

Presented at the ISPRS Geospatial Week 2015 GeoUAV, 1-2 October



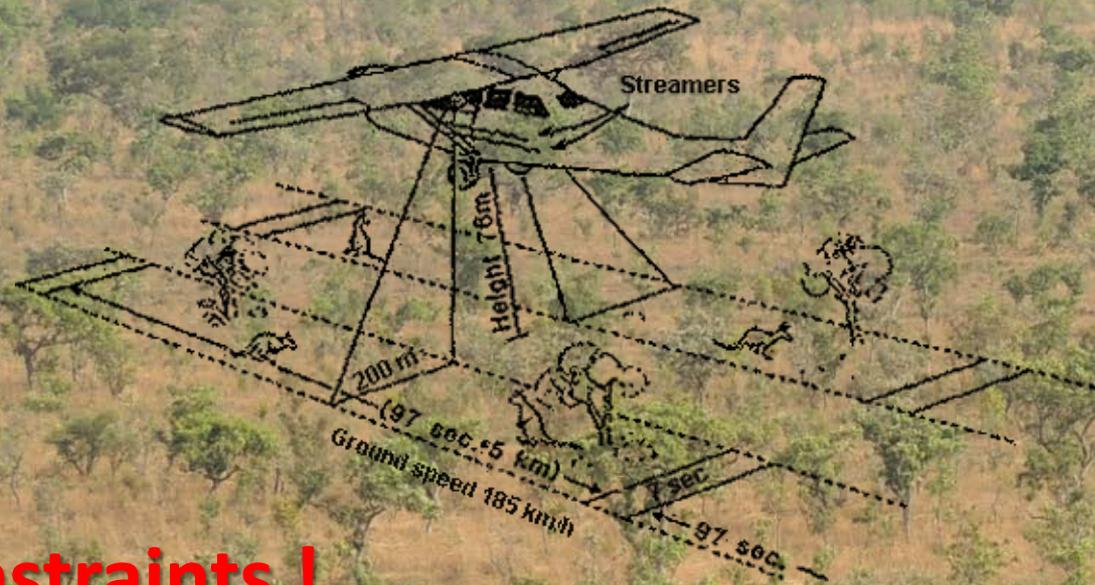
WiMUAS: A tool to review wildlife data from various flight plans

Linchant J, Lhoest S, Quevauvillers S, Semeki J, Lejeune P & Vermeulen C

Regular, standardized animal population inventories
= Management key to preserve wildlife

Usually aerial inventories with manned aircraft

→ Ideal for wide flat landscape of Africa



! But many constraints !

UAS, a new opportunity?

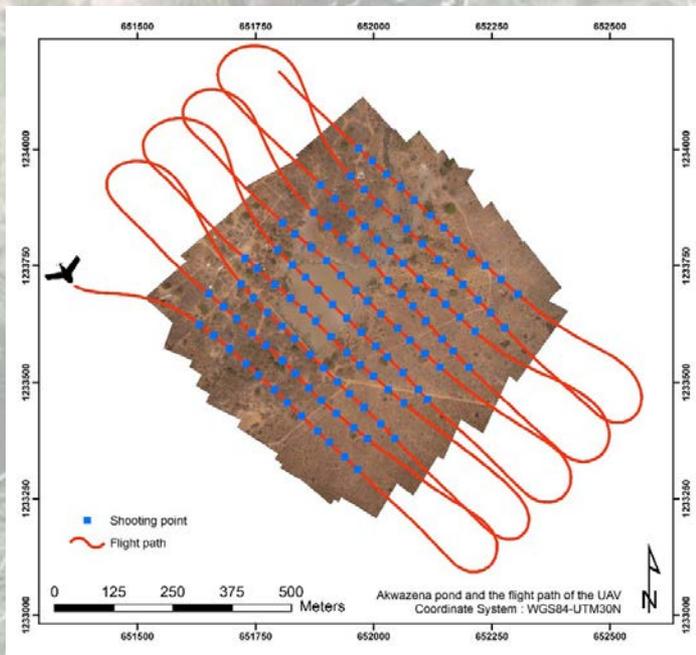
- High spatial and temporal resolution
- Repeatable flight plans
- Permanent data
- Several sensor types
- Fly low and slow

Problems?

Huge data sets >< Small areas covered

Main limitations
→ **endurance and range**

Why use classic methods?



× **Statistics unknown**

✓ **Flight parameters files available**

1. Create an easy tool to analyze huge datasets from all UAS inventories



2. Test new flight plan

Observation database

Easy counting process for observer

Multiple observers

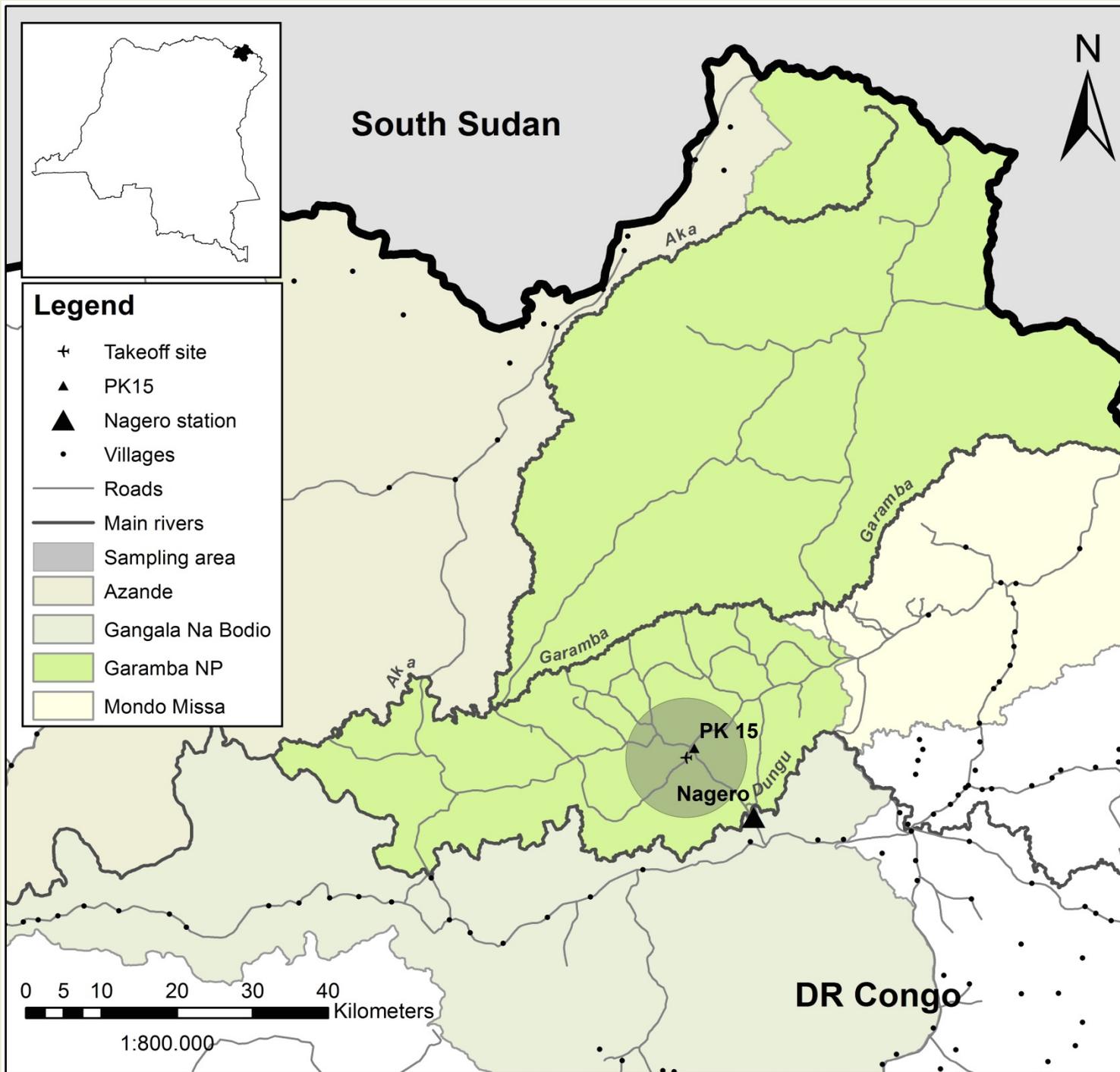
Modifiable obs.

