



Proposal to the African Elephant Fund

1.1 Country: **Gabon**

1.2 Project Title: **Developing a Quadcopter and Infrared Camera System to Monitor and Track the African Forest Elephant (*Loxodonta cyclotis*)**

1.3 Project Location: **Wonga Wongué National Park and Lopé National Park in Gabon**

1.4 Overall Project Cost: **\$45,000.00**
AMOUNT Requested from African Elephant Fund: **\$16,399.80**

1.5 Project Duration: **1 Year**

1.6 Project Proponent: **Gabon Park Agency**

1.7 Name of Project Supervisor: **Mary L. Cummings, PhD**

1.8 Address of Project Supervisor: **Box 90300 144 Hudson Hall Durham, NC 27708**

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1.12 Date proposal submitted: **09/10/2015, 17:00 EST**

2.0 Project Summary: (not more than 250 words)

In an effort to help combat the alarming decline of African forest elephants, the Humans and Autonomy Laboratory at Duke University is partnering with the Nicholas School of the Environment at Duke University and The Elephant Sanctuary in Hohenwald, Tennessee to design and develop a low-cost, mobile airborne elephant monitoring and tracking system. Current state-of-the-art methods of estimating elephant populations rely on counting dung piles; however, these methods are known to be imprecise and labor-intensive. Our system, which uses a quadcopter, custom infrared camera, and tablet-based ground control station, will give conservationists a direct method of counting elephants, as well as monitoring their behavior non-invasively.

Unlike other drone conservation systems, our system has both daytime and nighttime capabilities, allowing conservationists to observe the behavior of the African forest elephant across all hours of the day. In addition to the on-board hardware, the system includes a user interface design component for developing an easy-to-use ground control station that is displayed on a tablet, making the system light and portable, as well as accessible to a wide population of users. The interface is designed such that users with

little technical experience can designate waypoints for the quadcopter to circle, capture video, and return to the pre-designated home location.

By arming local conservationists with this new technology, they will be able to more directly monitor the behavior of forest elephants, and more accurately estimate population numbers.

3.0 Which Priority Objectives and Activities (there may be more than one) in the African Elephant Action Plan does this project fall under? (For ease of reference, Priority Objectives are attached under Appendix 1)

The project described in this proposal falls under Objective 1: Reduced Illegal Killing of Elephants and Illegal Trade in Elephant Products, Objective 2: Maintained Elephant Habitats and Restored Connectivity, and Objective 3: Reduced Human-Elephant Conflict. Below are specific strategies and activities that our proposal will assist in establishing, building, and continuing.

Objective 1: Reduced Illegal Killing of Elephants:

Strategy 1.1: Strengthen the capacity of law enforcement authorities/agencies to combat poaching and illegal trade in ivory and other elephant products.

Activity 1.1.2: Recruit and train staff at all levels to combat poaching and illegal ivory and other elephant products.

Activity 1.1.3: Equip wildlife authority staff on the frontline of enforcement with appropriate tools to carry out their mission as safely and effectively as possible.

Objective 2: Maintain Elephant Habitats and Restore Connectivity:

Strategy 2.1: Ensure connectivity, where possible, between elephant ranges within and among range States.

Activity 2.1.5: Identify and rehabilitate migration corridors and dispersal areas for effective protection of the African elephant.

Strategy 2.2: Establish and strengthen bilateral and multilateral support for the management of sites and corridors across borders.

Activity 2.2.3: Assess and monitor habitat change and fragmentation, with a focus on transboundary populations.

Strategy 2.4: Ensure adequate maintenance of current elephant habitat within and between elephant range States.

Activity 2.4.1: Provide adequate resources for effective management of existing protected areas and dispersal areas.

Activity 2.4.2: Improve or maintain good management in existing protecting areas in African elephant range States.

Objective 3: Reduce Human-Elephant Conflict (HEC):

Strategy 3.1: Apply adaptive management approaches in addressing HEC mitigation, focusing on capacity building of managers and local communities.

Activity 3.1.3: Train and equip wildlife officers and local communities to ensure that appropriate HEC management approaches are implemented.

