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REPORT ON THE TRAINING OF CONSERVATIONISTS ON THE USE OF DRONES FOR ECOLOGICAL MONITORING OF THE HABITATS OF GREAT APES IN AFRICA.

SEBITOLI, KABALE NATIONAL PARK, UGANDA

JANUARY 11TH TO 15TH 2023



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List of Acronyms

AfriMAB	African Network of Man and Biosphere Programme National Committees
CAA	Civil Aviation Authority
CBD	Convention on Biological Diversity
COVID-19	Corona Virus Disease of 2019
ERAIFT	Regional Post-Graduate Training School on Integrated Management of Tropical Forests and Lands
GA	Great Apes
MAB	Man and Biosphere Programme
MNHN	Museum National D'histoire Naturelle (National Museum of Natural History)
PA	Protected Area
TF	Tropical Forest
UAVs	Unmanned Aerial Vehicles (Drones)
UNATCOM	Uganda National Commission for UNESCO
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPDF	Uganda Peoples' Defence Forces
UWA	Uganda Wildlife Authority

Acknowledgement

Uganda National Commission for UNESCO as coordinator of this activity wishes to register its appreciation to all those that made the implementation of the project possible. First is the UNESCO Director for Ecological and Earth Sciences and Secretary for Man and Biosphere Programme, Ms. Noeline R. Rakotoarisoa for “dreaming” about the project, initiating it and securing the necessary funding. The dream would not have come to reality without the collaboration with Dr Sabrina Krief of the French National Museum of Natural History and Director of Sebitoli Chimpanzee Project who developed a training Programme. The collaboration with Ms. Rosie Agoi the Secretary General, Uganda National Commission for UNESCO is also acknowledged with gratitude as well. Thanks are due to the two main trainers, pilots Bruno Rova and Plactevoet John for their expertise in handling first time learners in such a way that in three days they were able to acquire the necessary skills. Gratitude to UNDP for the security arrangements by deploying Mr. China Frank Hassan who did a marvelous job. The Uganda People’s Defence forces made the training possible by deploying an officer at the rank of a Lieutenant to coordinate the clearance and flight operations. The Commission will remain ever grateful for the good collaboration with Uganda Wildlife Authority represented in this project by Mr. John Makombo, Director for Conservation, and Mr. Edward Asalu, the Chief Warden, Kibale Conservation Area. Finally, gratitude is extended to all the participants for the interest in the course and active participation.

Executive summary

In the third week of January 2023, a total of seventeen participants were hosted in Sebitoli Centre in Kibale National Park for the purpose of training on the operation of unmanned aerial vehicles (UAVs) commonly called Drones for use in ecological monitoring. The reason behind the project was the concerns about increased reduction of the habitats of the Great Apes due to the degradation of tropical forests which are very important both for climate mitigation and biodiversity conservation. The tropical forests form a very important ecosystem not only for local communities for whom they provide numerous ecosystem services such as food, medicine, woodfire and other resources, but also for wildlife and flora in terms of biodiversity. They are also the home of Great Apes, the chimpanzees, gorillas and orangutans. There is an urgent need in updated data on the number of Great Apes in and outside of the protected areas especially given that the future of humans is tightly linked to the future of Tropical forests and thus of Great Apes. Kibale National Park was selected as the main reference site for the monitoring activities as regards the work already done by Sebitoli Chimpanzee Project.

The project was funded by UNESCO Natural Science Sector – Division of Ecological and Earth Sciences – Man and Biosphere Reserves (MAB) and implemented in collaboration with The French National Museum of Natural History, known in French as the Muséum national d'histoire naturelle, (MNHN) and The Regional Post-Graduate Training School on Integrated Management of Tropical Forests and Lands (**ERAIFT**), a regional school under the auspices of UNESCO.

The training with the overall goal of establishing a harmonized protocol and providing data using drones to monitor the forested habitat of the Great Apes including Chimpanzees and Gorilla of selected biosphere reserves was conducted by two trainers from France and the Team at Sebitoli Centre. The beneficiaries of the training were from Oban Biosphere Reserve, Nigeria, Queen Elizabeth Biosphere Reserve, Uganda, Bwindi National Park, Uganda, Kibale National Park, Uganda, Comoe National Park, Ivory Coast and Tai National Park/OIPR, Ivory Coast.

Within Uganda, the training was made possible through the collaboration of **Uganda** Wildlife Authority, Uganda National Commission for UNESCO, Uganda People's Defence Forces (UPDF), Ministry of Foreign Affairs and the Civil Aviation Authority (CAA) and the United National Security Services. The training was preceeded by a Risk Assessment Report conducted by the team listed. The trainees graduated as Trainers (ToTs) for their areas and thus were awarded certificates. Three Drones were allocated to the Uganda Wildlife Authority distributed one each to the three National Parks that host the great apes namely Kibale, Queen Elizabeth and Bwindi Impenetrable Forest. This report is an account of the proceedings of the training exercise.

REPORT ON THE TRAINING OF CONSERVATIONISTS IN UGANDA ON THE USE OF DRONES FOR ECOLOGICAL MONITORING OF HABITAT OF GREAT APES IN AFRICA

1.0. Introduction

1.1. Background

In September 2019, during the 6th general assembly of AfriMAB in Abidjan, Côte d'Ivoire, the network of African Biosphere reserves home to Great Apes was established. As a flagship project, UNESCO Natural Science Sector – Division of Ecological and Earth Sciences – MAB, The French National Museum of Natural History, known in French as the Muséum national d'histoire naturelle, (MNHN) and The Regional Post-Graduate Training School on Integrated Management of Tropical Forests and Lands (**ERAIFT**), a regional school under the auspices of UNESCO then partnered to implement a long term monitoring protocol of great apes habitats using drones. The first step for an anglophone training of trainers session was initially proposed to run from 10 to 15 January 2022 in Kibale National Park, Uganda. This was however postponed twice due to delayed approval of the Drones by the Ugandan Army (UPDF) and the Civil Aviation Authority (CAA)

The reason behind the project was the concerns about increased reduction of the habitats of the Great Apes due to the degradation of tropical forest which are very important both for climate mitigation and biodiversity conservation. The tropical forests form a very important ecosystem not only for local communities (they provide numerous ecosystem services such as food, medicine, woodfire and other resources for 1.6 billion people (CBD, 2009; GNFT, 2012) but also for wildlife and flora in terms of biodiversity (50% of the world vertebrate species and 60% of the plants are found in TF). They are also the home of Great Apes (GA). Chimpanzees, gorillas and orangutans are charismatic and useful umbrella species that are endangered.

The main threat for the seven species is habitat loss and fragmentation (7 M ha of tropical forest are lost every year, poaching for meat and commercial trade of young individuals (5,000 apes are victim of illegal trade every year) and diseases. Armed conflicts and civil war also threaten the species survival.

There is an urgent need in updated data on the number of Great Apes in and outside of the protected areas in the range states especially given that the future of humans is tightly linked to the future of Tropical forests and thus of Great Apes. This will also help reducing conflict between, human and wildlife through a better knowledge on the sites/situation where they happen. The project targeted the 22 African biosphere reserves or biosphere reserves/World Heritage mixed sites that are habitat to Great Apes. Kibale National Park was selected as the main reference site for the monitoring activities as regards the work already done by Sebitoli Chimpanzee Project.

1.2. Rationale and purpose

1.2.1. Overall Purpose

The overall goal of the project is to establish a harmonized protocol and to provide data using drones to monitor the forested habitat of the Great Apes including Chimpanzees and Gorilla of selected biosphere reserves. It is much easier to survey dangerous or isolated areas with drones, and this reduces human impacts and disturbance of protected areas, thus eliminating any risk of transmitting zoonotic diseases.

1.2.2. Specific Objectives

The project aims:

- a) To provide data which could be systematically collected and compared over seasons on the food resources present inside the forest but also at the edge, e.g. to monitor the crops which are around to better understand the crop-feeding behavior and better plan how to prevent it.
- b) To monitor the illegal activities related to forest degradation (charcoal burning, fire, agriculture inside PA, illegal tree cutting...).
- c) To monitor Great Apes distribution. The Great Apes are shy and elusive and their census require using indirect methods like nest counting. Furthermore, many areas (protected areas but also not protected) home to great apes in Africa are vast and some located in remote areas, making it difficult and costly to monitor ecological integrity and compliance with relevant regulations using conventional means.

In addition to financial constraints which limit field inventory methods and dangers to human lives linked to illegal activities or human-wildlife conflicts, these reasons justify the use of new technologies that can thus serve as a better

means of monitoring the biodiversity, human interference and the risks that are present. They would also ensure more safety and less hardship in the field and collect and analyze more data in a more systematic way.

1.2.3. Challenges

The training had been postponed twice due to the requirements for clearance of the use of the Drones (UAVs) by the Military and Civil Aviation Authority of Uganda.

1.3. The targeted Biosphere Reserves and Countries

For the first session, these included:

- i. Bia Biosphere Reserve, Ghana
- ii. Gombe Masito Ugalla Biosphere Reserve, Tanzania
- iii. Omo Biosphere Reserve, Nigeria
- iv. Okwangwo Biosphere Reserve, Nigeria
- v. Oban Biosphere Reserve, Nigeria
- vi. Queen Elizabeth Biosphere Reserve, Uganda
- vii. Bwindi National Park, Uganda
- viii. Kibale National Park, Uganda
- ix. Volcans Biosphere Reserve, Rwanda

The Participants trained consisted of those involved in **monitoring activities** who serve as trainers once back to their places of work.