Generate counting results and comparisons

GIS compatible

Generate accurate sampling surface

Project observation points



UAV Falcon:

- Electric propulsion
- 45 min endurance
- Digital radio link (telemetry and video)
- 8-10 km range (obstacle free)
- Cruise speed 50km/h
- APM/Mission Planner©

Payload:

- Sony Nex7
- 24MP
- No gimbal



Buffaloes, elephants,
giraffes, hippos, lions,
various antelopes



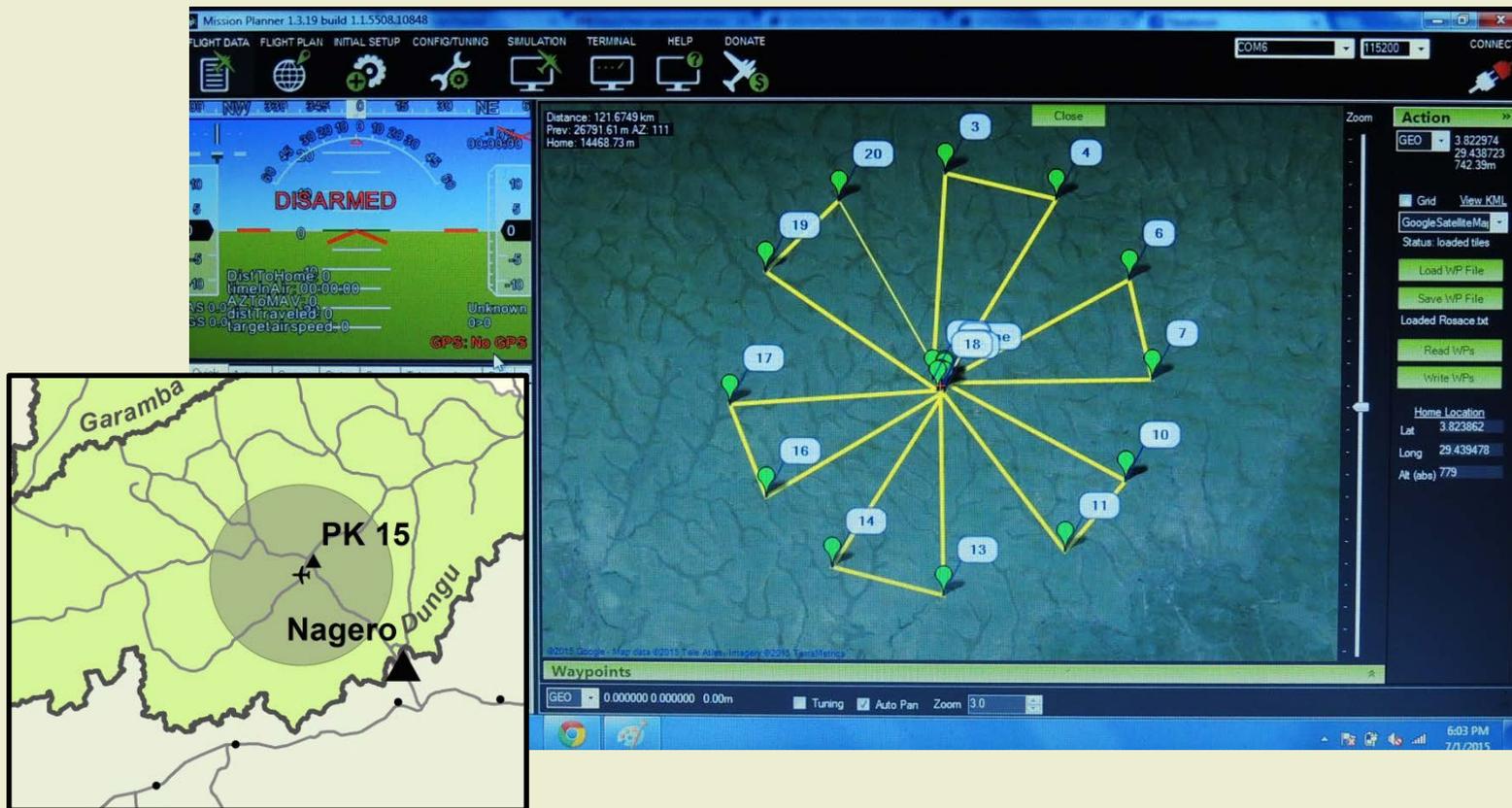
Average flight altitude: 100m



➔ Footprint: 119 x 82 m

3 flights a day, 40 km per flight, 8 km range

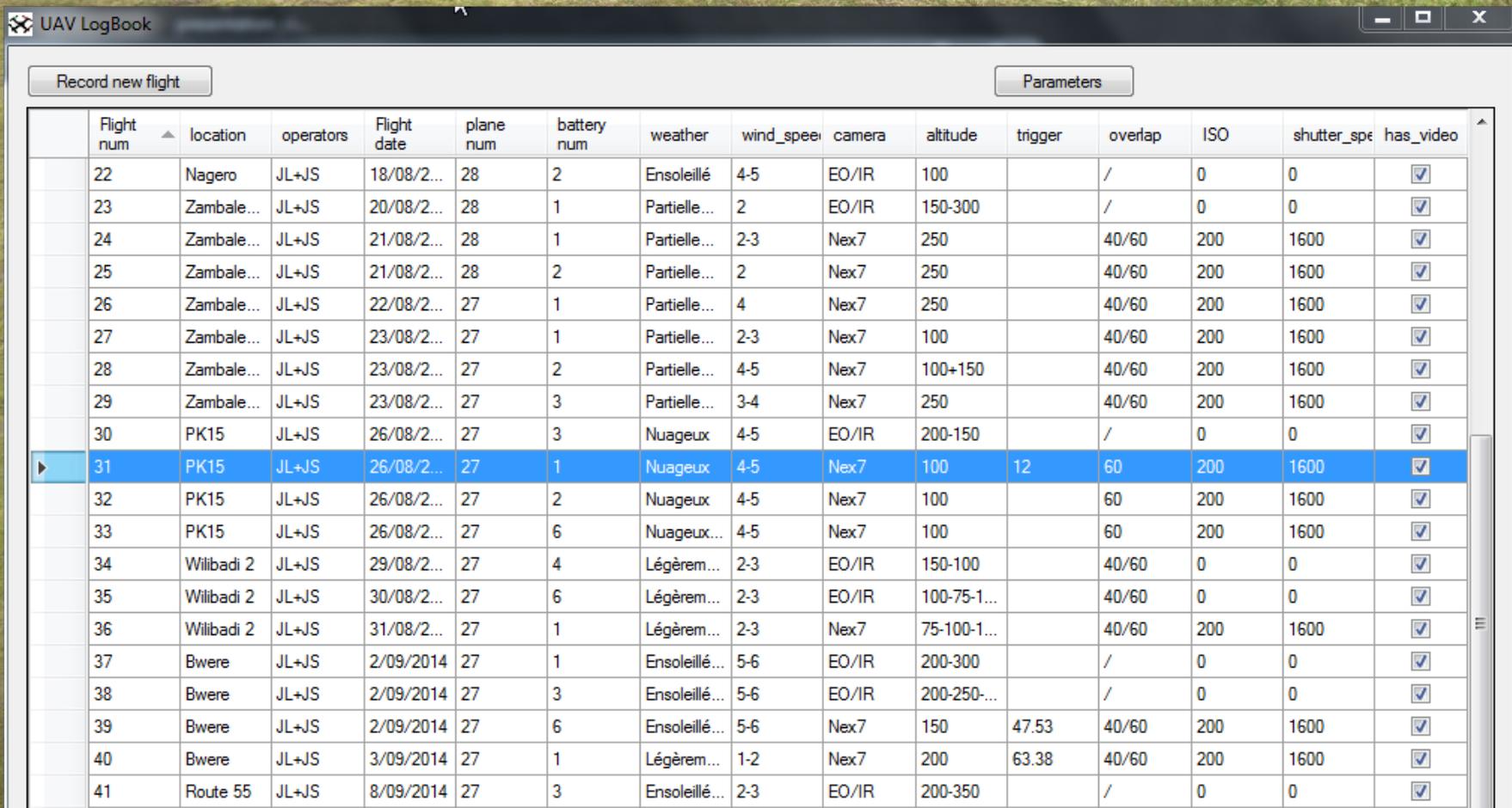
Rosette-shape is the most efficient



120 km of transects in 3 x 2 petals of 20 km

WiMUAS software:

Starts with a logbook



UAV LogBook

Record new flight Parameters

Flight num	location	operators	Flight date	plane num	battery num	weather	wind_speed	camera	altitude	trigger	overlap	ISO	shutter_speed	has_video
22	Nagero	JL+JS	18/08/2...	28	2	Ensoleillé	4-5	EO/IR	100		/	0	0	<input checked="" type="checkbox"/>
23	Zambale...	JL+JS	20/08/2...	28	1	Partielle...	2	EO/IR	150-300		/	0	0	<input checked="" type="checkbox"/>
24	Zambale...	JL+JS	21/08/2...	28	1	Partielle...	2-3	Nex7	250		40/60	200	1600	<input checked="" type="checkbox"/>
25	Zambale...	JL+JS	21/08/2...	28	2	Partielle...	2	Nex7	250		40/60	200	1600	<input checked="" type="checkbox"/>
26	Zambale...	JL+JS	22/08/2...	27	1	Partielle...	4	Nex7	250		40/60	200	1600	<input checked="" type="checkbox"/>
27	Zambale...	JL+JS	23/08/2...	27	1	Partielle...	2-3	Nex7	100		40/60	200	1600	<input checked="" type="checkbox"/>
