Project Proposal: Monitoring Kenyan Ungulates with WildDroneEU

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Abstract

I will be conducting field work at the Ol-Pejeta Conservancy in Kenya with the WildDroneEU Project team January 21 through February 5. I will be assisting with the WildVigilance project, lead by Lucie Laporte-Devylder, and the WildWing project, lead by myself. The WildVigilance project aims to collect a dataset of in situ drone noise propagation levels in the different habitats where target species are found, at different times of day and during the night. This study will implement the methodology established during the KABR data collection in Mpala Research Centre, Kenya, in 2023. The WildWing project will test my autonomous system for wildlife monitoring using drones in the field.

1. Team Members

Jenna Kline

- Project lead: WildWing
- PhD candidate studying Computer Science and Engineering at The Ohio State University
- Thesis: Autonomous, Adaptive Vision-Based Remote Sensing System for Dynamic Field Animal Ecology Studies

Lucie Laporte-Devylder (DC4)

- Project lead: WildVigilance
- PhD candidate conducting research on Coastal Monitoring at WIPSEA and Southern Denmark University
- Thesis: Tracking Cetaceans in Coastal Areas

Saadia Afridi (DC5)

- PhD candidate researching calm drones at AVY (Amsterdam) and Southern Denmark University
- Thesis: VTOL Drone Noise Profile Optimization for its Impact on Animal Behaviour

Elena Iannino (DC1)

- PhD candidate researching livestock-wildlife interactions at Max Planck Institute of Animal Behavior
- Advised by Blair Costelloe and Martin Wikelski
- Thesis: Scouting Drones to Prevent Human-Wildlife Conflict in Livestock Grazing Systems

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2. Research Questions

1. How does drone noise impact wildlife vigilance in different habitats and at different times of day?
2. Can the WildWing system autonomously monitor wildlife in the field?
3. (Optional) Does herd size impact wildlife vigilance towards drones? How does vigilance propogate through a herd?

3. Project Goals

3.1. WildVigilance

Collect a dataset containing the following:

1. Wildlife vigilance towards drones
2. In situ drone noise propagation levels
3. Different habitats where target species is found
4. Different times of day and during the night.
5. (Optional) Reticulated giraffe vigilance towards drones
6. (Optional) Different sized herds of target species

3.2. WildWing

Deploy the WildWing system in the field to validate the autonomous system for wildlife monitoring using drones. The system has been tested at The Wilds in Ohio, but has not been tested in the field in Kenya. I also have a new version of the monitoring software that I will test in the field.

4. Fieldwork Approach

Our main target species is Plain's zebras, with reticulated giraffe as optional. During data collection, we will aim to keep anthropogenic noise to minimum by conducting our tests in a quiet area of the park, without too many cars driving by. We will also keepKeep human presence/movements to a minimum while conducting drone approaches to target animals. Initially, the animals must be in an initial calm state, i.e. not already in a state of vigilance caused by human presence or drone takeoff.

The crew includes (1) certified drone pilot, (2) asistant pilot for situational awareness, including spotting of approaching wildlife, and (3) observer for behavioural recording of target animals.

4.1. Data Collection

1. Locate herd of zebras (10 individuals); park field vehicle 200m away
2. Behavioural observation of animals for 5 mins
3. For WildVigilance,
   (a) Perform animal approach trials, at constant speed (*)
   (b) Following animal approach with drone, perform microphone approach at the same location (or as close to as possible) so that we are under same environmental conditions (i.e. time of day and habitat).
4. For WildWing,
   (a) Manually pilot the drone to the herd of zebras
   (b) Deploy WildWing system to monitor wildlife autonomously

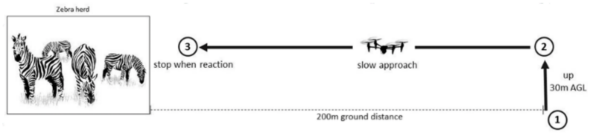
Contingency Plan: If animal approach is not possible or limited during hackathon, the minimum requirement will be to perform drone approaches towards the microphone in every possible type of habitat (relevant for the target species), and at different times of day and night. Example, for each habitat type, every hour between 06:00 and 18:00, + once at sundown, + once at nighttime. Additionally, achieving at least one animal approach per condition would serve as preliminary flights to test and refine protocol, i.e., validate optimal take-off distances, angle of approach, and test altitudes. Team members will be able to perform animal approaches during their longer stay at Ol-Pejeta.