Due to various problems, the trainees from Omo BR, Bia BR, Gombe Masito Ugalla BR and Volcans BR did not attend. Participants were also from Democratic Republic of Congo (ERAIFT) and two National Parks in Ivory Coast namely; Comoe National Park and Tai National Park/OIPR that were previously not in the target group above.

2.0. Preparatory Activities

2.1. Meetings

2.1.1. Initial Preparatory Meetings

Planned and unplanned meetings and consultations were held both on phone and physically with various stakeholders between October to December 2022 as follows:

- i) Uganda Wildlife Authority: Consultations with both Executive Director, Director for Conservation and Chief Warden, Kibale NP on several occasions between October to December 2022
- ii) Follow up Correspondences with UPDF and Ministry of Foreign Affairs
- iii) Consultative follow ups with the Head of Protocol, Ministry of Foreign Affairs

The training was finally given a green light by the approval of the use of the Drones on 3rd January 2023 by the Uganda Peoples Defence forces. This opened the way to invite participants to report to the training location beginning from 10th to 15th January 2023. The site of the training was also specified in the letter of approval.

UPDF appointed an Officer at the rank of a Flight Lieutenant to serve in liaison between the Army, the Civil Aviation Authority, UNESCO/UNATCOM, Uganda Wildlife Authority.

One condition, though was that the approval was subject to Civil Aviation Flight Regulations (Annex 1)

2.1.2. Further Meetings after Approval of Training

- i. Meetings with the UPDF Liasion Officer, Lt. Emanuel Smith Ojok
- ii. Meetings with the Trainers from France
- iii. Arrangements for Medical Examination for the Trainer-Pilots
- iv. Meetings involving the UWA Director Conservation, UPDF Liasion Officer and UNATCOM for preparation of the Risk Assessment Report
- v. Follow ups by UWA Chief Warden with the Resident District Commissioner and District Policy Commander of Kabarole District to endorse the Risk Assessment report

- vi. 3 Consultations and follow ups with the Civil Aviation Authority for approval of the operations of the Drones



One of the preparatory meetings involving the two trainers, the UPDF Liaison Officer and the Assistant Secretary General, UNATCOM on 9th January 2023.

2.3. Preparation of Risk Assessment Report of the Area of Operation

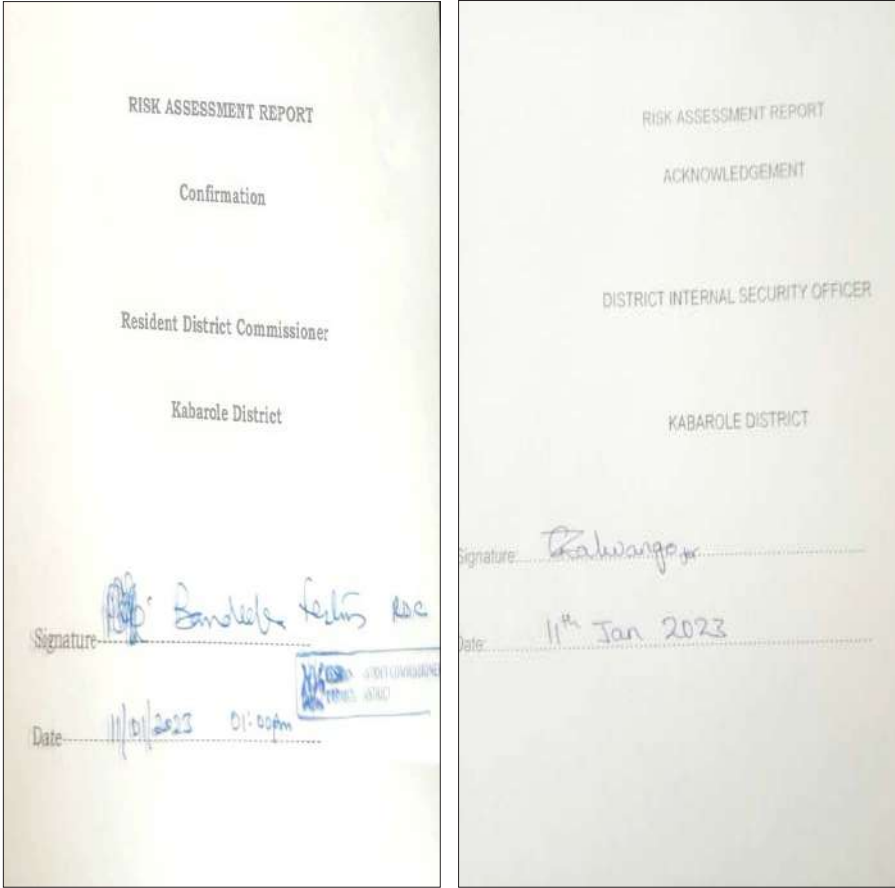
i) Field and Secondary Data

The team from UWA, UNATCOM and UPDF/Liasion engaged in data search from the field and documented records to compile in regard to the requirement from CAA for submission as condition for approval. The data collected was to form the basis for the Risk Assessment Report (RAR). This took about 3 days from 5th to 7th January 2023.

ii) Risk Assessment Report Compilation

A full-day meeting was held at the Uganda Wildlife Authority Offices for the preparation of the detailed Risk Assessment Report on 9th January 2023.

This was shared with the Resident District Commissioner and District Police Commander of Kabarole District for review and approval before submission to the CAA as basis for clearance for the operation of the drones. The report is attached in the Annex 2.



Sample Cover page of the endorsement of the Risk Assessment Report by the Resident District Commissioner, Kabarole.

3.0. Implementation of the Training

3.1. Implementation Strategy

1. Training Tool

a) Training Protocol

A first protocol had been drafted by Dr Sabrina Krief (Sebitoli Chimpanzee Project, Kibale National Park, UNESCO, in collaboration with 4 pilot sites (Dja Biosphere Reserve/Dja Faunal Reserve, Cameroon, Luki Biosphere Reserve, Democratic Republic of the Congo, Niokolo Koba Biosphere Reserve/Niokolo-Koba National Park, Senegal and Badiar Biosphere Reserve, Guinea). This was ready for testing and fine-tuning in Kibale National Park by the Sebitoli Project team at the time of the training.

b) Use of UAVs (Drones)

These are the key instruments on which the training was focused. A total of five unmanned aerial vehicles (UAVs) called Drones and their accessories (batteries, low-noise helices, take off/landing platforms, etc.) that had been purchased as part of this project for all the sites concerned were the materials for the hands-on training to ensure a uniformity in the data gathered to allow for comparison.

2. The Training Venue

The training venue right from the inception was earmarked as Sebitoli Centre which had facilities for a project on the monitoring of the Great Apes and related Research Activities including Post-graduate Training and Research Facilities.



The Sebitoli Centre, Kibale National Park where the training was conducted from 12th to 14th January 2023.

4.0. The Training.

4.1. Official Opening

i) **Welcoming Remarks from the Uganda Wildlife Authority**

The Official welcoming remarks was by the Chief Warden, Kibale Conservation Area, Mr. Edward Asalu on behalf of the Director for Conservation, Mr. John Makombo who sent apologies and delegated the Chief Warden to act on her behalf.

Mr. Asalu very warmly welcomed all the participants, trainers and organisers to Sebitoli Site and the Kibale National Park. He informed the meeting that Kibale conservation area covers Kibale National Park, Toro-Semliki Wildlife Reserve and Semliki National Park.

He informed the participants about the process of getting security clearance for the training that involved the District Security Officials namely the District Intelligence Security Officer (DISO), the District Resident Commissioner and the District Police Commander. He was happy to report that all were well informed and happy about the training and had formally endorsed the Risk Assessment Report as demonstration of their support for the project.

ii) **Remarks from the Uganda National Commission for UNESCO**

The Secretary General, Ms. Rosie Agoi, greeted all the participant and welcomed all to the very important training organized to build capacity of Conservationists in the use of Unmanned Aerial Vehicles (Drones) to not only improve the monitoring, observation and data collection on Great Apes but also for monitoring of the health of ecosystems they depend on. She described it as an important project under a special initiative called: “Using drones to protect Great Apes in Africa” saying that it was an initiative that envisions developing the next generation biodiversity and ecosystems health managers and specialists in remote monitoring and effective management of conservation sites using technology that is consistent with the current fourth industrial revolution.

She informed all the Participants about the history of UNESCO, its mandate, functions, fields of competence and Programmes informing the participants further that the training was under the Man and Biosphere Programme of the

Natural sciences Sector which in the current biennium was focused on a number of areas including two that were relevant to the training namely:

- Building institutional capacities in science and engineering;
- Fostering international science collaboration for earth systems, biodiversity, and disaster risk reduction;

She pointed out that the training was part of the commemoration of the [50th anniversary of the Man and the Biosphere \(MAB\) Programme](#) that was celebrated in 2021.

The Secretary General also reminded the participants about the Uganda National Commission for UNESCO (UNATCOM) which was established in 1963 as the liaison body between UNESCO and Uganda and informed them that the coordination of the implementation of the training was by UNATCOM on behalf of UNESCO. She outlined UNATCOM's core functions as: Consultation, Liaison, Information, Programme formulation, implementation, monitoring and evaluation. She informed the participants about the Strategic Plan of UNATCOM hinged on UNESCO's Biennial Plan with the Natural Science Sector Strategic Objective being: ***To Support the strengthening of national capacity in Science, Technology, Engineering and Innovation (STEI) policies and management of natural resources and ecosystems for sustainable development.*** She said that the training was part of the fulfilment of the above strategic objective as it was to build the capacities of relevant national stakeholders on the use and application of technology in monitoring and response focused on the Great Apes which are threatened with extinction, because of the fragmentation or loss of their habitat, poaching and trade and even disease transmission, an extinction that would trigger the disappearance of other species that play a fundamental role in the ecological balance of tropical forests and ecosystems, and therefore in adaptation to climate change.