28	Zambale...	JL+JS	23/08/2...	27	2	Partielle...	4-5	Nex7	100+150		40/60	200	1600	<input checked="" type="checkbox"/>
29	Zambale...	JL+JS	23/08/2...	27	3	Partielle...	3-4	Nex7	250		40/60	200	1600	<input checked="" type="checkbox"/>
30	PK15	JL+JS	26/08/2...	27	3	Nuageux	4-5	EO/IR	200-150		/	0	0	<input checked="" type="checkbox"/>
31	PK15	JL+JS	26/08/2...	27	1	Nuageux	4-5	Nex7	100	12	60	200	1600	<input checked="" type="checkbox"/>
32	PK15	JL+JS	26/08/2...	27	2	Nuageux	4-5	Nex7	100		60	200	1600	<input checked="" type="checkbox"/>
33	PK15	JL+JS	26/08/2...	27	6	Nuageux...	4-5	Nex7	100		60	200	1600	<input checked="" type="checkbox"/>
34	Wilibadi 2	JL+JS	29/08/2...	27	4	Légèrem...	2-3	EO/IR	150-100		40/60	0	0	<input checked="" type="checkbox"/>
35	Wilibadi 2	JL+JS	30/08/2...	27	6	Légèrem...	2-3	EO/IR	100-75-1...		40/60	0	0	<input checked="" type="checkbox"/>
36	Wilibadi 2	JL+JS	31/08/2...	27	1	Légèrem...	2-3	Nex7	75-100-1...		40/60	200	1600	<input checked="" type="checkbox"/>
37	Bwere	JL+JS	2/09/2014	27	1	Ensoleillé...	5-6	EO/IR	200-300		/	0	0	<input checked="" type="checkbox"/>
38	Bwere	JL+JS	2/09/2014	27	3	Ensoleillé...	5-6	EO/IR	200-250-...		/	0	0	<input checked="" type="checkbox"/>
39	Bwere	JL+JS	2/09/2014	27	6	Ensoleillé...	5-6	Nex7	150	47.53	40/60	200	1600	<input checked="" type="checkbox"/>
40	Bwere	JL+JS	3/09/2014	27	1	Légèrem...	1-2	Nex7	200	63.38	40/60	200	1600	<input checked="" type="checkbox"/>
41	Route 55	JL+JS	8/09/2014	27	3	Ensoleillé...	2-3	EO/IR	200-350		/	0	0	<input checked="" type="checkbox"/>