4.0 Project Rationale – why is this project necessary and urgent? What threats face this elephant population (give, for example, what information you have regarding population details, trends in population (downward or upward), ivory seizure information, details about levels of poaching, human/elephant conflict, etc.).

Over the last two decades populations of forest elephants have declined dramatically in Central Africa as a result of poaching. With accelerating demand from China (Vigne & Marin, 2011) driving up ivory prices (Wittemyer et al., 2011), elephant poaching has

decimated forest elephant populations across Africa (UNEP et al., 2012). Maisels et al. (2013) estimated that 62% of forest elephant populations were lost between 2002 and 2011.

Gabon, which holds 13% of Africa's rainforests, may maintain nearly half of the surviving populations of forest elephants (UNEP et al., 2013). With the dedication of 10% of its land area to 13 national parks in 2002, Gabon emerged as a model of biodiversity conservation in the region. However, despite the Government's efforts, poaching is now emptying Gabon's parks of elephants.

Since 2014, the Gabon Parks Agency (ANPN) has been implementing a national wildlife survey. In its first stages, the national wildlife survey focused on the Minkébé landscape in northeastern Gabon, an area thought to have one of the highest densities of forest elephants in Africa (Blake, 2005). In 2004, a survey of Minkébé National Park and its buffer zone indicated that it supported a population of approximately 29,147 elephants, with 22,678 elephants in the park (Blake, 2005). The initial results from the survey suggest that Minkébé National Park has likely lost most of its elephants since 2004, with a 76% decrease in elephants in the park, or a reduction of 17,212 elephants depending on the manner that elephant densities are calculated.

ANPN law enforcement data, observations of carcasses, and DNA analyses of ivory seizures demonstrate that elephant poaching is likely the key driver in the reduced elephant numbers and densities. Results of the national survey also suggest that elephant dung density increases with distance from the Gabon border, indicating that much of the pressure is coming from outside of the country. At the same time, elephants also face pressure from within Gabon. With the construction of roads, expansion of logging, and development of industrial and small-scale agriculture, elephants are increasingly coming in contact with humans, leading to human-elephant conflict.

The effort in this proposal has the capability of providing several direct impacts on forest elephants that could assist in the fight against the rapid decline in the elephant population:

- 1) Monitor forest elephant behavior and presence and/or abundance in forest clearings or in low density foliage. This could allow for research without disturbing the animals and/or a way to check if elephants are in clearings before sending tourists in the case of tourist attractions.
- 2) Monitor the presence in fields. This could potentially be used to mitigate human/elephant conflict, particularly by being able to survey fields at night.
- 3) Monitor for poachers. This technology could search clearings for poachers and poaching camps, particularly at night, and ecoguards could be dispatched once they are located.

References:

Blake, S. (2005). Long-term system for monitoring the illegal killing of elephants (MIKE): Central African forests – Final report of population surveys (2003-2004). *Wildlife Conservation Society, New York, NY*.

Maisels, F., Stinberg, S., Blake, S., Wittemyer, G., Hart, J., Williamson, E. A., . . . Warren, Y. (2013). Devastating decline of forest elephants in Central Africa. *PLoS One*, 8(3), e59469.

UNEP, CITES, IUCN, & TRAFFIC. (2013). Elephants in the dust – The African elephant crises. *United Nations Environment Programme, GRID-Arendal*. Retrieved from: https://cites.org/common/resources/pub/Elephants_in_the_dust.pdf.

Vigne, L., & Martin, E. (2011). Consumption of elephant and mammoth ivory increases in southern China. *Pachyderm*, 49, 79-89.

Wittemyer, G., Daballen, D., & Douglas-Hamilton, I. (2011). Poaching Policy: Rising ivory prices threaten elephants. *Nature*, 476(7360), 282-283.

5.0 Detailed Proposal – including activities to be carried out, milestones (at least quarterly milestones), timelines, equipment to be purchased, reporting procedures, etc. (not more than 1000 words). It will be helpful in evaluating this Project Proposal if you to divide it into Phases such as Planning; Procurement; Implementation; Evaluation and Reporting

Should include anticipated benefits (including benefits to the conservation and management of elephant populations and communities) and outputs from the project, and how the project will be monitored and evaluated.