The Secretary General thanked UNESCO for this initiative and the French National Museum of Natural History that had joined hands with UNESCO in this project and the fact that this project is to support Great Ape conservation efforts in Africa, in 23 UNESCO designated sites using drones to perform remote monitoring and surveillance of habitats and species. She called upon UNESCO for support to increase the number of Biosphere Reserves in Uganda, echoing

the suitability of Kibale Forest as a candidate for designation as a Biosphere Reserve,

She also thanked all participants together with the UNDP Security representative, Mr. China and the UPDF representative, Mr. Emanuel Smith Ojok for being present at the training, informing the trainees that they were being trained as Trainers for their respective institutions and countries on the use of this technology. She concluded by urging all to pay very close attention, participate actively in the practical exercises of the training and make the necessary feedback including recommendations for taking this project forward.

iii) **Remarks from the Director, Ecological and Earth Sciences and Man and Biosphere Programme Secretariat.**

Ms. Noeline Rakatoarisoa, the Ag, Director Ecological and Earth Sciences and Global Secretary to the Man and Biosphere Programme also thanked all the participants for responding to the call for the training. She particularly thanked Dr Sabrina, the person incharge of Sebitolli Site responsible for the initiation of the idea based on her long experience of working with the Great Apes, thanking her for being a good scientist and good communicator.

She informed the participants that the training was a dream of two years ago conceived to help build the capacity of the managers in-charge of the conservation areas. She informed the participants that the programme had a lifespan of ten years and what was important was that those leaving their posts in conservation needed to ensure that the knowledge gained is transferred to successors who come later. She supported the proposal of the UNATCOM Secretary General to have Kibale National Forest as a Biosphere Reserve.

She urged all to take the training as a very important opportunity to improve conservation and declared the training officially open.



Opening Ceremony: (Front left to right) Edward (UWA), Rosie (UNATCOM), Noeline (UNESCO), Sabrina (Host) and Staff of Sebitoli.



Sec. General, Rosie Agoi (2nd Left) being welcomed by Noeline (middle) to Make Remarks



Sec. General, Rosie Agoi (2nd left) speaking at the welcoming Ceremony for the Training



Sections of the Participants listening to the Speeches at the Opening Ceremony to the Training

4.2. The Training sessions

4.2.1. Introductory Session

Dr Sabrina gave opening remarks at the start of the first session. She gave a background information about the Sebitoli Project and expressed happiness that the year 2022 was a special year as the area witnessed no snares, no injuries of Chimpanzees seen in patrols or on the road and no COVID-19 cases. Even Ebola was not reported. She informed the participants that Kibale is considered the “Headquarters” of the Great Apes or simply the Primate Capital because it supports many of the Great Apes. She said that the training sessions were planned as part of the project and elaborated that the Programme for protection of the Great Apes started in Uganda with young children being exposed to the knowledge of the wildlife, making them explain about the Chimpanzees and Gorillas. Dr. Sabrina explained further that Ugandan and Gabonese Children were nominated to travel to France to understand the importance of saving the Chimpanzees. She then presented the programme for the training to the participants as below

PROGRAMME FOR THE TRAINING

Day and Date of the Week	Morning Activities	Afternoon Activities
Thursday 12 th January 2023	Opening and welcoming Ceremony	Basic training: take off, landing
	Introduction of the program and the objectives	
	Sebitoli Chimp Project : Chimp behavior and threats to chimp survival : why do we need to save GA	
	The drone, presentation of the engine, basic regulation, safety	
FRIDAY, 13 th January 2023	Theory on Drone Operations: Planning and Programming of Flights and data collection on a 200 x 200 m Plot.	Practicals
SATURDAY, 14 th January 2023	Theory on Data Analysis	Practicals: Examination and Award of Diploma.

- a) The theoretical training sessions covered explanation of the protocol, imaging software, interpretation of data.
- b) The Practical training in the field covered manipulation of the UAVs (Drones), implementation of the protocol.



Dr. Sabrina, the host venue Manager and Trainer, giving introductory Remarks



Participants in Sebitoli at the Launch of the Drones Training on Day one, Thursday 12th January 2023. On the left above and right: UNESCO Director N. Rakotoarioa launching the Drones Training Seson on 12th Jan. 2023.

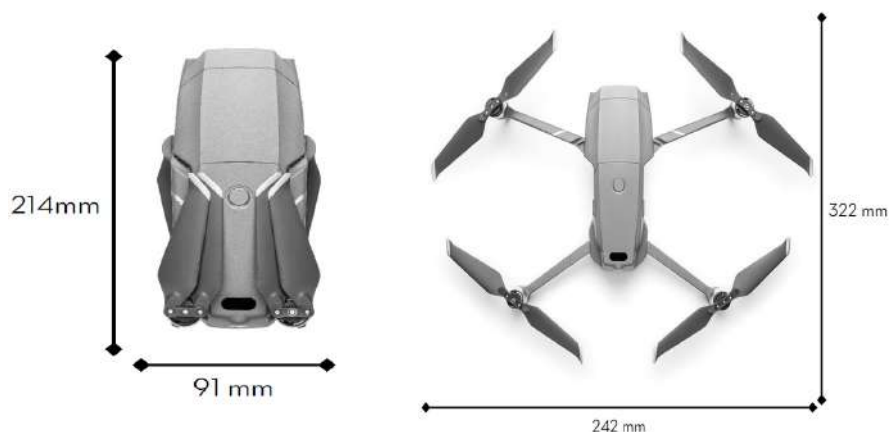
4.2.2. Introduction Lesson about the Drone and its Parts

The introductory lecture showed the picture of the Drone and parts. Participants were taken through the unassembled parts consisting of the following:

- Aircraft
- Remote Controller
- Battery
- Propellers
- Batteries
- Protection of camera
- USB adapter
- Spare control sticks
- Power cable
- Communication cable
- Charger
- RC cable



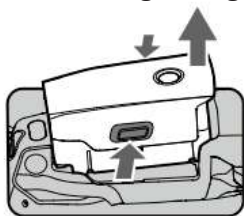
4.2.3. Preparing the Aircraft



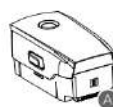
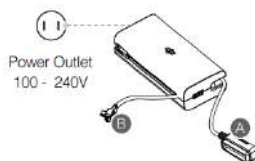
Remote Controller



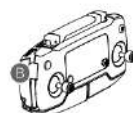
4.2.4. Intelligent Flight Battery



Remove the Intelligent Flight Battery



Charging Time:
~1 hour 30 minutes



Charging Time:
~2 hour 15 minutes

Battery Protection

Battery Protection Mechanisms					
LED 1	LED 2	LED 3	LED 4	Blinking Pattern	Battery Protection Item
				LED 2 blinks twice per second	Overcurrent detected
				LED 2 blinks three times per second	Short circuit detected
				LED 3 blinks twice per second	Overcharge detected
				LED 3 blinks three times per second	Over-voltage charger detected
				LED 4 blinks twice per second	Charging temperature is too low
				LED 4 blinks three times per second	Charging temperature is too high

4.2.5. Flight Modes

3 MODES:

- **P-mode (Positioning) :**

when GPS signal is strong :

GPS + Vision Systems = Locate / Stabilize / Detect and Avoid obstacles

Max flight speed = 50 km/h

SEMI-AUTOMATIC

when GPS signal is weak :

Automatically changes to ATTI mode (Attitude)

GPS weak or No Vision Systems or interference compass = No locate

FULL MANUAL

- **S-mode (Sport) :**

Only GPS = Locate / Stabilize

No Vision Systems = No Detect and Avoid obstacles

Max flight speed = 72 km/h

VERY SPEED

- **T-mode (Tripod) :**

GPS + Vision Systems = Locate / Stabilize / Detect and Avoid obstacles

Max flight speed = 3,6 km/h VERY SLOW

Fly Safe





Fly in Open
Areas

+



Strong GPS
Signal

+

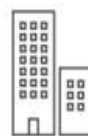


Maintain Line of
Sight

+



Fly Below 400 Feet
(120 m)

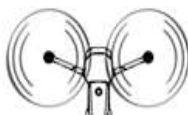


Avoid flying over or near obstacles, crowds, high voltage power lines, trees or bodies of water.

DO NOT fly near strong electromagnetic sources such as power lines and base stations as it may affect the onboard compass.



DO NOT use the aircraft in adverse weather conditions such as rain, snow, fog and wind speeds exceeding 10 m/s or 22 mph.



No Fly Zone

Stay away from the rotating propellers
and motors.