All flight characteristics and environmental conditions

Flight record

Location: PK15

Operators: JL+JS

Flight number: 31

Flight date: 26/08/2014

Plane number: 27

Battery number: 1

Weather: Nuageux

Wind speed: 4-5

Start hour: 11:30

End hour: 12:20

Camera: Nex7

Altitude: 100

Trigger: 12

Overlap: 60

ISO: 200

Shutter speed: 1600

Video saved ?

Flight time:

Prepare time:

Treatment time:

Note: Inventaire en rosette part 1

Flight folder path: H:\Vols_drone\PK15\Vol_31_26082014

Additional informations:

- Number of OK photos : 645
- Number of blurry photos : 3
- Number of videos : 1
- TLOG LOG
- location file (.txt)

Actions:

- Detect animals (slider)
- Open flight folder
- Create ground projection (.shp)

Save

Double-click to reach each flight sheet and access treatment options

Flight folder path

H:\Vols_drone\PK15\Vol_31_26082014

Additional informations

Number of OK photos : 645

Number of blurry photos : 3

Number of videos : 1

TLOG LOG

location file (.txt)

Actions

Detect animals (slider)

Open flight folder

Create ground projection (.shp)

Specific folders for each flight and type of files.

Available for every flight: log and tlog, photos_ok and videos



photos_blur



photos_filter



photos_ok



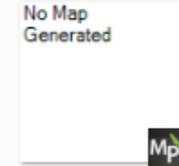
videos



2014-08-26
11-21-45.gpx



2014-08-26
11-21-45.rlog



2014-08-26
11-21-45.tlog



2014-08-26
11-21-45.tlog.kmz



DETECTION_AVA
NCEMENT.txt



