**B. Project Summary**

Cameroon has a wide range of landscapes and climates, from grasslands and highlands to dense rain forests. With its varied geography and habitats, Cameroon has remarkable diversity and an abundance of wildlife (Republique du Cameroun, 2014). Cameroon is also an important distribution hub for goods going to the Central African Republic, Equatorial Guinea, Gabon, and Chad. Recently, there has been increased investment in major infrastructure projects, including transportation, water supply, and power generation in areas that were once largely inaccessible. The combination of increasing natural resource extraction and infrastructure development has lead to increasing human-wildlife interactions. Furthermore, wildlife populations are being pushed into ever-smaller areas, and hunting pressure has simultaneously increased (Brashares et al., 2011). To reduce threats to key wildlife populations, and enhance institutional conservation capacity in Cameroon under the **Cameroonian Environment Management Framework and Forestry and Environment National Program**, we are submitting this proposal to advance our understanding of wildlife-sourced protein acquisition, bushmeat consumption, and commercial trade to inform efforts to reduce demand and improve sustainability.

Recent economic progress has led to advancing education levels and improved health in Cameroon, yet poverty remains high at 40%, and life expectancies are lower relative to the regional averages (World Bank, 2014). Bushmeat represents one of the main sources of animal protein in extractive industries throughout of Cameroon. Additionally, wildlife hunting is important for rural food security and income. However, it has placed extreme pressure on some wildlife populations, as urban and rural demand for bushmeat has increased. Hunting and **wildlife meat processing** carries a substantial risk for cross-species **exposition and transmission of zoonotic pathogens of wildlife origin**. Despite the increasing demand for bushmeat in Cameroon, the goal for this project is to reduce bushmeat consumption and its commercial trade, to reduce the risk of pathogen exposition, transmission and spread.

Wildlife pathogens, including new retroviruses, have been detected in people that hunt and butcher wild animals in Cameroon (Wolfe et al., 2004, 2005; Zheng et al., 2010). Importantly, this high-risk activity in Western Africa was the likely pathway by which multiple zoonotic diseases emerged in people. Preventing the emergence of zoonotic diseases requires an enhanced understanding in human food preferences, nutrition, cultural practices, and behaviors. Especially in areas with recent anthropogenic disturbance and high-risk human-wildlife contact, which increases the likelihood of emergence and spread of zoonotic pathogens. We will study these complex and interacting preferences, practices, and behaviors in Yaoundé, the capital of Cameroon, due to the high population density and thus increased likelihood of disease spread. Furthermore, education and outreach activities are likely to be more impactful in a densely populated city. Via community outreach, assessment, and education, we hope to identify the social and human factors that contribute to the consumption of bushmeat in hope of reducing consumer preferences for bushmeat and its consumption in Cameroon.

**C. Project Narrative**

**1. Statement of Need**

Emerging infectious zoonotic diseases have existed for as long as man and animals have walked the Earth; however, only recently has the global impact of emerging infectious diseases been quantified in terms of cost to economies, biodiversity, and to public health (Jones et al., 2008). Specifically, in Western Africa, the very real threat of zoonotic diseases, like the Ebola Virus, poses danger to local and international communities alike. Evidence suggests that HIV-1, a zoonotic disease, emerged from geographically isolated chimpanzee communities in Cameroon (Keele et al., 2006). This likely occurred because blood and body fluid exchange with non-human primates via hunting, butchering, and pet contact are risk factors for human T-lymphotropic virus emergence (Wolfe et al., 2005). These findings suggest that reducing wildlife contact and bushmeat contact will reduce emerging infectious risk.

Bushmeat has been defined in multiple ways over the years. In this proposal, bushmeat is a term referring to the use of wild animals, ranging from cane rats to gorillas, for food. Bushmeat consumption is tied to health of the global economy, and the state of the economy contributes to the health of the environment (Sayer et al., 2012). Cultural, political, and economic factors have led to an increase in the bushmeat trade over the past 2 decades and thus increased the opportunities for the successful transmission of disease from a wild reservoir to a host, the first step in disease emergence (Karesh & Noble, 2009). This myriad of factors makes curtailing the trade and consumption of bushmeat a very difficult task.