4.2.6. Basic Pre-Flight Check

It is always important to first check the weather conditions of the day before flying the drone. Below is an illustration of the weather chart



**BASIC
PRE-FLIGHT
CHECK**

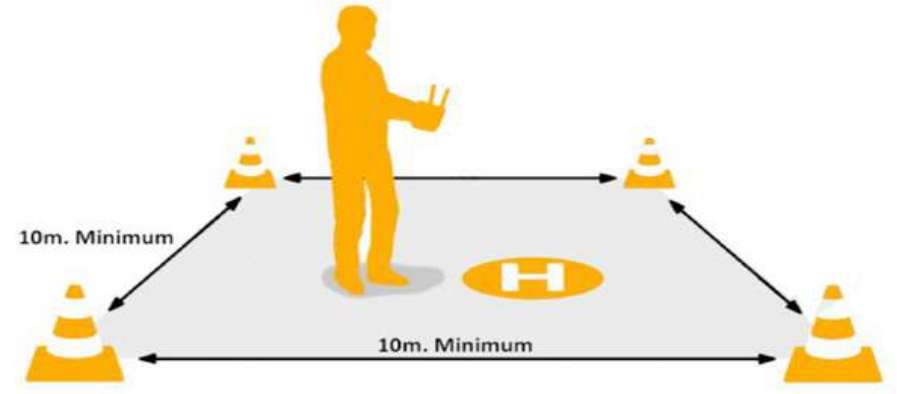


① WEATHER	CHECK THAT IT'S NOT GOING TO RAIN OR BE TOO WINDY
② INTERFERENCE	MAKE SURE THERE ARE NO RADIO TOWERS, ELECTRICAL, WIRES ETC
③ OBSTACLES	FLY IN AN OPEN SPACE AWAY FROM OBSTACLES
④ PEOPLE	AVOID HAVING PEOPLE IN YOUR FLIGHT AREA
⑤ NO FLY ZONE	CHECK IF THE AREA YOU PLAN TO FLY IN IS A NO FLY ZONE
⑥ TEMPERATURE	OPERATING TEMPERATURE RANGE 0° TO 40° C
⑦ TAKE OFF	MAKE SURE YOUR DRONE IS ON A LEVEL SURFACE FOR TAKE OFF

4.2.7. Mavic Pre-Flight Checklist

There are two important steps to pre-flight preparation:




- Create your safe zone for take-off and landing
- Don't fly directly






☐ EQUIPMENT

- ☐ Drone
- ☐ SD cards
- ☐ Batteries (charged)
- ☐ Remote control (RC/charged)
- ☐ Mobile device
- ☐ Appropriate wire to link RC and mobile device

☐ MISSION PLANNING

- ☐ Area is clear of obstructions (powerlines, trees, steep terrain changes, crowds, etc.)
- ☐ Check airspace and obtain LAANC authorization
- ☐ Power on RC
- ☐ Power on Drone
- ☐ Connect RC to mobile
- ☐ If no LTE, connect hotspot
- ☐ Open **Pix4Dcapture app** 
- ☐ Tap  **SETTINGS** button
- ☐ Ensure *Units* are set to **Feet**
- ☐ Select 
- ☐ Establish mission
- ☐ Tap the **center of the screen** for new mission
- ☐ Tap  to adjust mission's shape
- ☐ Tap  to add new nodes
- ☐ Drag a node near a partner node to delete it
- ☐ Set *Flight altitude*: **10x height of highest object** or highest legal flight height, whichever is smaller
- ☐ **Minimum overlap of 80%** (Frontal and side)
- ☐ Tap  button
- ☐ *Angle of camera*: **90°**
- ☐ *Drone speed*: **Normal**






☐ FLIGHT

- ☐ Tap  **START** button
- ☐ Tap  **Next >** button
- ☐ All green checkmarks populate the *flight checklist*
- ☐ Tap  **START** button
- ☐ Confirm drone is flying mission autonomously
- ☐ Maintain visual line of sight
- ☐ Home position clear of obstructions before landing
- ☐ Following mission, allow drone to return to home position, descend, and land autonomously
- ☐ Power off drone, RC, and remove mobile link

POST FLIGHT

- Create a new folder on a computer
- Remove SD card from drone
- Connect SD card to computer
- Copy images to the created folder on the computer

MAP PROCESSING

- Open **Pix4Dreact** 
- Click 
- Set units to **imperial**
- Click 
- Click 
- Navigate to folder where the images were copied
- Hold the **Ctrl** button down and Press the **A** button on the keyboard to select the images
- Click the **open** button
- Click 

POST PROCESSING



Hold down the **left-click** of mouse to pan around

Scroll the **mouse wheel** back and forth to zoom in and out

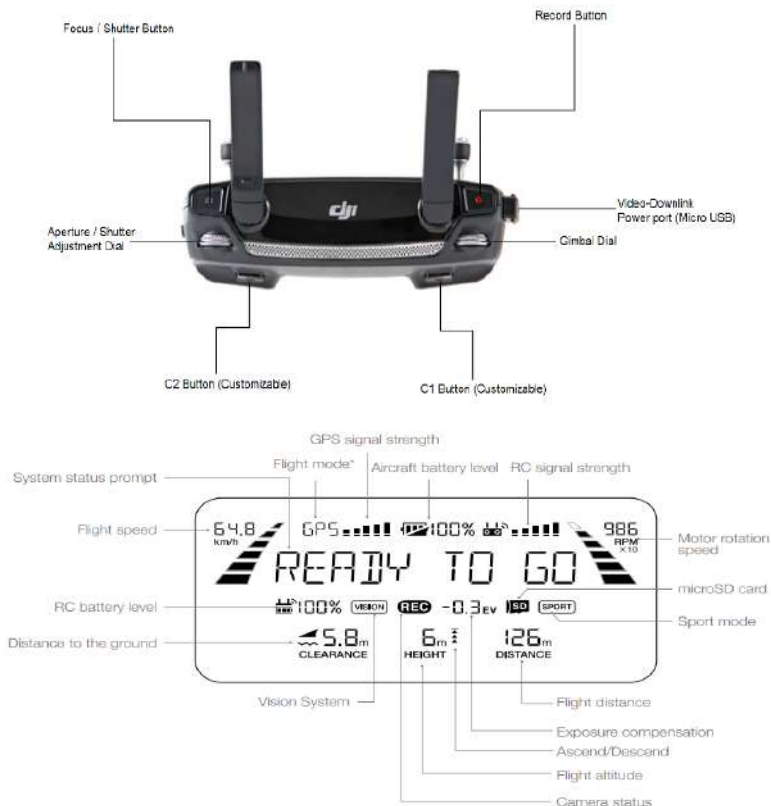
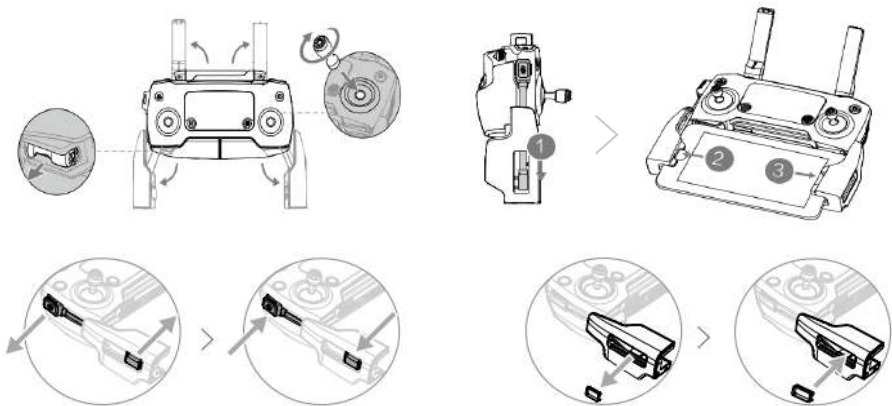
The following tools are available on the left side of screen:

-  **Move** (arrow button): Enables navigation throughout the map
-  **GPS** (crosshair button): Displays a GPS position on the map when clicked
-  **Measure** (ruler button): Enables relative measurements of lines or areas
-  **Mark** (location button): Enables placement of discrete points, lines, or polygons on the map

EXPORT

- Click 
- For a orthomosaic, select **GeoTIFF**
- For a PDF report, select **PDF**
- For a screenshot, select **JPG**
- Click 
- Navigate to the project folder
- Click the **Select Folder** button to save the file(s)
- Open a *File Explorer* window
- Navigate to the project folder
- Locate the orthomosaic, report, etc.

4.2.8. Preparing the RC



4.2.9. Flight Planning

 SETTINGS



LOG OUT 

Plan new mission



POLYGON
For 2D maps



GRID
For 2D maps



DOUBLE GRID
For 3D models



CIRCULAR
For single 3D model



FREE FLIGHT
Advanced users

PROJECT LIST

TUTORIAL/HELP

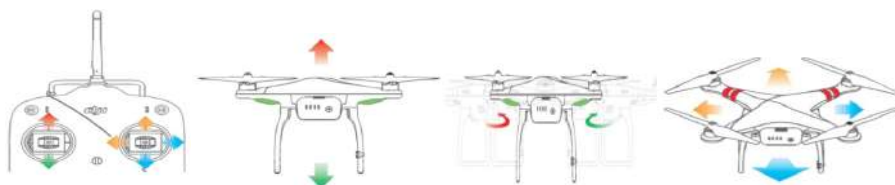
4.2.10. Flight Characteristics / Specifications



Aircraft	
Takeoff Weight	907 g (Mavic 2 Pro); 905 g (Mavic 2 Zoom)
Dimensions	Folded: 214×91×84 mm (length×width×height) Unfolded: 322×242×84 mm (length×width×height)
Diagonal Distance	354 mm
Max Ascent Speed	5 m/s (S-mode), 4 m/s (P-mode)
Max Descent Speed	3 m/s (S-mode), 3 m/s (P-mode)