Problem Statement:

Due to the rising price of ivory in Eastern Asian nations, the African forest elephant (*Loxodonta cyclotis*) has become one of the most heavily poached species in the world. Insufficient methods of monitoring the African forest elephant have left officials and staff with few tools in combating this escalating problem. In addition to the poaching problem, because forested elephants are hard to locate, the actual population numbers are unknown. The current state-of-the-art method for estimating African forest elephant populations is through dung counts, but these methods are known to be imprecise. Dung counts are converted to elephant counts by estimating the dung degradation rate and elephant defecation rate, which drastically reduce precision and can result in estimates of elephant densities that vary by 100%. These methods are key to estimating the impact of poaching and other human influences on the decline of elephant populations.

In an attempt to gain precision in population numbers of forest elephants as well as provide a way to track the elephants in real time, we propose to develop a low cost unmanned aerial system that allows an operator with no formalized training to observe elephants from just a few hundred feet in the air. In addition to the value in estimating population numbers, such an application can provide invaluable *in situ* observational information.

We propose to design a system that is low cost (~\$1,000) with a ground control station developed on an easy-to-use tablet (thus making it extremely portable), that communicates to the drone and receives real-time video feed from the infrared camera (or daytime camera) via radio frequency (RF). The infrared camera that has been built has the capability of seeing elephants in forest clearings and through thin foliage cover. As new infrared sensors are developed this technology could someday advance to survey the entire forest. This system is designed to be cheap, extremely portable, and robust. In addition, training time will be kept at a minimum due to the embedded layers of automated control from the ground control station and high-level user interface. The goal is to be able to turn these systems over to local staff of the Gabon Parks Agency so they can monitor the elephants themselves.

Project Goal:

Provide officials and conservation staff with the technology and equipment to monitor and track the African forest elephant in an effort to determine more accurate population estimations, as well as less uncertain population forecasting.

Planning:

The system is currently being design, integrated, and tested, primarily based on donations. We will be testing the integrated system in the coming months in Durham, NC and at The Elephant Sanctuary in Hohenwald, TN. It is projected that there will be some debugging after testing the complete system, which should take approximately one month. Once a finalized system has been successfully tested and evaluated, we will travel to

Gabon with the intent of leaving a system at both national parks once the initial launch, training, and data collection has been accomplished. Below is a quarterly breakdown of the proposed effort:

First Quarter (in progress) - Finalize the design and integration of the proposed system. Once integration has been finalized, begin testing and evaluation in Durham, NC for flight time, communication distances, and system robustness. (estimated 10% of funds requested)

Second Quarter - Work with the staff at The Elephant Sanctuary in Hohenwald, TN to test the fully integrated system with African forest elephants. (estimated 5% of funds requested)

Third Quarter - Travel to Wonga Woungué and Lopé National Parks for the initial launch of the system. Ensure that officials and staff at the parks are comfortable with using the system and with them gather population data. A system will be left at both of the parks at no cost to the Gabon Parks Agency or staff members. (estimated 80% of funds requested)

Fourth Quarter - Using the data and experiences collected while in Gabon, work on writing a tier 1 journal publication on the effectiveness of implementing drones into the effort to save the African forest elephant. (estimated 5% of funds requested)

Procurement:

All funds that have been requested in this proposal will go toward purchasing equipment and paying for expenses once in Gabon. The primary expenses will be purchasing 2 new IRIS+ drones, 4 infrared cameras, spare parts and batteries for the IRIS+ drones, field supplies, and 2 ground control station Nexus tablets for both parks. Funds will also go towards guide services, visa costs, food, lodging, and fuel while we are in Gabon.

Implementation:

We will test our system at the Wonga Woungué and Lopé National Parks in Gabon in partnership with the Gabon Park Agency. The Parks Agency is currently implementing a nationwide elephant census using dung count methods while simultaneously initiating an elephant-collaring program, with the goal of GPS-collaring 40 elephants. Thus, the country and the partnership are ideal for this project because (a) Gabon is the second most forested country and has one of the largest remaining forest elephant populations in the world; (b) the location of elephants will be known, facilitating the location of elephants and testing of our drone technology; and (c) we can compare dung-count elephant abundances to real-time drone survey abundances.