Even the scale at which these factors (e.g., local, regional, national) are analyzed seems to play a role in the harvest and consumption of bushmeat. Even small-scale regional economics are a factor in the spatial location and types of bushmeat sold at markets (Fa et al., 2014). The relationship between wealth and wildlife consumption varies geographically (Brashares, Golden, Weinbaum, Barrett, & Okello, 2011). Wealthier households tend to consume more bushmeat in settlements nearer urban areas, but the opposite pattern is observed in more isolated settlements. Bushmeat hunting is an important source of income in rural areas of Africa, and Cameroon produces 88% of all ungulate bushmeat throughout Africa (Davies & Brown, 2008). The price of bushmeat at local markets is dependent on seasonality and the method of capture used by hunters (Allebone-Webb et al., 2011). An inventory of the four main markets in the Cameroonian capital, Yaoundé, from 1995 to 1996, found that 70–90 tons of bushmeat was sold monthly. Similarly, the overall annual bushmeat trade in Gabon has been valued at about $25 million (Nasi et al., 2008). Bushmeat is not only a primary source of protein for many families in Cameroon, but also a source of income and wealth.

Unfortunately, animal husbandry is not a viable income source in rural areas, and forest, concession, and conservation lands are increasingly being controlled by local management with the local communities acting as stewards (Russell, Mbile, & Tchamou, 2011). This focus on sustainable forest management, which may require sourcing timber from plantations, means managing natural forests for the provision of non-traditional forest products and forest services like ecotourism and habitat for wild animals (Ndoye & Tieguhong, 2004). Thus, forest protection is providing habitat for the wild game hunted in Cameroon. Community investment and compensation for conservation should be directly related to the benefits generated by the areas protected, including the community's wages, income, sustainable access to meat, and non-timber forest products; investments should simultaneously improve community-based social services and infrastructure (Schmidt-Soltau, 2004). Despite these observations and findings, compensation for conservation is not offsetting the benefits of bushmeat acquisition and trade.

Finding a consensus solution to the bushmeat crisis is a difficult task because of the many competing interests and social factors involved (Karesh & Noble, 2009). In 2006, Edderai and Dame identified 15 bushmeat markets and 145 restaurants and cafeterias selling roughly 1,000 bushmeat dishes per day in Yaoundé. This trade provided employment for 249 people. A vast network of routes transported Bushmeat, in particular from the savannah and central provinces, which are rich in wildlife and contain National Parks and safari hunting areas. In addition to the underlying economic and infrastructure factors related to the bushmeat trade, individuals are able to discern the type of protein being consumed. Despite individual’s ability to identify bushmeat, individual preference seems to play a role in the choice of protein (Schenck et al. 2006). These preferences seem to be influenced by familiarity with the protein, tradition, prestige, and price. Therefore, we need to understand the difference between stated and observed preferences for bushmeat, by each species type, while evaluating the combined quality and preferences for alternative protein sources.

Despite individual differences and preferences of bushmeat, several possible solutions to the bushmeat crisis (e.g., legalization and taxation of the bushmeat and wildlife trade) are unlikely to be effective due to insufficient tax revenue and will not likely reduce demand for wildlife in Cameroon (Wilke et al., 2006). More investment in Africa, in areas that ensure education and political stability and move beyond resource depletion, would go a long way in controlling the bushmeat trade and reducing emerging infectious disease risk (Karesh & Noble, 2009). Furthermore, a better understanding of the specific social factors that influence bushmeat consumption and trade will help inform outreach efforts to reduce bushmeat consumption and associated disease risk. This study seeks to explore the social factors influencing bushmeat consumption and trade, the barriers to alternative sources of protein, and indicators for change in consumption and trade patterns.

**2. Project Goals & Objectives**

The term bushmeat holds different meanings for different people. For many people bushmeat is a necessary protein source, and for others the bushmeat trades represents an overzealous exploitation of endangered and threatened species that can result in disease spread. Our primary goal in this study is to understand the complex interactions of culture, food security, food safety, and wildlife conservation, and social factors like economics, anthropology, and sociology. These factors drive hunting behaviors, consumption of bushmeat, and wildlife management strategies at local, national, and international levels.

Our goals are to:

* understand what protein sources are available (all types) for consumption;
* understand how and why individuals and families make bushmeat consumption decisions;
* develop and promote best practices for bushmeat consumption;
* use the best practices identified to promote less risky choices to community leaders and to the general public; and,
* develop and implement indicators that will measure changes in bushmeat attitudes, awareness, consumption, and trade.