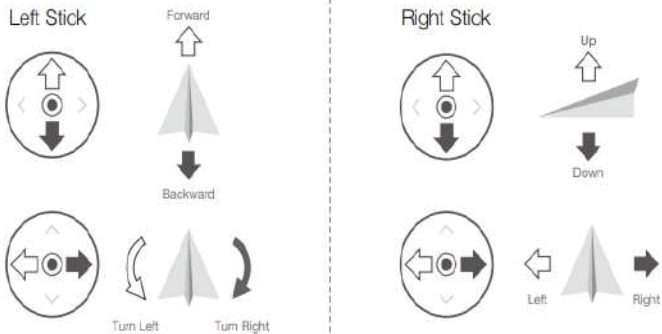
Max Speed	72 km/h (S-mode) (near sea level, no wind)
Max Service Ceiling Above Sea Level	6000 m
Max Flight Time	31 minutes (at a consistent 25 kph, no wind)
Max Hovering Time	29 minutes (no wind)
Overall Flight Time	25 minutes (In normal flight, 15% remaining battery level)
Max Flight Distance	18 km (at a consistent 50 kph, no wind)
Max Wind Speed Resistance	29–38 kph
Max Tilt Angle	35° (S-mode, with remote controller), 25° (P-mode)
Max Angular Velocity	200°/s
Operating Temperature Range	-10°C - 40°C
GNSS	GPS+GLONASS
Hovering Accuracy Range	Vertical: ±0.1 m (when vision positioning is active) ±0.5 m (with GPS positioning) Horizontal: ±0.3 m (when vision positioning is active) ±1.5 m (with GPS positioning)
Operating Frequency	2.400 - 2.4835 GHz; 5.725 - 5.850 GHz
Transmission Power (EIRP)	2.4 GHz FCC: ≤26 dBm; CE: ≤20 dBm; SRRC: ≤20 dBm; MIC: ≤20 dBm 5.8 GHz FCC: ≤26 dBm; CE: ≤14 dBm; SRRC: ≤26 dBm
Internal Storage	8 GB

4.2.11. Controlling the Aircraft

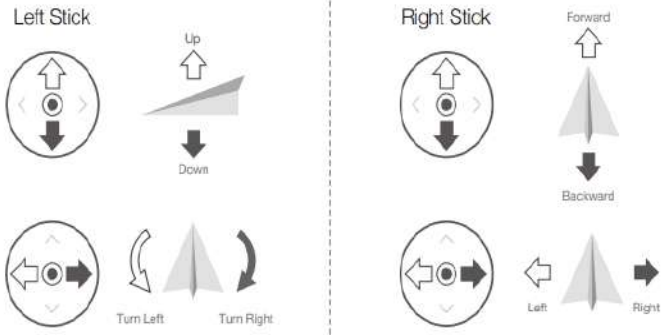


Operation Knob movement directions illustrated above and shown by the Arrows below.

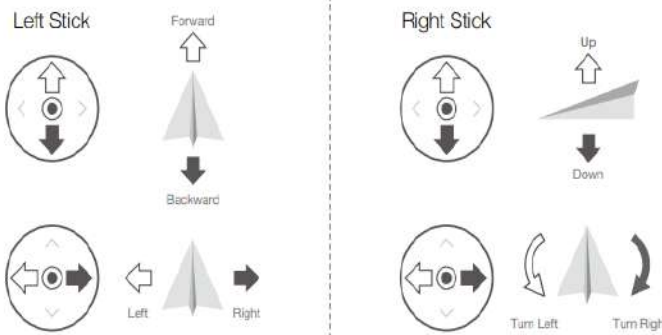
Mode 1



Mode 2



Mode 3



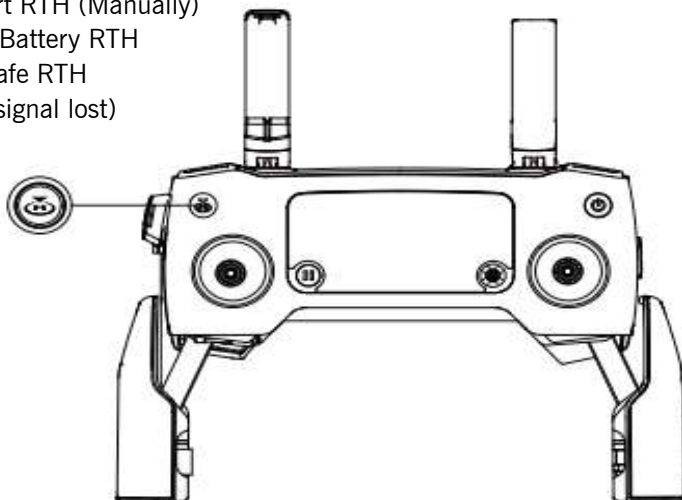
4.2.12. RTH (Return to Home)

This is an automatic setting for the Drone to return home if it loses signal, low battery or gets lost from monitoring or in a place where it cannot get way through.



3 TYPES of situations for RTH:

- Smart RTH (Manually)
- Low Battery RTH
- Failsafe RTH (RC signal lost)



4.2.13. Drones and Wildlife

Possible wildlife reactions: The following were mentioned:

1. **Escape:** This may result into the following:
Abandonment of eggs by birds leading to breeding failures.
Stress, discourages
2. **Attack:** Aggressive birds may attack the drone as it flies leading to damage to the drone and death of the bird.



Solution to bird attacks:

The advice to remote pilots is to limit disturbance of wildlife in the natural environment:

1. Ask the managers of the Reserve if there are any flight restrictions
2. Take off and land vertically, directly below the pilot
3. Avoid flying over animals on the ground, do not chase birds and mammals
4. Do not fly within 50 meters of rock bars, scree, forest areas (edge & canopy), snowfields, or any other environment that can serve as shelter, resting place or nesting sites for a species
5. Don't fly low to the ground
6. Limit speed, sudden acceleration movements of the drone
7. Land the drone immediately if raptors are present

5.0. Partnership

In this training, UNESCO partnered with the French National Museum of Natural History to support the Great Ape conservation efforts in Africa, by improving observation and data collection on Great Apes but also on the health of ecosystems they depend on. Initially, UNESCO developed a research protocol with Dr Sabrina Krief, expert primatologist of the Museum, and four UNESCO biosphere reserves:

- Dja Biosphere Reserve, Cameroon,
- Luki Biosphere Reserve, Democratic Republic of Congo,
- Niokolo Koba Biosphere Reserve, Senegal, and
- Badiar Biosphere Reserve, Guinea.

The protocol proposes to use drones to collect various data, such as the feeding areas of the Great Apes, their nests or other points of interest for these species, while also collecting information on the interfaces between their habitats and areas of human activities, areas sensitive to natural hazards or even illegal activities (timber extraction, illegal land use, poaching, etc.). A pilot study was successfully carried out in July-August 2021 by the Sebitoli Chimpanzee Project implemented by Dr Krief in Kibale National Park, Uganda.

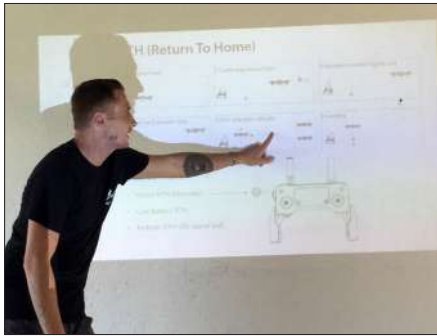
6.0. Results of the Training-Conclusion

The expected outcomes were met. The capacity of targeted site managers and other participants was built and strengthened in the use of drones as new technology for site monitoring, data collection and management.

At the end of the training, all participants were awarded certificates. Three Drones were ceremonially handed over to the three Conservations areas of Kibale National Park, Bwindi Impenetrable Forest World Heritage Site and Queen Elizabeth Biosphere Reserve.

The concluding sessions are pictorially captured in the photo gallery

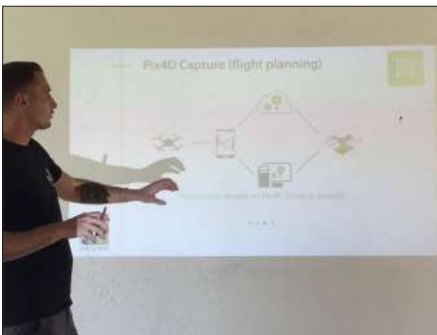
PHOTO GALLERY



Trainer introducing the Basics of Drone Operations starting with the Pre-flight Checks.



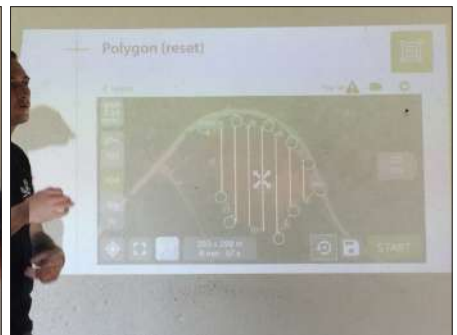
Trainer elaborating on the Drone Operations and Wildlife.



Trainer introducing the various software in use in Drone Operations



Drone Flight Planning



Flight Planning



Practicals on Drone Manipulations and Operations for Remote Pilots. A drone set for take-off operation



Participants keeping watch as a Drone is flown high up in the Air



Trainers making presentations during the training



Award of Certificates to Participants. In the Picture is a participant from Nigeria.



Three Drones being assembled for handover to the three Conservation Areas in Uganda,



Ceremony for handing over of the Drones to Kibale National Conservation Area.



Ass. Secretary General, UNATCOM, Dr Mundrugo-Ogo Lali Officiating at the Hand-over of Drones to the 3 Conservation Areas of Uganda.



The Uganda People's Defence Forces Airforce Liasion Officer, Lt. Smith addressing the participants at the closure of the Training.

ANNEXES

ANNEX 1: Approval of Training

a) Approval Letter from the UPDF

UGANDA PEOPLES' DEFENCE FORCES

Office of the Chief of Defence Forces
MoD - Headquarters
P.O. Box 3798
Mbeya - UGANDA
Tel: + 256-41-4 565136/7/8
Fax: + 256-41-4 220324
E-mail: cdff@updf.go.ug

Ref: UPDF/CDF/831/C-2

03 January, 2023

Ambassador/Head of Mission
Embassy of the Republic of Uganda Paris
121 Avenue de Malakoff
75116, Paris
France
Tel: +33 1 88 24 52 19
+33 1 88 24 52 18

Attn: **HE. Doreen Ruth Amule**

PERMISSION FOR RENEWAL OF UGANDA WILDLIFE AUTHORITY TO USE DRONES FOR WILDLIFE MONITORING AND PROTECTED AREA MANAGEMENT


The Tripartite Committee has cleared the Extension of the working permit for the use of drones by UWA.


