Feasibility study for elephant inventory with an Unmanned Areal Vehicle

Lisein Jonathan, Cédric Vermeulen, Philippe Bouché and Philippe Lejeune

ULg, Gembloux Agro-Bio Tech
Unit of Forest and Nature Management

Gembloux, 4 october 2012

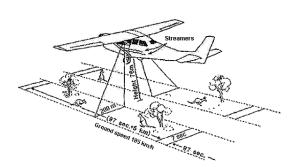# Outline

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]

---

[a]UAV: 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 Gpixels[1]

---

[1]Resolution of 3 cm at 100m Above Ground Level

Context

Traditionnal Aerial-Based wildlife inventory have several drownbacks, 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?

Jones 2006 : First use of UAV for wildlife assessment.

Koh 2012 : inventory of orang outang.

Main Research Question

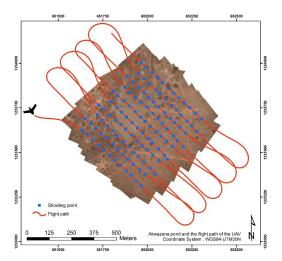1. Are aerial elephant inventory with UAV feasible?

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?
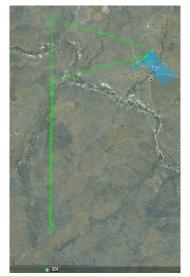6. How to properly count the elephant?

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

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

Strip flights along transects for testing the inventory feasibility.

It worked nicely...

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Results

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Specific Research Questions

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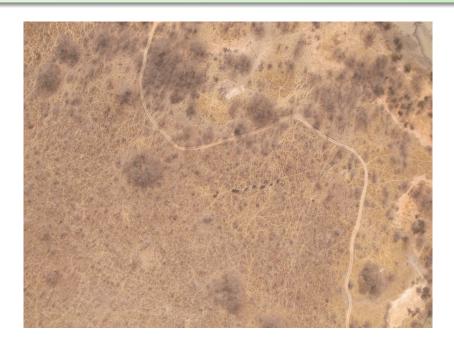- ▶ Are the elephants disturbed by the presence of a mini-UAV?

Results

- ▶ It is necessity 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.

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Images overlap

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Counting

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Counting

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Counting

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Counting

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Counting

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

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

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

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)

Introduction
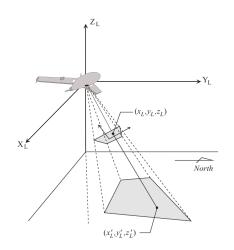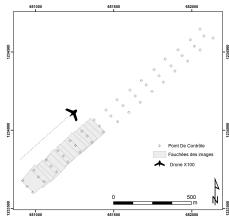Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Automatic detection

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Automatic detection

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

Surface computation by Image footprint projection

Introduction
Aerial survey
Results

Elephant Detection
Images overlap
Counting
Automatic detection
Surface estimation

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 flights[2]
- ▶ Algorithm for (semi-)automatic detection of Elephant
- ▶ Flights regulation

---

[2]similar than corridor mapping

Thank you for your attention...