Our supporting objectives are to:

1. develop, design, and conduct a seasonal longitudinal survey in Yaoundé, Cameroon;
2. design risk management strategies for bushmeat consumption in terms of food safety conservation, and sustainability of natural resources;
3. engage local authorities and community leaders on the reduction and safe - sustainable commercial bushmeat trade where culturally appropriate;
4. engage the general public to understand bushmeat risks and reduce overall bushmeat consumption; and,
5. understand the drivers of the bushmeat value chain from baseline over time by measuring bushmeat attitudes, awareness, consumption, and trade patterns using key indicators from our seasonal survey, while measuring the impact of our activities over time.

**3. Project Activities, Methods, & Timetable**

***Objective 1: Design and conduct a seasonal, longitudinal survey in Yaoundé, Cameroon.***

*Activity 1 - Focus Groups:* Our Partners in Cameroon will lead and conduct focus groups in Yaoundé. Focus groups will consist of 10 participants, aiming for a mix of rural residents, local government officials, non-governmental organization representatives, and wildlife professionals. There will be 4 focus groups for a total of 40 participants. Sessions will be recorded and detailed notes taken in accordance with obtaining informed consent in accordance with international IRB standards. Results from focus groups will be thematically coded using qualitative software for key patterns and distilled to inform indicators of change in bushmeat consumption and trade patterns as well as best practices.

*Activity 2 - Structured Interview-based Survey:* We will conduct structured interviews with residents in Yaoundé. We will draw our sampling frame from a stratified random sample after dividing Yaoundé into gridded squares. We will also interview organizational leaders, industry, and government officials involved in wildlife preservation, food systems, and bushmeat regulation. These interviews will focus on bushmeat hunting activities and awareness, bushmeat consumption, cultural factors, demographics. We aim to conduct 400 repeated measures interviews. Interviews will be audio-recorded, data will be automatically entered into survey software via iPads taken out into the field, and field notes will be taken.

***Objective 2: Design culturally appropriate risk management strategies for bushmeat consumption.***

*Activity 3 - Risk management strategy development.* During interviews and focus groups with leaders, industry, and government officials, we will co-develop risk management strategies appropriate for the governance context of the country. Interviews will be audio-recorded with permission from participants and transcripts will be thematically coded for relevant patterns and consensus on strategy development. Stakeholders will approve copies of strategies.

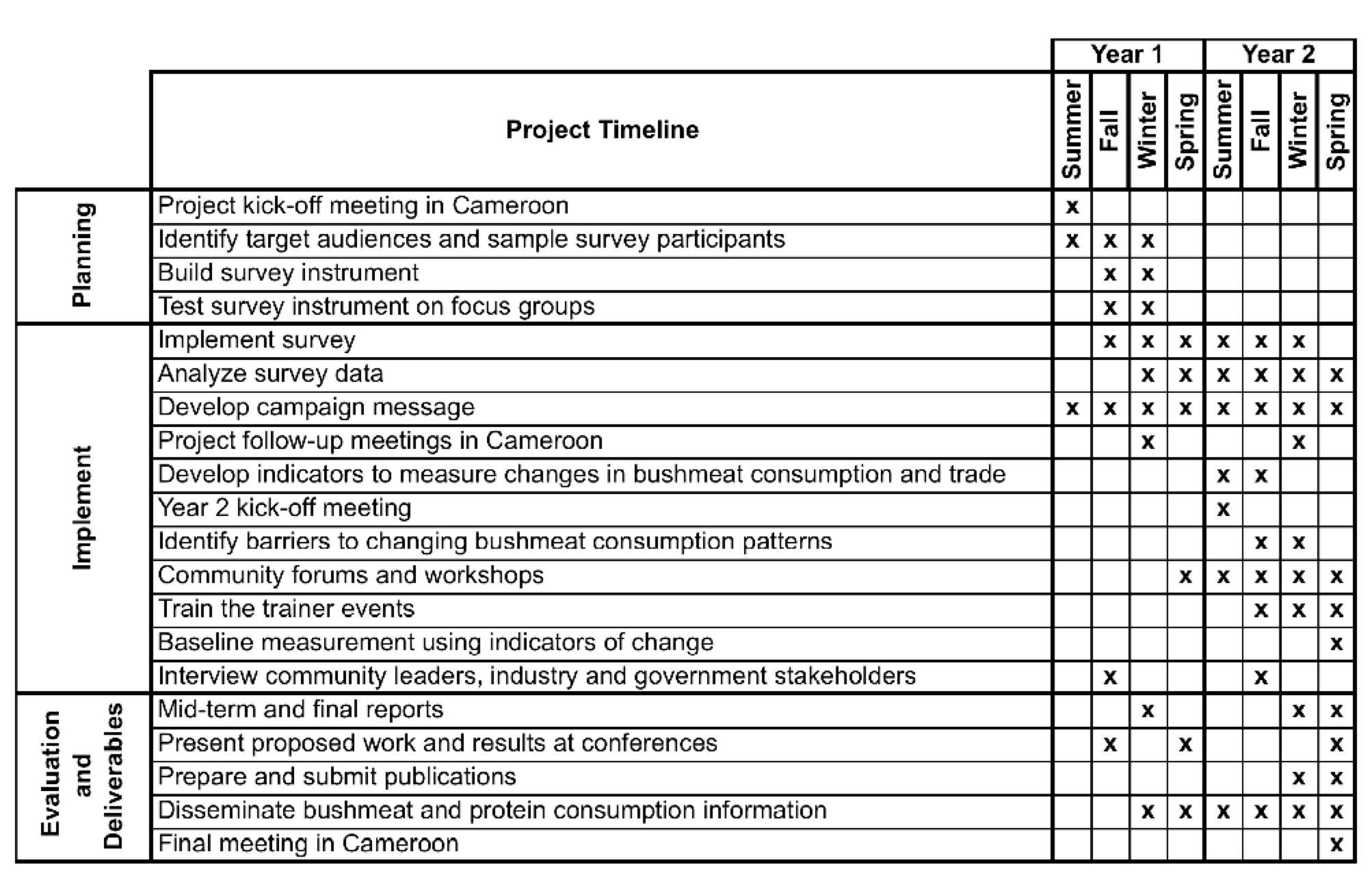
***Objective 3: Engage local authorities and community leaders on reduction of commercial bushmeat trade.****Activity 4 - Community forums.* Local partners in Cameroon will host community workshops and forums to train community leaders and authorities on bushmeat risks and the benefits of using bushmeat management strategies in their communities, and will provide training on how to provide their newly acquired knowledge and skills to others.