However, you should take note of the following:

- Only cover areas stipulated in your request, excluding sensitive Government and Military Installation.
- Be subjected to Civil Aviation Flight regulations and Standards.
- Intelligence personnel from nearby Unit to be present during drone operations.
- The clearance is valid for a period of (06) six months with effect from 10/01/2023 to 10/07/2023 renewable after every six (06) months.

Should the above guidelines be infringed upon, Uganda Wildlife Authority will be held accountable.


Sincerely,


CHRISTOPHER KYANKU psc
Colonel
Military Assistant to the CDF

 **MILITARY ASSISTANT-CDF
MINISTRY OF DEFENCE
Uganda People's Defence
Forces**

Copy to: Commander Air Force, UPDF.
Chief of Military Intelligence – UPDF.
Commander Special Force Command, UPDF.
Director Safety, Security & Economic Regulation, CAA

b) Approval Letter from Civil Aviation Authority

 **UGANDA CIVIL AVIATION AUTHORITY**

Our Ref: DSSER/UWA-UNESCO/UAS
Your Ref: 14th/01/2023

Head Office Building
Entebbe International Airport
P.O. Box 5536, Kampala, Uganda

The Accountable Manager
Uganda Wildlife Authority
C/O Uganda National Commission (UNESCO)
King George VI Way
2nd Floor, Embassy House
P.O. Box 4962 Kampala

UNMANNED AIRCRAFT SYSTEM OPERATIONS PERMIT FOR UGANDA WILDLIFE AUTHORITY & UGANDA NATIONAL COMMISSION (UNESCO)


This Permit authorizes Uganda Wildlife Authority & Uganda National Commission (UNESCO) the "Operator" to operate Unmanned Aircraft (Drones) for the purposes of Monitoring great apes habitats in Kabaro'e, Kibale, Sebei Research station
The Permit is valid for the remaining period on the security clearance up to 10th /07/2023 renewable on application to the authority.

Please note:

1. The authorization is limited to Uganda Airspace, Visual Line of Sight (VLOS) Operations Only.
2. The registered information attached is part of this Permit.
3. Only two pilots Mr. John Platevoet & Mr. Bruno Roux have been registered under this authorization.
4. The Pilot's means of Communication during operations shall be through Cellphone No +256392830982, +256756448209, 0772540415
5. It is the responsibility of the authorized operator to ensure that:
 - The flight operations are carried out in accordance with the Unmanned Aircraft User Manual of Procedures.
 - The Resident District Commissioner (RDC) and other State Security Agencies in the areas of operation are notified and permission granted before and after commencement of UA flight operations.
6. The pilot is required to:
 - Know and avoid controlled airspace areas in Uganda.
 - Ensure that the operations do not violate State security locations, territorial borders of neighboring countries and the public privacy rights. Please take note of the Prohibited, Restricted and Danger Areas indicated in the attached map.

Notify and maintain contact with the Air Traffic Control (ATC) center, local ATC or local aerodrome supervisor of the nearest aerodrome in the area of operation. Report specific location and time of the flight operations for clearance and assurance that there are no other aircraft flight activities in the area. In this regard, contact the office of the CAA Officer in Charge of Air Navigation Services. Telephone No. +256 0312 352531, +256 0708786132, Officer in charge ATM Operations +256 312 352556, +256 772 330486, Entebbe ACC +256 312 352541, +256 414 353247, +256 0312000890

The UA registered under this Permit is listed in the attached Unmanned Aircraft System Registered Information.


Oringi Bruno
DIRECTOR SAFETY, SECURITY AND ECONOMIC REGULATIONS.

Head Office Tel: +256-41-4352000, +256-31-2352000,
+256-20-0452000
Airport Tel : +256-41-4353000, +256-31-2353000
Toll free : 0800-388700
E-mail : aviation@caa.co.ug, AFS:HUYENYAYX
Website: www.caa.gov.ug

For Aircraft Flight Clearance requests
Tel: +256-41-4321173, +256-41- 4321016
Email : aircraftpermits@caa.co.ug
Fax No : +256- 41-4321452

cc Chief of Defence Forces
Uganda Peoples Defence Forces
Mod – Headquarters
P. O. Box 3798
Mbuya – Uganda

Commander Air Forces
Uganda Peoples Defence Forces
Air Force Headquarters
Plot 7 Combe Close
P.O. Box 105
Entebbe – Uganda

Commander Special Forces Command
Uganda Peoples Defence Forces
P. O. Box 11
Entebbe – Uganda

Director Air Navigation Services
Civil Aviation Authority Uganda
Entebbe International Airport



Uganda

Uganda National Commission Unmanned Aircraft System

Registered Information.

UNESCO is the accountable registered Operator authorized to use Unmanned Aircraft (UA) in compliance with this Authorisation Permit and the registered information listed below. The Unmanned Aircraft (UA) is identified by its Model Designation and Serial Number.

Registered Information:

1. Applicant - Uganda National Commission (UNESCO)
2. Project Owner - Raondry Rakotoarisoa Noeline
3. Project Duration - 6 Months up to 10/07/2023
4. Project Name - Monitoring of great apes & habitats
5. Survey Areas - Kabarole District, Kibale, Sebtoi Research Station
6. Aerial Survey Justification - Application of drone technology in monitoring great apes & their habitats including a training session.
7. Ministry Letter of No-objection- Granted by Ministry of Tourism, Wildlife & Antiquities Letters. Dated: 14th July, 2021
8. Office of CDF Clearance - Granted: UPDF Letter ref. UPDF/CDF/831/C-2
Dated: January 03, 2023
9. Insurance - SMA Insurance.
10. Pilot - Name: Mr. John Platevoet
Drone Pilot Training
Class III Medical Certificate

Mr. Bruno Roux
Drone Pilot Training
Class III Medical Certificate
11. Tel. Number +256392830982, 0772540415, 0704698238

12. RPA TECHNICAL SPECIFICATIONS

- Five (5) Mavic 2 pro drones
- Serial numbers 20002690, 20002691, 20002692, 20002693, 20002694
- Weight 907 g
- Max Speed 44.7 mph (72 kph) in Sport mode without wind
- Max Service Ceiling Above limited to 120 m AGL
- Operating Temperature 14° to 104° F (-10° to 40° C)
- Operating Frequency 2.4-2.4835 GHz; 5.725-5.850 GHz

Gimbal


- Controllable Range Pitch: -90° to +30°
- Camera
 - Sensor 1" CMOS; Effective pixels: 20M
 - Lens FOV: approx. 77°
 - 35 mm format equivalent: 28 mm
 - Aperture: f/2.8-f/11
 - Focus: 1 m to ∞
- ISO Range Video: 100-6400
- Supported SD Cards microSD
- Max Capacity: 128 GB (UHS-I Speed Grade 3 rating required)

Remote Controller

- Operating Frequency 2.4-2.4835 GHz; 5.725-5.850 GHz
- Max Transmission Distance (Unobstructed and free of interference) FCC: 5 mi (8 km); CE/MIC: 3.1 mi (5 km); SRRC: 3.1 mi (5 km)
- Operating Temperature 32° to 104° F (0° to 40° C)
- Battery 3950mAh @ 3.83V
- Transmitter Power(EIRP) 2.4 GHz
- Operating Voltage 1800mA @ 3.83V (when charging the mobile device)
- Charger Voltage 17.6±0.1 V Rated Power 60 W

Intelligent Flight Battery

- Capacity 3850 mAh
- Voltage 17.6 V (max) 15.4 V (typical)
- Battery Type LiPo 4S
- Energy 59.29 Wh
- Net Weight Approx. 297 g
- Charging Temperature
- Range 41° to 104° F (5° to 40° C)
- Max Charging Power 80 W


Oringi Bruno

DIRECTOR SAFETY, SECURITY & ECONOMIC REGULATIONS

ANNEX 2: Risk Assessment Report



UGANDA WILDLIFE AUTHORITY OFFICE OF THE EXECUTIVE DIRECTOR

PLOT 7 KIRA ROAD KAMWOKYA
P. O. Box 3530, Kampala, Uganda

Our Ref: EDO/ 35/ 07

January 10, 2023

Ang. Ronny Barongo,
Director Safety Security and Economic Regulation,
Uganda Civil Aviation Authority (UCAA),
P.O Box, 5536,
KAMPALA

UWA - UNESCO PARTNERSHIP IN MICRO-UAS TRAINING AT SEBITOLI, KIBALE NATIONAL PARK, UGANDA - RISK ASSESSMENT REPORT

Greetings from Uganda Wildlife Authority (UWA) and Happy New Year to you and the entire staff of the Uganda Civil Aviation Authority (UCAA).

Background

UWA, in collaboration with the Uganda National Commission for UNESCO (UNATCOM), intends to conduct a micro-drone training for experts in conservation at **Sebitoli Station** in Kibale National Park in Kabarole District. The training will be carried out 4 times every year, starting this January 2023, with each course lasting four (4) working days. The training is aimed at equipping the conservationists with skills to monitor biodiversity and habitat conditions. The training is already approved by UPDF as per the **attached letter**.

Site Risk Assessment

After a careful assessment of the Park, Sebitoli station met all UPDF, UNATCOM and UWA approval requirements as a suitable location for micro-drone training. The site has also been reviewed by the UNESCO drone training experts and **Annex B** hereto attached is a risk assessment report for this training.

This information may be used for approval of operations and also to generate NOTAM when required.