liste_img_31.txt



location.txt



photos_etoile.dbf



photos_etoile.prj



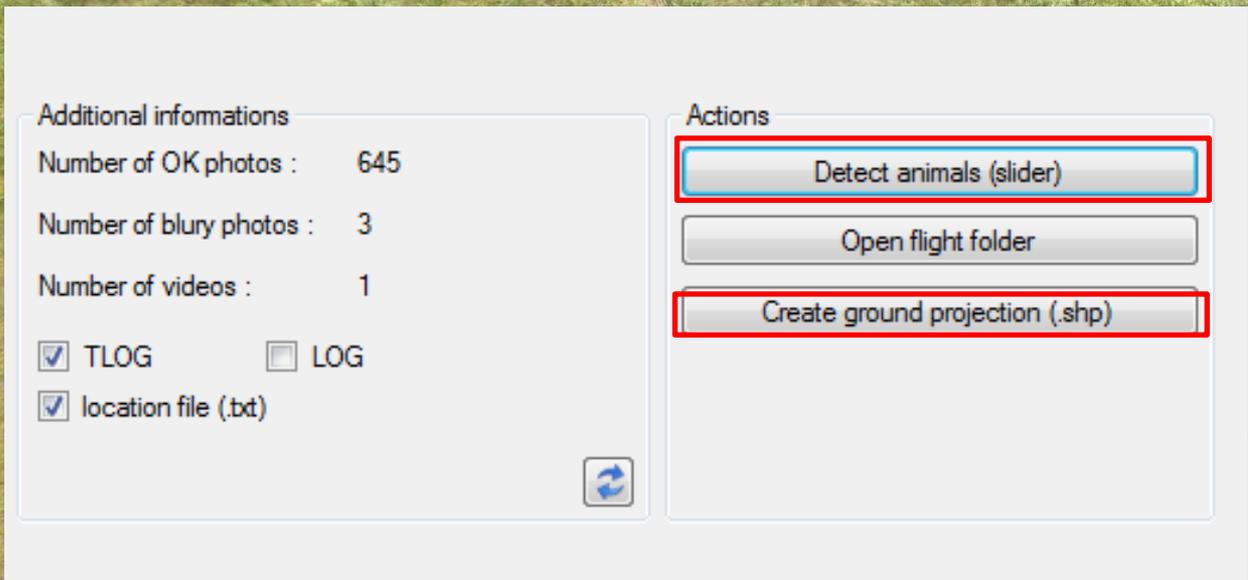
photos_etoile.qpj



photos_etoile.shp

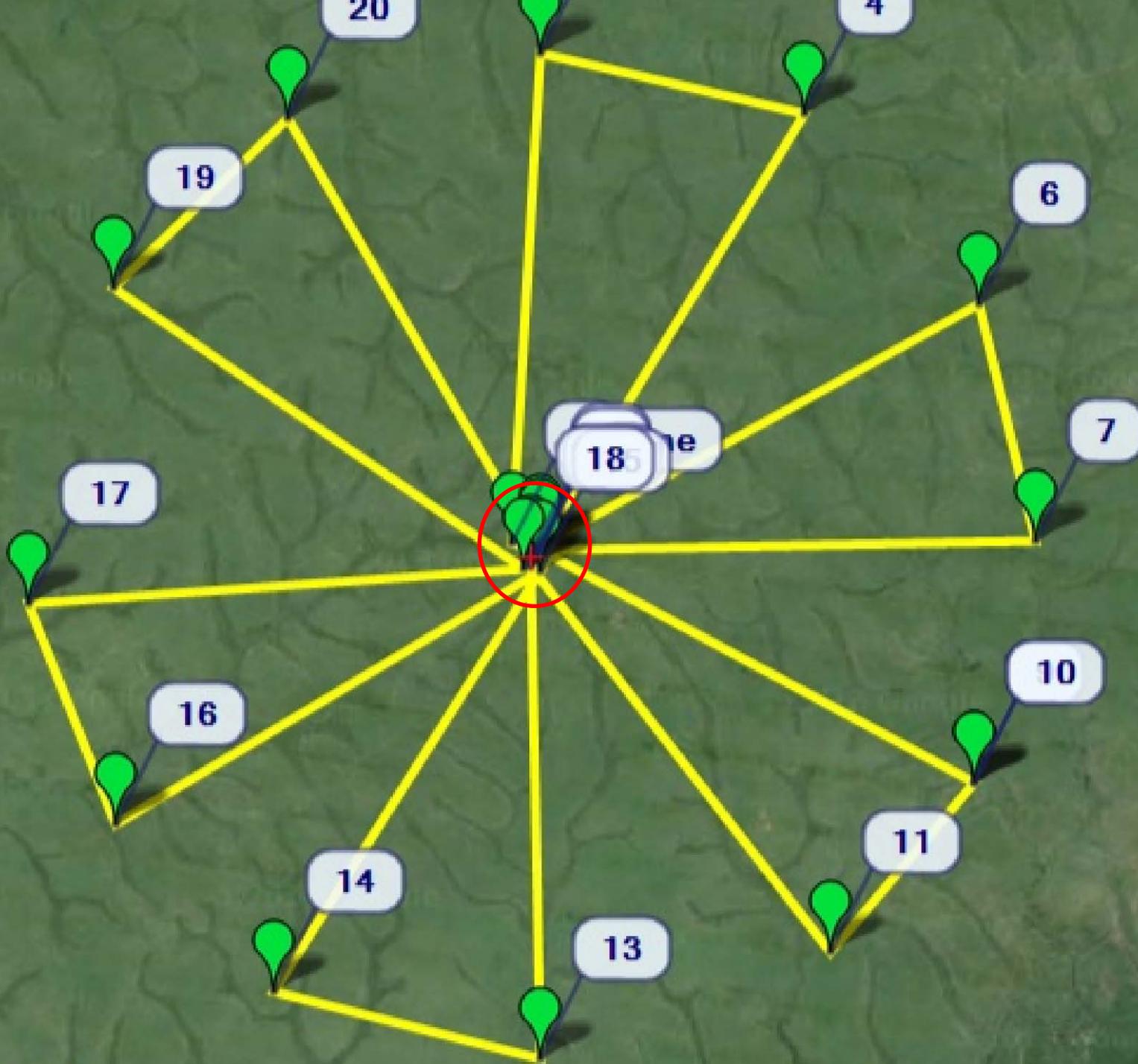


photos_etoile.shx



To estimate wildlife density
→ **Area covered**
→ **Animal count**

Both treatments need to be done only for efficient parts of the flight!



➔ Georeference images to select spatially the photos that need to be discarded

➔ Generate the location textfile

Geo Ref Images

H:\Vols_drone\Tests_détection\Quadrat1\Config_2\2015-03-24 09-26-01.log Browse Log

H:\Vols_drone\Tests_détection\Quadrat1\Config_2 Browse Pictures

Time offset CAM Message Synchro

Use Cam Messages

Seconds offset Estimate Offset Shutter lag (ms)

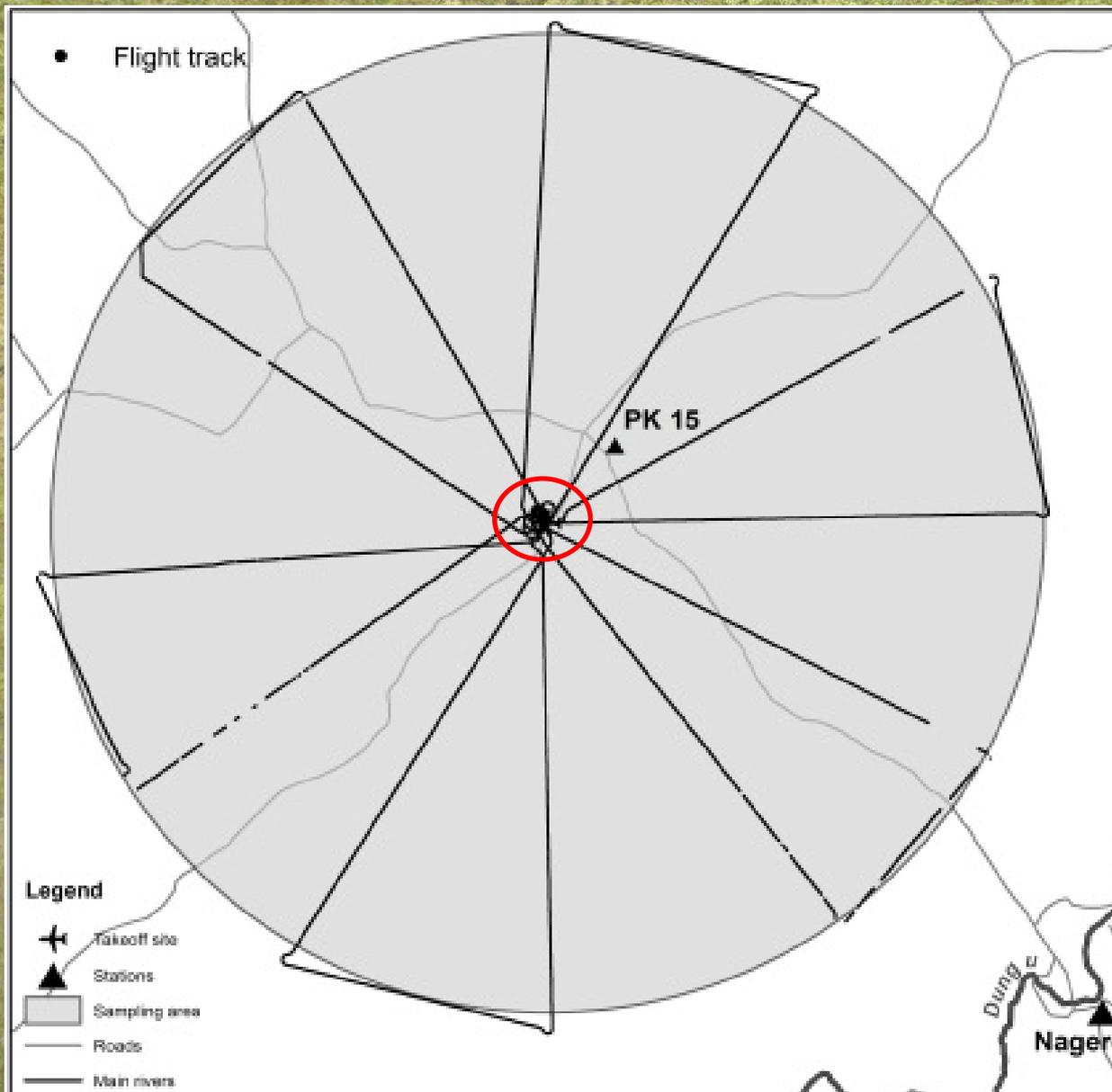
CAM Message Offsets				GPS Message Offsets			ATT Message Offsets	
GPS Millis	Lat	Lon	Alt	GPS Millis	GPS Week	AMSL Alt	Head	Roll
<input type="text" value="1"/>	<input type="text" value="3"/>	<input type="text" value="4"/>	<input type="text" value="5"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="9"/>	<input type="text" value="7"/>	<input type="text" value="3"/>
GPS Week	Head	Roll	Pitch	Lat	Lon	Alt	Pitch	
<input type="text" value="2"/>	<input type="text" value="8"/>	<input type="text" value="7"/>	<input type="text" value="6"/>	<input type="text" value="6"/>	<input type="text" value="7"/>	<input type="text" value="8"/>	<input type="text" value="5"/>	