***Objective 4: Engage the general public to reduce bushmeat consumptions***

*Activity 5 - Disseminate materials on effects of bushmeat consumption.* Brochures, posters, websites, text messages, and radio announcements will be assembled that highlight current statistics and potential negative consequences of bushmeat consumption and trade.

***Objective 5: Take a baseline measurement of bushmeat attitudes, awareness, consumption, and trade patterns using key indicators from our seasonal survey.***

*Activity 6 - Survey key stakeholders and general public using indicators.* A sub-sample of the participants from *Activity 2* will be re-surveyed using the indicators developed from survey results on what factors are most related to bushmeat consumption and trade.



**4. Stakeholder Coordination/Involvement**

The program is designed to be highly collaborative and multidisciplinary in nature, and aims to work closely with the following list of individuals, organizations, and agencies in establishing, developing, and implementing the program:

* University of Minnesota, USA (Veterinary Population Medicine and School of Public Health; Dr. Dominic Travis and Dr. Mac Farnham)
* Association Epidémiologie Santé Publique Vétérinair, Cameroon (Dr. Serge Tchuenteu Nzietchueng)
* Ministry of Forestry and Wildlife (MINFOF) Cameroon (Yaoundé Education Unit; Dr. Kuete Fidèle)
* Ministry of Livestock, Fisheries and Animal Industries, Cameroon (MINEPIA; Dr. Loul Séverin)
* Linnaues University (Sweden), Cameroon (Department of Pedagogy and Psychology; Dr. Dapi Nzefa)
* **The local community and community leaders in Yaoundé, Cameroon**
* **The Ministry of Forestry and Wildlife**

**5. Project Monitoring and Evaluation**

Project activities will be monitored and administered by EHA. We will measure project success continuously, and in a comprehensive yearly project update and report to

USFWS. Success is defined by meeting our target units for measurable results. We will seek feedback from local community leaders and stakeholders at our kick-off and follow-up meetings, and at community forums and workshops to continually improve our research and education materials. At the conclusion of outreach events, we will request feedback and record the number of participants.