Course Details

The drones involved are within the micro class (1kg each) and will be limited to a maximum of 600m altitude above ground level as well as being geofenced within Sebitoli area in Kibale National Park. The drones will be flown within Sebitoli area as shown in Figure 1 under Annex B.

UWA and UNATCOM training team will always have two-way communication during practical flight training with the Air Traffic Control (ATC) through the UPDF Liaison Officer physically present on site to support each of the training sessions. UCAA will be notified in at least 2days prior to the commencement of the practical training sessions. The course will be attended by 12 students flying five (5) drones.




The Course will be conducted by suitably qualified and experienced UNESCO instructors and no flight will take place without their presence.

A joint team of UPDF, UCAA, UWA, UNATCOM and the UNESCO trainers conducted a joint site assessment of Sebitoli on 10th January 2023 to evaluate the safety elements of the area and have generated a risk assessment report which is hereto attached.

The purpose of this letter is to submit to you the Risk Assessment Report and to request you to clear the use of the specified drones during the planned training.

Conserving for Generations

Yours sincerely,


John Makombo
FOR EXECUTIVE DIRECTOR
OFFICE OF THE DIRECTOR
AUTHORITY

- c.c. Commander Air Force, UPDF
Chief of Military Intelligence, UPDF
Commander Special Force, UPDF
Secretary General, UNATCOM
Director Conservation, UWA
Chief Warden, Kibale Conservation Area, UWA

Annex B – Risk Assessment

I. OPERATION RELEVANT INFORMATION

A. Organization overview

- **Safety:** The management of safety is of paramount importance during planning and execution of the activities of the course. The Uganda Wildlife Authority (UWA) team, in conjunction with the Uganda National Commission for UNESCO Office (UNATCOM), has developed this aeronautical safety analysis, based on the SORA JARUS methodology and the International Civil Aviation Organization (ICAO) Document 9859 Safety Management Manual.

UWA training team will manage and implement the safety measures stated in this analysis, during all UAS activities of the training. The senior safety instructor will be in charge of the supervision and control of the safety measures. No flights will take place without the approval of the senior safety instructor, Entebbe ATC and UPDF. Furthermore, approval shall be sought at the commencement of each exercise and information on completion of each exercise shall be communicated to Entebbe Control Tower.

UWA drone experts will conduct a site survey at Sebitoli within Kibale National Park (KNP) in January 2023 in order to evaluate, on-site, any other potential risk or situation that may be included in this safety analysis report. An Emergency Response Plan (ERP) will be developed after this survey.

- **Maintenance:** the preventive and corrective maintenance of the UAS are performed according to the manufacturer recommendations. The UAS used for the course activities will have their scheduled maintenance up to date. Before the beginning of the training UWA training team will check each UAS.

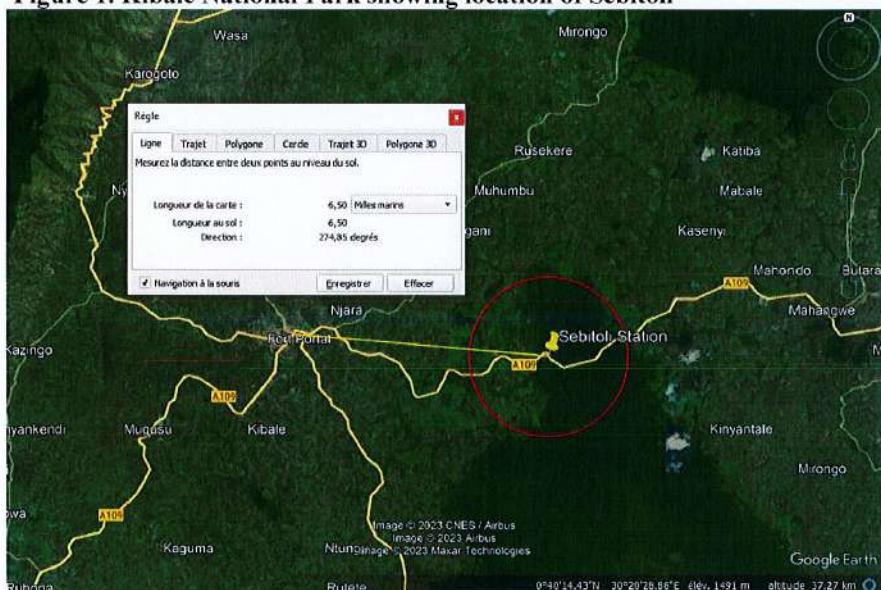
B. OPERATIONS

- **Type of operation and CONOPS:** all the UAS operations will be conducted at Sebitoli in KNP and the co-located flight area (figures 1 & 2). The activities to be carried out are basic daylight flight training, take-off and landing, fly a box pattern, wildlife and forest overwatch mission both manually and using automated tracking functions on UAS, high visibility deterrence patrols and other camp security related operations will also be taught. The latest FAA Final Rule on Operation of Small Unmanned Aircraft Systems Over People (December 28, 2020) will be used to guide the night time and camp security training.

- **Airspace classification:** controlled airspace category.
- **Operational scenario:** all the flight activities will be conducted under VLOS (Visual Line of Sight) flight mode in a sparsely populated environment.
- **Working area, geographic coordinates:** the activities will be carried out in KNP, Latitude: 0° 38' 49.93"N, Longitude: 30° 23' 7.82"E (Reference system WGS-84).

The location of the compound is shown in the following image marked with a circle.

Figure 1. Kibale National Park showing location of Sebitoli



- **Type of working area:** Circular area of 2NM radius.
- **Maximum altitude (AGL):** 600 metres (drone limited in altitude and geofenced).
- **Illuminance level:** daylight only.
- **UAS details and safety features**

UAS	Serial number	RPA type	MTO W	Speed	Range
III Mavic 2 PRO	UN3480/3481	Type I Micro UAS	1kg	72 km/hr	10 km

Navigation: GNSS. **ADS:** yes, ADS-B In only. **Navigation lights:** yes.

- **Capacity to see and avoid collision:** yes, omnidirectional detection sensors.
- **Strobe lights:** yes.
- **Communications (main / secondary):** Direct contact with ATC by Mobile phone on numbers: +256 392 830982.
- **Flight rules:** V (VFR).

II.- RISK MANAGEMENT METHODOLOGY

Introduction

This document recommends a risk assessment methodology to establish a sufficient level of confidence that the operations can be conducted safely.

A proven risk management methodology used for UAS operations in the Open Category (A) is based upon guidance in the SORA JARUS methodology and the International Civil Aviation Organisation (ICAO) Document 9859 Safety Management Manual.

This study involves hazard identification, risk analysis, risk assessment, risk mitigation and risk re-assessment to deliver an acceptable level of safety. The methodologies help to evaluate the risks systematically and determine the boundaries required for a safe operation. This method allows the applicant to determine acceptable risk levels and to validate that those levels are complied with by the proposed operations.

Definitions

For the purposes of this methodology the following definitions apply:

HARM Loss or damage to property or the environment, injury or death to persons.

HAZARD Anything with potential to cause HARM.

RISK A measure of a HAZARD's potential to cause HARM.

SAFETY A state in which RISK is reduced to an acceptable level.

A.- REFERENCES:

- JARUS guidelines on Specific Operations Risk Assessment (SORA), edition 2.0, date 30.01.2019.
- ISO 31000 Risk Management, 2018.
- Technical manual UAS DJI Mavic 2 Enterprise Dual.
- <https://www.seguridadaerea.gob.es/es/ambitos/drones>
- <https://www.seguridadaerea.gob.es/es/ambitos/drones/registro-de-operador-de-dronesuas> (Registro como operador)
- <https://www.seguridadaerea.gob.es/es/ambitos/drones/formacion-de-pilotos-a-distanciade-uas-drones> (Formación de pilotos)
- <https://www.seguridadaerea.gob.es/es/ambitos/drones/operaciones-con-uasdrones> (información sobre la operativa de las categorías y coordinación)

B.- RISK ASSESSMENT PROCESS.

Step #	Action	Explanation
1	HAZARD identification	Identify all HAZARDS likely to be encountered in the operation
2	RISK analysis	Analyse each HAZARD's potential to cause HARM
3	RISK assessment	Assess the RISK of HARM to determine whether or not it is acceptable
4	RISK mitigation	Develop mitigation strategies for all unacceptable RISKS
5	RISK re-assessment	Re-assess the RISKS after mitigation
6	Monitor	Monitor HAZARDS, RISKS and mitigation strategies for any significant changes

1.- HAZARD IDENTIFICATION:

From the definition above a HAZARD is anything with potential to cause HARM and can be an object, a person, an act or omission and/or a condition. Air and ground HAZARDS are identified for this operation, according to:

- a) Reactive HAZARD identification – lessons learned from past experience of similar operations;
- b) Proactive HAZARD identification –a detailed analysis of a proposed operation by experienced personnel to identify anything with potential to cause HARM.

The scope of the HAZARD identification may be extended after the site survey.

PHASES OF OPERATION	HAZARD	POTENTIAL TO CAUSE HARM
Pre-flight	N/A	N/A
Flight	Collision of the drone with other aircraft	1) Erroneous manipulation of the drone controls due to lack of flight knowledge of the pilot or lack of specific knowledge of the drone model. 2) Electromagnetic interference. 3) Loss of visual contact with the drone due to pilot's carelessness. 4) Loss of control of the drone due to technical malfunctions of the equipment (drone and remote control). 5) Erroneous manipulation of the controls due to physical or psychological fatigue of the pilot.
		6) Presence of other drones or aircraft in the area of operation. 7) Technical malfunction of anti-collision sensors.