Dir fov Rotation Cross fov

Use AMSL Alt Rel Alt base

Pre-process >> Location Kml >> GeoTag Images

```
location.txt - Bloc-notes
Fichier Edition Format Affichage ?
#name longitude/X latitude/Y height/z yaw pitch roll
DSC05186.JPG 3,8280911 29,4359352 879,739990234375 355,3039 2,524372 1,328421
DSC05187.JPG 3,8284604 29,4359433 880,080017089844 358,0114 4,263785 1,934068
DSC05188.JPG 3,8285946 29,4359432 880,070007324219 357,7289 3,951024 1,86594
DSC05189.JPG 3,8289316 29,4359539 881,460021972656 3,970823 3,588393 2,227355
DSC05190.JPG 3,829296 29,4359725 881,599975585938 1,708485 2,365655 1,952237
DSC05191.JPG 3,8303956 29,4360349 886,469970703125 3,891034 -1,952573 1,27352
DSC05192.JPG 3,830753 29,4360574 888,159973144531 6,640726 -3,418233 0,4104981
DSC05193.JPG 3,8314173 29,4360957 893,030029296875 2,682792 -6,771892 2,040522
DSC05194.JPG 3,8316363 29,4361107 894,210021972656 6,264057 -7,819668 1,275731
DSC05195.JPG 3,8329046 29,4361915 895,909973144531 4,916134 -8,91298 3,836637
DSC05196.JPG 3,8332257 29,4362199 894,409973144531 2,104844 -9,163411 -0,4985346
DSC05197.JPG 3,8337618 29,4362508 890,830017089844 5,271055 -10,17189 0,1191576
DSC05198.JPG 3,8341557 29,4362707 888,080017089844 5,074267 -7,671563 1,063719
DSC05199.JPG 3,8344698 29,4362904 886,77001953125 2,837628 -8,128714 2,05172
DSC05200.JPG 3,8353043 29,436341 884,190002441406 2,676651 -6,05644 1,182017
DSC05201.JPG 3,8366246 29,4364164 878,989990234375 6,794749 -2,174126 -3,759514
DSC05202.JPG 3,8375 29,4364662 876,049987792969 2,829377 1,182529 -0,8910919
```



Project GPX and select waypoints to be discarded

Actions

Detect animals (slider)

Open flight folder

Create ground projection (.shp)

New textfile produced
→ used as a filter

Slider - vol 31

Image DSC05186.JPG

! if the picture is centred or not at the top, change the window size !



Session

Observer :

Simon

Menu

Observation

Unique

Is a doubleton

Herd

Counting OFF ?

Delete last point

Observations count :

1

Observation types :

Bateleur
Bubale
Buffle
Carcasse
Cob
Crâne
Eléphant
Girafe
Hippopotame
Indéterminé
Lion
Mangouste
Ourébi
Phacochère
Vautour
Waterbuck

Filter by text file

location.txt - Bloc-notes

Fichier Edition Format Affichage ?

```
#name longitude/X latitude/Y height/Z yaw pitch roll
```

```
DSC05186.JPG 3,8280911 29,4359352 879,739990234375 355,3039 2,524372 1,328421
```

```
DSC05187.JPG 3,8284604 29,4359433 880,080017089844 358,0114 4,263785 1,934068
```

```
DSC05188.JPG 3,8285946 29,4359432 880,070007324219 357,7289 3,951024 1,86594
```

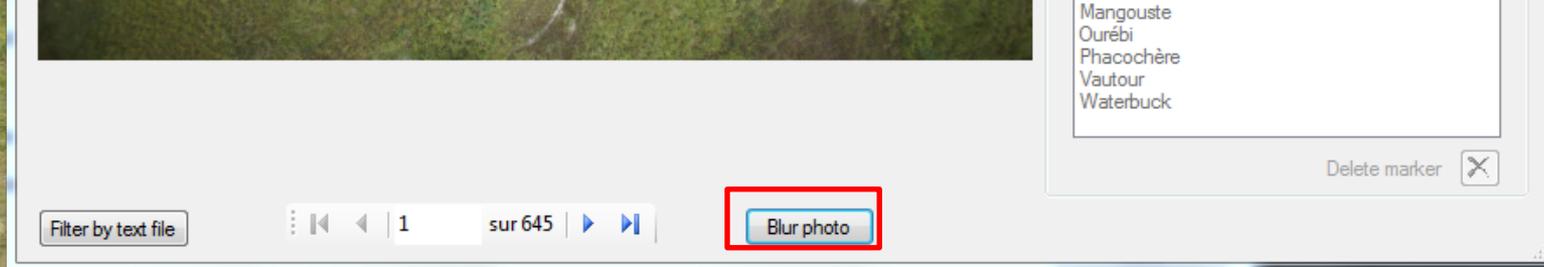
```
DSC05189.JPG 3,8289316 29,4359539 881,460021972656 3,970823 3,588393 2,227355
```

```
DSC05190.JPG 3,829296 29,4359725 881,599975585938 1,708485 2,365655 1,952237
```

```
DSC05191.JPG 3,8303956 29,4360349 886,469970703125 3,891034 -1,952573 1,27352
```

```
DSC05192.JPG 3,830753 29,4360574 888,159973144531 6,640726 -3,418233 0,4104981
```

```
DSC05193.JPG 3,8314173 29,4360957 893,030029296875 2,682792 -6,771892 2,040522
```