4.2. WildVigilance Protocol

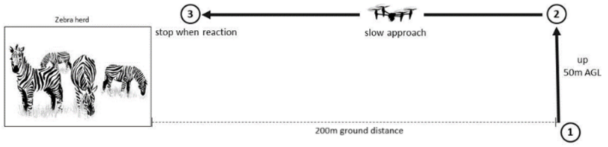
We will first perform animal approaches using our drone, directly followed by microphone recording of drone. This will be repeated as many times as possible with different groups and at various times of day and during the night. For example, locate herd of zebra in open grassland approached by drone at 16:00, followed shortly after by drone approach towards the microphone, at the same location.

4.2.1. Animal Approaches

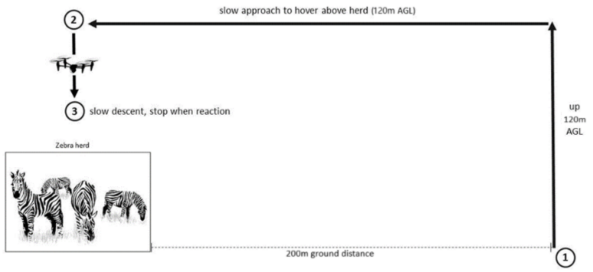
We will perform the following animal approaches: horizontal approach at 30m and 50m above ground level (AGL), illustrated in fig. 1a and fig. 1b, and a vertical approach at 120m AGL, illustrated in fig. 1c. We will also perform the same approaches at night, using drone's thermal camera.



(a) Horizontal approach at 30m AGL



(b) Horizontal approach at 50m AGL



(c) Vertical approach at 120m AGL

Figure 1: Wild Vigilance Animal Approaches

4.2.2. Equipment

- Drone DJI Mavic 3 Thermal Drone
- G.R.A.S Microphone array
- Hand-held camera
- Binoculars
- Night-vision rangefinder
- Ethograms/observation sheets

4.3. WildWing Protocol

The human pilot will orient the drone facing the target animals, and the drone will be launched. The WildDrone system will autonomously launch the drone deploying the horizontal approach at 30m AGL. The drone will move toward the target animals, until the object detector detects the animals. The system will be tested in different habitats and at different times of day. We will also test updated YOLO models for object detection and tracking in the field. We will test on a variety of herd sizes to test the system's resiliency in the face of large groups of animals, especially fusion-fission of subgroups within the herd.