The measurable results used to evaluate the project’s effectiveness will include:

* Execution of at 1 longitudinal survey in Yaoundé, Cameroon to identify and quantify the contributing factors to bushmeat consumption (e.g., economic, consumer preferences, availability, cultural).
* The number of participants not lost to follow-up.
* The number and percentage of individuals reached through the ‘train the trainers’ event to promote peer-to-peer learning.
* Peer-reviewed publications and conference submissions.
* Write and disseminate a bushmeat consumption guide with input from key community leaders. The intended audience is Yaoundé residents. It will not contain, but rather will compare alternate sources of protein in terms of nutritional value, average costs, flavor and taste, and individual health risks.
* The number of attendees at five community bushmeat workshops. We will create interactive sessions for participants to discuss the costs, benefits and preferences associated with bushmeat and alternate sources of protein. The forum will follow in the evening with information sharing.

Conservation outcomes will be achieved using bushmeat consumption indicators developed through our survey instrument, engaging with key partners in Cameroon. We will develop a best practices guide for reducing bushmeat consumption. The guide will be based on the indicators identified in our longitudinal survey that will capture seasonal variation in bushmeat trade and consumption patterns. This best practices guide and associated indicators will form the basis of continued monitoring of bushmeat consumption and the factors that lead to decreased bushmeat consumption in urbanized Cameroon.

Our partners in Cameroon will continue the longitudinal survey to monitor the effectiveness of trainers, to understand how many people are reached through this peer-to-peer network, how effective trainers are in reducing bushmeat consumption, and how cultural factors change as a result of the outreach performed in this study. Our goal is to roll this pilot study into a more regional platform using the USAID Emerging pandemic Threats program of which we are all participants (PREDICT, RESPOND, Building One Health Work Force). This will provide expansion and sustainability platform in culturally appropriate manner.

**6. Description of Organizations Undertaking the Project**

EcoHealth Alliance's work spans the U.S. and more than 20 countries in Central and South America, the Caribbean, Africa and Asia to research ways for people and wildlife to share bioscapes for their mutual survival. Our strength is built on our innovations in research, education and training and our accessibility to international conservation partners. Internationally, our [programs](http://www.ecohealthalliance.org/health) support conservationists in over a dozen countries at the local level to save endangered species and their habitats and to protect delicate ecosystems for the benefit of wildlife and humans via the PREDICT program. Our staff serve as advisors to USG, IUCN, WHO and FAO and have recently been developing bushmeat consumption guidelines for WHO and FAO.

The University of Minnesota has led technical programs for the U.S. Agency for International Development’s (USAID) Emerging Pandemic Threats RESPOND project, with a particular focus on applying One Health methodologies and collaborative approaches towards capacity building in disease outbreak response for countries in Eastern and Central Africa. The College of Veterinary Medicine and School of Public Health includes faculty with expertise in epidemiology, virology, infectious disease ecology, wildlife-human interactions, conservation, food security, biodiversity, disease surveillance, risk analysis, animal product exports, marine biology, wildlife control, and agricultural extension (e.g., One Health Work Force & RESPOND) .

The Association Epidémiologie Santé Publique Vétérinaire (ESPV) in Cameroon aims to promote epidemiology, veterinary medicine, and public health. ESPV assists with training public health practitioners and veterinarians in public health. ESPV publishes a periodical in epidemiology and public health and promotes and strengthens collaboration between community stakeholders in One Health. ESPV performs epidemiological research of animal diseases and then provides community outreach, veterinary extension services, and population health education of human and animal diseases to local communities in Cameroon.

**7. Sustainability**

EHA staff and partners have been working in Western Africa for over 25 years and the strength and success of our programs is centered on our long-term presence in building local capacity in country. Protocols, collaborative agreements, informational and communication networks will remain in place for the reporting longitudinal survey data for future analysis after the life of this grant. Additionally, computer equipment and software will allow future survey collection and analysis for the next stages of behavioral studies to continue. Education outreach directed at communities to minimize their consumption and trade of bushmeat will persist and expand through EHA and our partnerships. Ongoing training and professional development (capacity building) of Cameroon personnel will facilitate continuity in all aspects of our program.

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**9. Map**



**Figure 1.** Two-panel map of the location of the study area. The latitude and longitude of Yaoundé, Cameroon, is 3.8667° N, 11.5167° E using the simple cylindrical projection and WGS84 datum.

**10. Governmental Endorsement**

EcoHealth Alliance worked under an MOU with the government of Cameroon for the PREDICT project (USAID Cooperative Agreement # GHN-A-00-09-00010-00). A letter of support for this particular project is currently being obtained.

**11. Detailed Notification of Security Forces**

We will not be working with any security forces or law enforcement officials in Yaoundé, Cameroon.