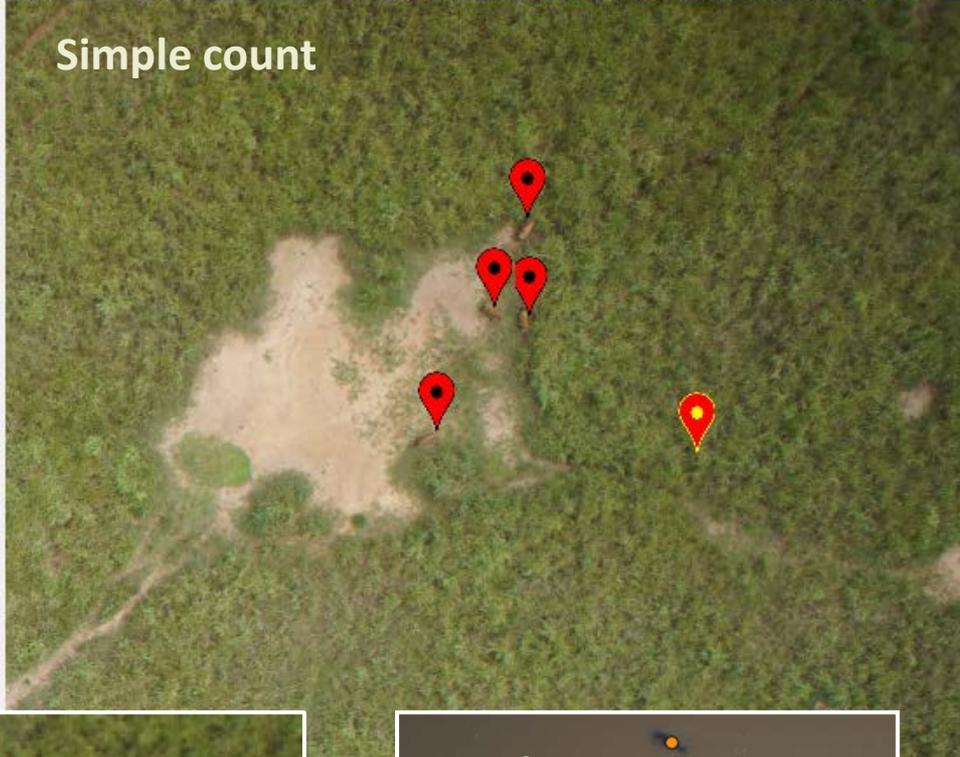
Flights	Trial 1			Trial 2		
	F 1	F 2	F 3	F1	F 2	F 3
Flight time (min)	50	45	45	50	45	50
Total photos taken	784	622	587	1300	993	1087
Photos discarded	136	90	71	130	80	179
Photos considered for detection	648	532	516	1170	913	908
Blurry photos	3	2	3	15	7	3

10-20% of the photos lost

Mainly due to landing phase and gaps in the .tlog file.

➔ Should be less with .log

Simple count



Session

Observer : Simon

Menu

Observation

Unique Is a doubleton

Herd

Comptage OFF ? Delete last point

Observations count : 1

Observation types :

- Bateleur
- Bubale
- Buffle
- Carcasse
- Cob
- Crâne
- Eléphant
- Girafe
- Hippopotame
- Indéterminé
- Lion
- Mangouste
- Ourébi
- Phacochère
- Vautour
- Waterbuck

Delete marker

Double count



Herd count



Slider and point
and click tool

Session

Ob

Me

Ob

Rapport

Rapport comparatif

Exporter

Importer

Le vol courant

Tout cet observateur

Slider - vol 31

Image DSC05694.JPG

! if the picture is centred or not at the top, change the window size !



Session

Observer : Simon

Menu

Observation

Unique Is a doublon

Herd

Counting OFF ? Delete last point

Observations count : 1

Observation types :

- Bateleur
- Bubale
- Buffle
- Carcasse
- Cob
- Crâne
- Eléphant
- Girafe
- Hippopotame
- Indéterminé
- Lion
- Mangouste
- Ourébi
- Phacochère
- Vautour
- Waterbuck

Delete marker

Filter by text file

489 sur 645

Blur photo

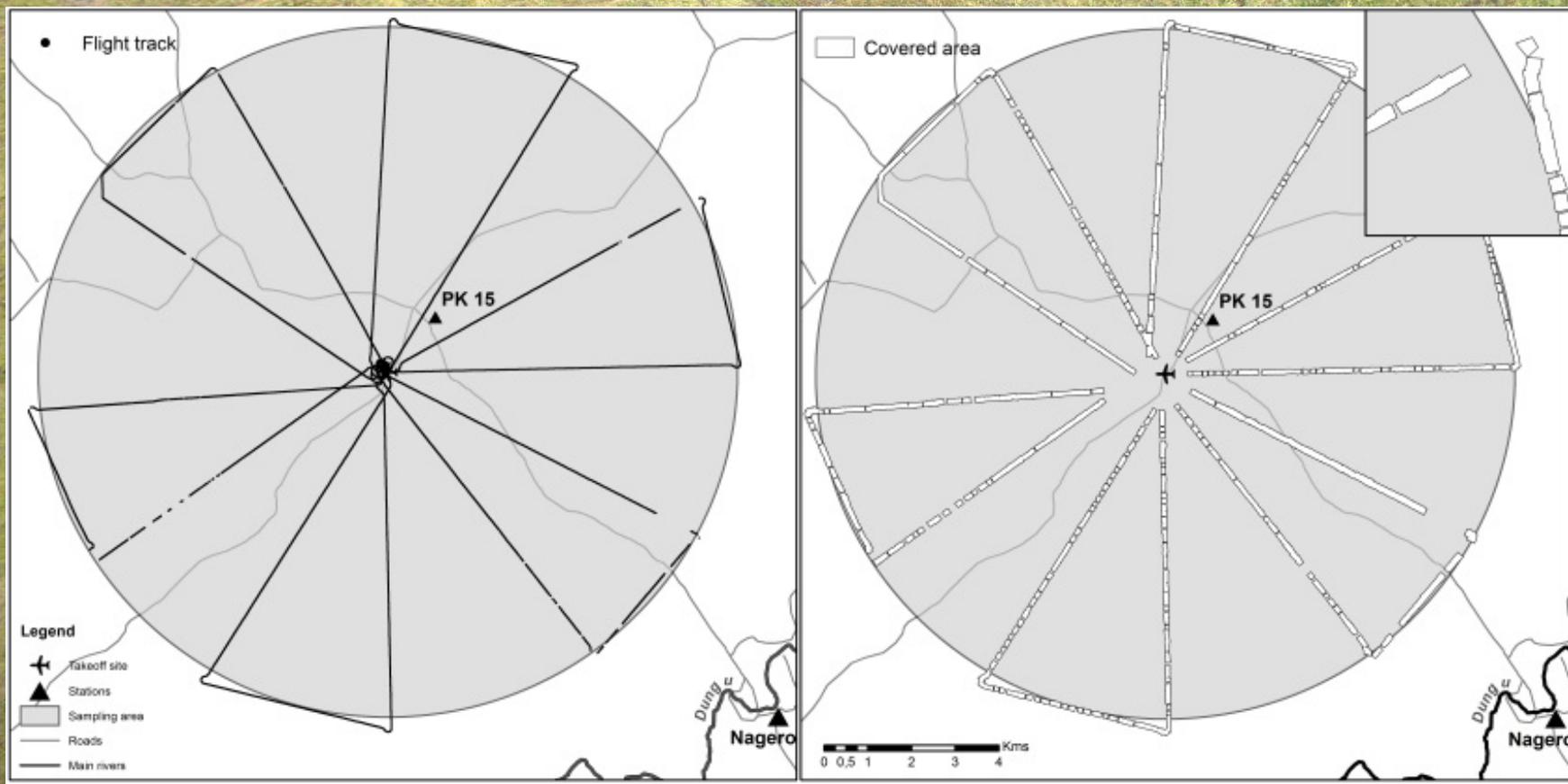
Multiple observers, modifiable observations, export and import database from different people