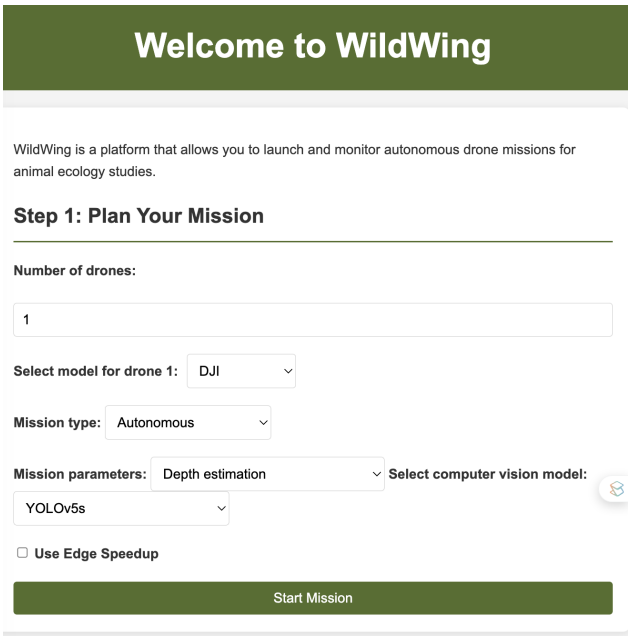


Figure 2: Launch Screen

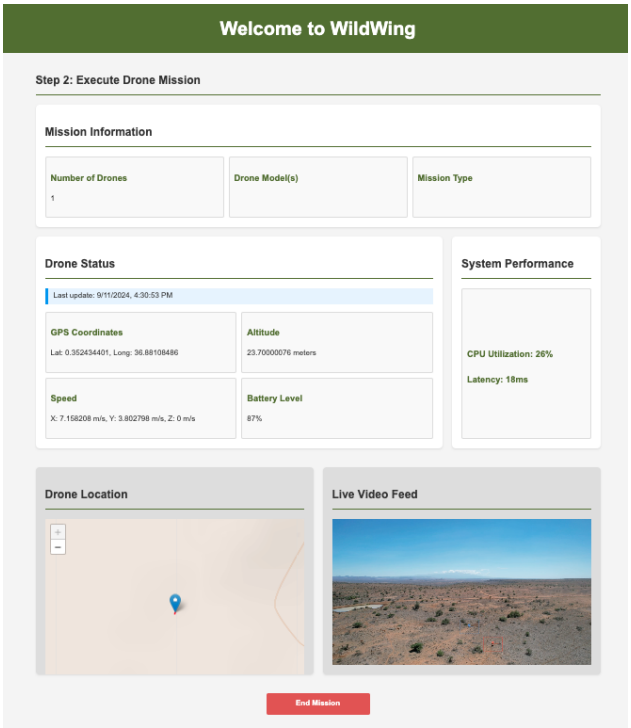


Figure 3: Monitoring Screen

4.3.1. *Equipment*

- 2 Parrot Anafi Drones
- GPU enabled laptop
- Hand-held camera
- Binoculars
- Ethograms/observation sheets

4.3.2. *Software*

New WildWing software will be tested in the field. The software has three main screens: Launch, Monitoring, and Data Analysis, illustrated in fig. 2, fig. 3, and fig. 4. The software will be used to record zebra behavior autonomously using drones in the field.

5. Relevance

The WildDroneEU project aims to develop a drone-based system for wildlife monitoring that is both effective and non-invasive. This project is significant because it will provide valuable data on how drone noise impacts wildlife vigilance in different habitats and at different times of day. This data will help us understand how drones can be used to monitor wildlife without causing undue stress to the animals. The WildWing project will test an autonomous system for wildlife monitoring using drones in the field. This system has the potential to revolutionize the way we monitor wildlife populations and track their movements. By combining the data collected from the WildVigilance and WildWing projects, we will be able to gain a better understanding of how drones can be used to monitor wildlife in a way that is both effective and ethical.

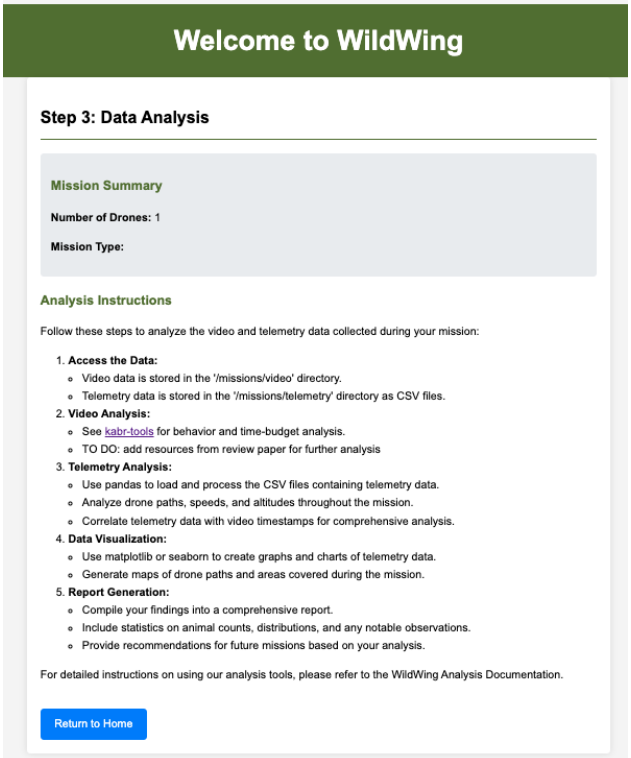


Figure 4: Data Analysis Screen