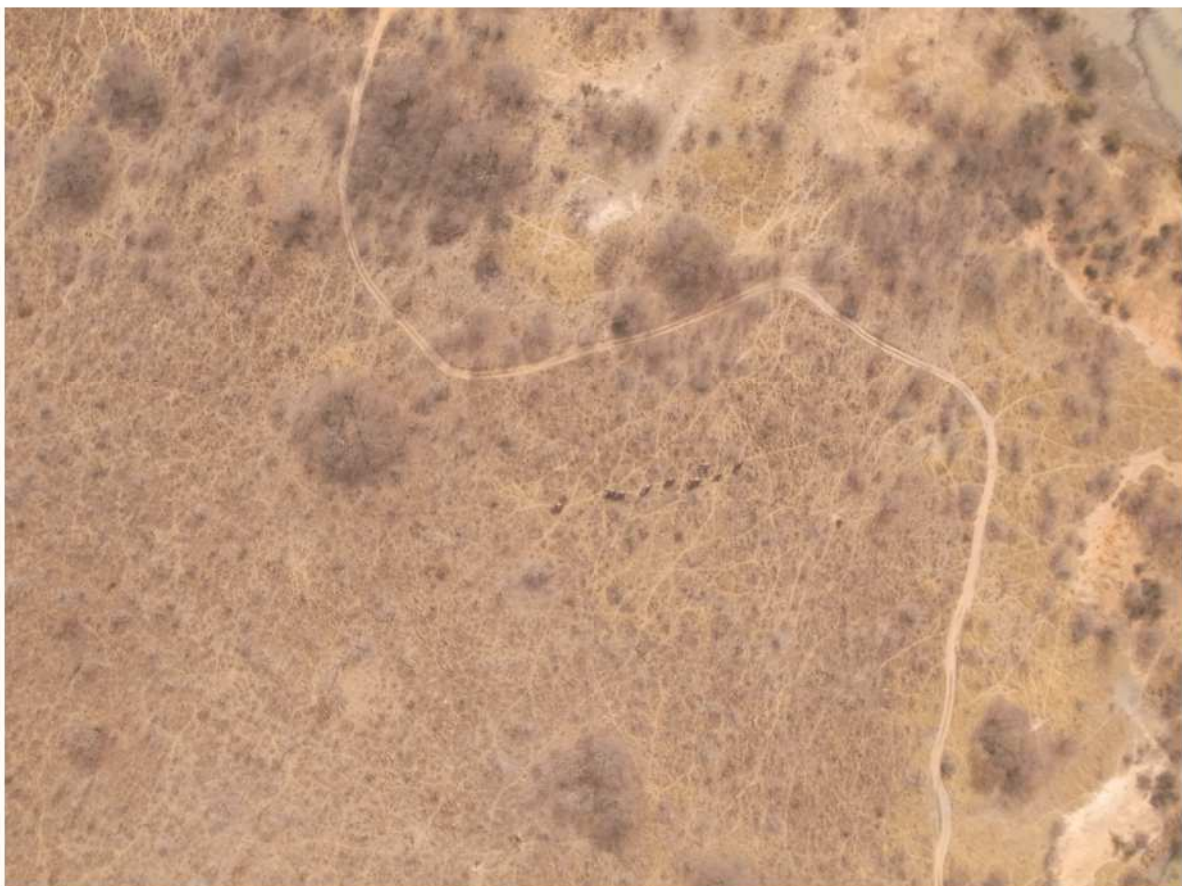
Results

- ▶ It is necessary to strike a balance between the **size of the animals on the pictures** and the **surface inventoried** (100m Above Ground Level)
- ▶ The animals do not seem to be disturbed by the UAV.

Elephant Detectability



Elephant Detectability



Images overlap



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Counting



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Unmanned aerial inventory of elephant

Counting



Counting



Counting



Counting



Counting

Test operator on 2700 images containing 34 elephants in 3 herds:

Operator	Count	Missing
Operator 1	33	1
Operator 2	29	5
Operator 3	24	11
Operator 4	31	3
Mean		5 (14%)

- ▶ The operator 3 has miss a complete herd
- ▶ Omission are sub-adult or young
- ▶ Necessity of double count

Specific Research Questions

- ▶ Are elephants easily detectable?
- ▶ How to properly count the elephant?

Results

Elephants in savanna aren't easily detectable, especially for sub-adult and young. Overlapping images facilitate the counting process and counts made by a duo of independent observers is recommended (info crosschecking)

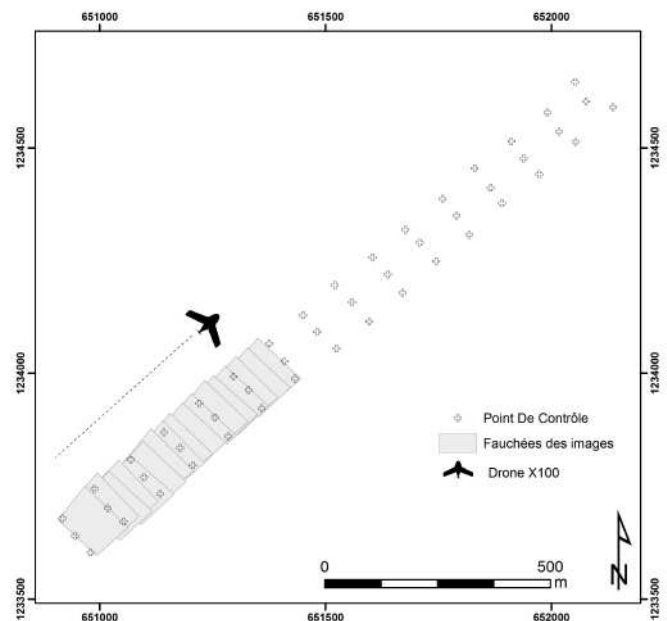
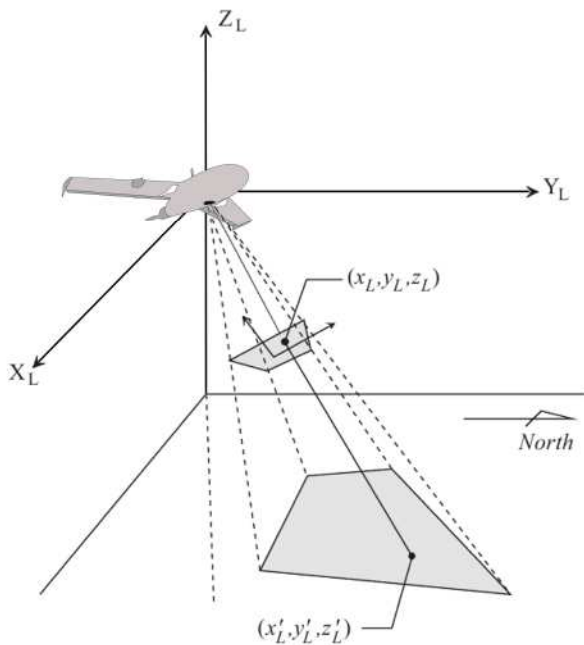
Automatic detection



Automatic detection



Surface computation by Image footprint projection



Take Home messages

Unmanned Aerial Wildlife inventory: an promising perspective, but still lot of improvements of the systems are required:

- ▶ Flight duration
- ▶ Images resolution
- ▶ Flight planning software adapted for transect flights²
- ▶ Algorithm for (semi-)automatic detection of Elephant
- ▶ Flights regulation



²similar than corridor mapping

Thank you for your attention...