Generate comparative results, list images with observations and list differences between observers
→ possibility to review errors and create a more accurate total

Species	Trial 1				Trial 2			
	O 1	O 2	O 3	Total	O1	O 2	O 3	Total
Buffaloes	232	249	245	249	19	9	5	10
Elephants	0	0	4	0	0	0	2	0
Giraffes	0	0	0	0	0	0	1	0
Hartebeests	3	12	8	13	9	4	8	6
Hippos	22	26	24	23	36	27	28	35
Cobs	12	14	16	14	5	16	8	18
Warthogs	3	8	6	9	5	28	25	27
Waterbucks	0	1	0	1	0	3	0	3
Total	272	310	303	309	74	87	77	99

Generate a shapfile of projected images footprints

- Use the flight parameters and orientation data
- Use average altitude or difference between absolute flight altitude and relief data (srtm)



We first used the average flight altitude, 100m

Results of the inventory tests

Mean sampling rate considering a circular area of 201 km² = 6,1%

	Trial 1				Trial 2			
Observers	O 1	O 2	O 3	Total	O1	O 2	O 3	Total
Sampling area	12,4 km ²				12,1 km ²			
Total animals	272	310	303	309	74	87	77	99
Sampling area	12,4 km ²				12,1 km ²			
Density	23,8			25,0	6,5			8,2
Coef. variation	6,9				8,6			

Big differences between the 2 tests

➔ Problem of the very low sampling rate and the small area covered, movements of the animals, buffalo herds

The tool created is:

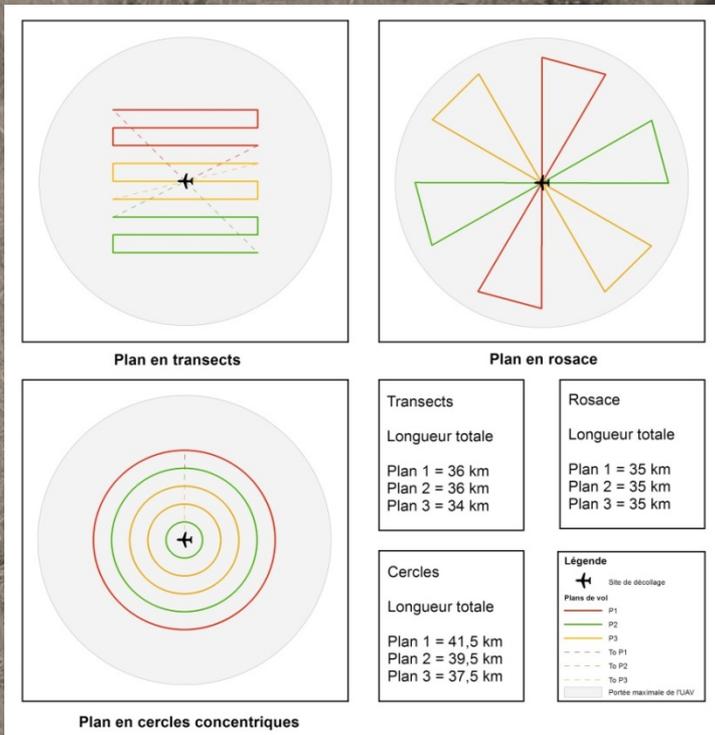
- ✓ easy to use for everyone, from researchers to park managers,
- ✓ light to download,
- ✓ works for any type of flight plan if log files are available,
- ✓ GIS compatible,
- ✓ data are exchangeable

Perspectives:

- Use of .log instead of .tlog to avoid gaps
- Use elevation model for more accurate surfaces
- Project observation points into a shapefile for further analyzes
- Density estimations could be included for several typical models with new statistics

- Georeferencing is still a long process and not very accurate in our case
- Comparison between observers could be easier using transparency to create the global count

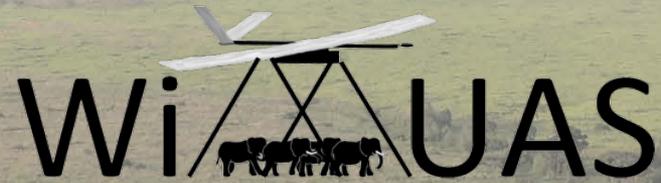
- Interesting inventory results
- Observer effect: trained observers have logically better detection rates
- Big differences between trials: small sampling and scarce wildlife
- Total observation number after comparison is higher: improve estimation



Perspectives:

- Test other types of flight plans with various criteria: sampling, efficiency, ...
- Develop the statistics
- Compare results with other inventory methods
- Do a full size inventory
- Repeat and compare results

Thank you for your attention!



Would like to thank the following institutions and partners for their support:



PARC NATIONAL
GARAMBA
R. D. CONGO



INSTITUT CONGOLAIS
POUR LA CONSERVATION
DE LA NATURE