The goal of this proposed effort is to develop a proof of concept that such an inexpensive and easy-to-use system can be achieved. The novel contributions of this effort are both the design of a low cost system and the development of an easy-to-use system that can be operated by park personnel on their own with minimal training in the manipulation of the touch screen.

Evaluation and Reporting

The project will be directed and evaluated by Mary Cummings, PhD, John Poulsen, PhD and the Gabon Park Agency. Professor Cummings has an extensive background in unmanned aerial systems and Professor Poulsen is a well-known tropical ecological conservationist. All data collected while in Gabon and after the initial trip will be available in the public domain. We will compile all of the data into an academic journal publication after the staff and officials at the parks have had some time to use the equipment.

6.0 Project Timeline – outline the timeline for proposed activities within this project. You may find it helpful to relate the timeline to the Phases identified in Section 5.0 above.

September - October 2015 - Finalize design of the ground control station user interface and integrate the infrared camera onto the IRIS+ quadcopter. Run test flight for various weather/wind conditions in Durham, NC for analysis of the total flight time and communication distance.

Late October 2015 - Final visit to The Elephant Sanctuary in Hohenwald, TN for drone tests with African forest elephants (other funding source will provide travel expenses)

November 2015 - Adapt any and all changes that need to be made to the system after the sanctuary testing phase.

December - January 2015 - Travel to Wonga Woungé National Reserve and Lopé National Park in Gabon for initial launch of the system (travel support will come from other funding source). Capture data over the period of 10 days at both regions in Gabon and collect feedback from the conservationists regarding the ground control station user interface/control and video quality.

February - April 2015 - Work toward a peer-reviewed journal publication using the data gathered in Gabon (appropriate acknowledgement will be made in any and all publications that result from this funding source).

May - August 2015 – Begin work on Version 2.0 of the system, which will involve a counting algorithm that automatically counts, marks, and labels any and all elephants on the user interface that are picked up by the infrared camera.

BUDGET

7.0 Has this project received or been pledged any other sources of funding (external)? Give all relevant details (for example, amount, source of funds, timetable, any restrictions):

The African forest elephant conservation effort in the Humans and Autonomy Laboratory has been in progress for 1 year. The project has been funded for the past year by the Duke Tropical Conservation Initiative (DTCI), and the funding amount was totaled at \$15,000.00. This money was used in sensor development and testing (including travel), which proved to be successful as the custom infrared camera has been tested at The Elephant Sanctuary in Hohenwald, TN at altitudes up to 300 feet. The funding source was retrieved in April 2015 and was allocated for 6 months (ending in September 2015). No restrictions were tied to the DTCI funding.

7.1 Please provide a detailed proposed budget for this project (in US\$). You may find it helpful to relate expenditure to the Phases you have set out in Section 5.0

Details included in Table annexed to the document:

See attached budget.

Any other budget lines:

7.2 Please specify the proponents' contribution towards the project

The Gabon Park Agency is contributing \$0.00 to the project.

Full Proposal Budget				
Budget line		Expected source of funds and amounts		
		Proponent(GOVT.)	AEF	Other (please specify)
1.	Field Equipment (please list the equipment)	\$0.00	\$5049.80	\$0.00
2.	Meetings/workshop	\$0.00	\$0.00	\$0.00
3.	Production of Awareness and Education materials	\$0.00	\$6,350.00	\$0.00
4.	Capacity building (Training)	\$0.00	\$0.00	\$0.00
5.	Consultancy /professional backstopping services	\$0.00	\$0.00	\$0.00
6.	Field supplies (e.g. Ranger Uniform, etc)	\$0.00	\$5,000.00	\$0.00
7.				
8.	Total Requested Amount	-	\$16,399.80	-
9.				
10.				

Note: AEF funding does not support purchase of firearms.

Please submit the completed proposal, either by:

Email:

Fax:

You should receive acknowledgement of receipt of your proposal within 14 days. If you do not receive such an acknowledgement, please telephone:

Further details on any of the above details may be requested by the Steering Committee of the African Elephant Fund.