	Collision of the drone with physical obstacles or people.	<ol style="list-style-type: none"> 1) Erroneous manipulation of the controls due to lack of flight knowledge of the pilot or lack of specific knowledge of the drone model. 2) Electromagnetic interference. 3) Loss of visual contact with the drone due to pilot's carelessness. 4) Loss of control of the drone due to technical malfunctions of the equipment. 5) Erroneous manipulation of the controls due to physical or psychological fatigue of the pilot. 6) Presence of people not involved in the operation or physical obstacles in the area of operations (e.g. cables, towers, etc.). 7) Technical malfunction of anti-collision sensors.
	Detachment and/or fall of parts or pieces of the drone on people or facilities.	<ol style="list-style-type: none"> 1) Assembling parts without following technical manuals and manufacturer's procedures. 2) Technical defect of the drone due to nonperformed maintenance. 3) Spare parts or alternative components installed. 4) Expired elements installed (e.g. seals, gaskets, etc.).
	Loss of the drone in visual	<ol style="list-style-type: none"> 1) Adverse weather conditions (fog, rain, snow, etc). 2) Pilot and assistant unfocused.
	Fire in facilities	<ol style="list-style-type: none"> 1) Collision of the drone with high-voltage electrical wires. 2) Collision of the drone with highly combustible elements (e.g. fossil fuels, lubricants, etc.).

	Fainting or fall of the pilot and/or flight attendant	1) Unknown area of operation. 2) Day time/night time schedule. 3) Uneven terrain, or with geographical features. 4) Inappropriate clothing and/or footwear.
		5) Inadequate physical conditions or pilot and/or flight attendant fatigue due to weather conditions.
Post flight	N/A	N/A

2.- RISK ANALYSIS AND RISK ASSESSMENT:

Once HAZARDS have been identified the associated RISK of HARM can be analysed. This methodology allows for analysis of RISK in terms of the *probability* of HARM occurring and the *severity* of the HARM if it does occur. To guide the analysis and improve consistency across RISK analyses the methodology provides four levels of probability and four levels of severity, according to the criteria established in Annex B1, sections I and II. Then, the obtained values for every HAZARD in terms of probability and severity are represented in the risk evaluation matrix shown in Annex B1, section III.

The table below shows the probability of occurrence, the severity of the consequences for the hazards identified in the previous section. The colours are representative of the following risk code:

1	Critical
2	Major
3	Moderate
4	Minor
5	Negligible

HAZARD	PROBABILITY OF OCCURRENCE	SEVERITY OF THE CONSEQUENCES	INITIAL RISK CODE
Collision of the drone with another aircraft	<u>C</u>	I	2
Collision of the drone with physical obstacles or people.	<u>C</u>	II	3
Detachment and/or fall of parts or pieces of the drone on people or facilities.	<u>C</u>	III	4
Loss of the drone in visual	<u>C</u>	III	4
Fire in facilities	<u>D</u>	II	4
Fainting or fall of the pilot and/or flight attendant	<u>C</u>	III	4

3. RISK MITIGATION AND RISK REASSESSMENT:

Having analyzed the initial risk assessment and risk codes for each of the identified hazards, the following strategic and tactical mitigation actions are suggested:

HAZARD	RISK MITIGATION ACTIONS	FINAL RISK CODE
Collision of the drone with another aircraft	<ol style="list-style-type: none"> 1) Certified and experienced trainers conducting the activities. 2) High ratio of instructor to student training concept implemented (one instructor per two students). 3) Flight assistant position implemented. 4) Pilot and flight attendant maintain visual contact at all times on the drone. 5) Drone limited in altitude (600m AGL) and geofenced. 6) Appropriate air and ground risk buffer areas established. 7) Operations area set out of any airways, runway approach routes or aviation airspace. 8) Permission from airspace owner to operate in that airspace has been obtained. 9) Emergency response plan established. 10) Drone operational and up to date maintenance. 11) Pilot in good physical and psychological condition. Assistant supervises the behavior at all times. 12) Assistant permanently verifies that the drone remains within the area of operations. 13) Coordination with aeronautical authority and internal coordination at the Sebitoli station carried out. 14) Compliance with the airspace UAS Flight Rules, Regulation, and Policies. 15) Anti-collision sensors tested in initial flight stage. 16) Operational procedures are defined, validated and adhered to. 17) For instances where more than one drone will be operated (basic skill training), in addition to all measures mentioned above, the 	

	<p>drones will be vertically separated and only one drone will be flown per time for more advanced training.</p>	
Collision of the drone with physical obstacles or people.	<p>1) Certified and experienced training conducting the activities.</p>	4
	<p>2) 1 on 2 concept implemented (one instructor per two students). 3) Flight assistant position implemented. 4) Concentrated pilot and assistant, maintaining visual attention at all times on the drone. 5) Drone operational and maintained up to date. 6) Pilot in good physical and psychological condition. 7) Assistant supervises the behavior at all times. 8) Emergency response plan established. 9) Assistant permanently verifies that the drone remains within the area of operations. Coordination with aeronautical authority and internal coordination at Sebitoli – KNP (UWA) carried out. 10) Operational procedures are defined, validated and adhered to. 11) Inform the school management that the activity will take place. UPDF ensures that non-authorized personnel do not enter the area.</p>	
Detachment and/or fall of parts or pieces of the drone on people or facilities.	<p>1) UAS maintained by competent and/or proven entity. 2) Assembly of parts according to technical manuals and manufacturer's procedures (check list). Visual inspection performed by qualified pilot on the drone, prior to flight. 3) Up to date maintenance. 4) Only original spare parts installed.</p>	5

	5) Only components with their useful life used.	
Loss of the drone in visual	1) Check local weather forecast prior to operation and be aware of weather changes during operation. 2) Operate only under favorable conditions and within the parameters indicated in the manufacturer's manual. 3) Environmental conditions for safe operations defined, measurable and adhered to. 4) Pilot and assistant should be focused, keeping visual attention on the drone at all times.	
Fire in facilities	1) Previous inspection of the area of operations and flight airspace. 2) High voltage electrical cables outside the area of operations. 3) Absence of combustible elements in the area of operations.	
Fainting or fall of the pilot and/or flight attendant	1) Known and area of operation 2) Previous inspection of the area of operation and flight airspace. 3) Flat area, no observations. 4) Pilot and flight attendant rested and in good physical condition. 5) Maintain permanent cross-check of conditions until the end of the activity. 6) Postponement of training in the case of inclement weather, extreme heat or fatigued pilots.	

5.- MONITOR

During operation, it is mandatory to implement and permanently comply with the controls stipulated in the table in Annex B1 of this study. The senior safety instructor of the team will be in charge of the supervision and control of the implemented safety measures. These measures will be constantly reviewed and assessed during the flight operations, in order to ensure the proper risk performance and to avoid any issues or casualties.

6.- CONCLUSION:

Having carried out the logical process for the identification of the intrinsic harms and hazards of the operation to be performed, having evaluated and analyzed the risks and having identified the actions to mitigate the risks, it is concluded that it is feasible to perform the air operation in question with an acceptable level of risk (Moderate) and with full confidence in its performance.

The risk analysis summary is contained in Annex B2 of this study.

7.- RECOMMENDATION:

This study has been refined after the collection of information, as part of the survey which has been performed in January 2023, by the drone experts trainers for UNESCO.

I.- Probability levels:

Probability	Meaning	Score
Frequent	Likely to occur many times or has occurred frequently	A
Occasional	Likely to occur sometimes or has occurred infrequently	B
Improbable	Unlikely to occur but possible or has occurred rarely	C
Extremely improbable	Almost inconceivable that it could occur	D

II.- Severity levels:

Severity	Meaning	Score
Catastrophic	Valuable property destroyed and/or multiple fatalities	I
Major	Valuable property damaged and/or serious injuries	II
Minor	A nuisance inhibiting normal operations	III

Negligible	Few if any consequences	IV
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III.- Risk evaluation matrix:

		PROBABILITY			
		A	B	C	D
SEVERITY	I	1	1	2	3
	II	1	2	3	4
	III	2	3	4	5
	IV	3	4	5	5

IV.- Risk code:

1	Critical
2	Major
3	Moderate
4	Minor
5	Negligible

Annex B2

RISK ANALYSIS SUMMARY

EVENT	TIME	ACTIVITY	HAZARD	INITIAL RISK EVALUATION	RISK MITIGATION ACTIONS	FINAL RISK EVALUATION
TBC	<u>TBC</u>	Drone training flights	Collision of the drone with another aircraft	2	Implementation of flight assistant, verification of drone maintenance, batteries, signals and sensors. Permanent supervision of batteries and remote control signals. Close coordination with ATC and UPDF to ensure deconfliction. UAS are equipped with ACAS system to alert the pilot of any commercial aviation in the area.	3

			Collision of the drone with physical obstacles or people.	3	Implementation of flight assistant. Verification of drone and collision avoidance sensors maintenance. Permanent supervision of batteries and remote control signals. Notifying the school management of when training will take place.	4
			Detachment and/or fall of parts or pieces of the drone on people or facilities.	4	Check list with procedures for assembly and verification of the drone with pre-flight checks regarding functionalities. Visual inspection of drone and verification of maintenance log book.	5
			Loss of the drone in visual	4	Check the weather forecast 24 hours before the operation.	5

					Regular checks of weather forecast and visual attention to weather	
					changes. Permanent visual attention of flight attendant and pilot on the drone and its signals.	
			Fire in facilities	4	Inspect training area before operations verifying the absence of flammable hazards.	5
			Fainting or fall of the pilot and/or flight attendant	4	Inspect one hour before operations area. Perform cross-check of clothing and footwear between pilot and flight attendant. Assess suitability of students to conduct flight training.	5

ANNEX 3: List Of Participants

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