Final report submitted to Bat Conservation Trust (BCT)

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Project title: Why hunt: assessing drivers and sustainability of intense Egyptian Fruit bat hunting to guide conservation intervention.

Project location: Southern Nigeria

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Project Summary: (up to 400 words)

This report summaries the activities of the project ”Why hunt: assessing drivers and sustainability of intense Egyptian Fruit bat hunting to guide conservation intervention” conducted between February 2019 - January 2020.
About 20% of sub-Saharan bat species are hunted for food and medicine, with large- bodied fruit bats (Chiroptera: Pteropodidae) the most targeted. In southern Nigeria, the Egyptian Fruit bat (*Rousettus aegyptiacus*) is the most abundant non-migratory fruit bat species wherever they occur, and hence a critical species for pollination and seed dispersal of ecologically and economically important plants. Unfortunately, southern Nigeria is a hotspot of intense bat hunting. To stop/reduce this intense hunting, I conducted a study across three localities in Southern Nigeria (Akoko-edo, Boki, and Obanliku Local Government Areas) where hunting is widespread. The specific objectives were to assess the sustainability of *R. aegyptiacus* populations under current hunting levels, identify the drivers of bat hunting/ bat meat consumption behaviour, Identify the environmental predictors of *R. aegyptiacus* abundance at roost sites, and conduct locality-specific conservation outreach and development of CITES proposal for this species.

Employing innovative socio-ecological techniques, I estimated *R. aegyptiacus* abundance from 41 caves (1-54,800 per cave) and evaluated hunting offtakes (can be as high as 4000 individuals per caves in one hunting effort) across study sites. Focus group discussions, questionnaire surveys, and interviews identified availability, taste, and income as important drivers of bat hunting and bat meat consumption in southern Nigeria. Locality-specific conservation education/outreach programs significantly improved knowledge and perception of bats in school children. Participatory town hall meetings led to key outcomes such as ban on bat hunting and identification of appropriate alternative protein source and livelihood.
While this study provides the first direct measure of hunting pressure in bats, it also demonstrates negative impact on roosting ecology of *R. aegyptiacus.*

Importantly, this study provided the opportunity to train three undergraduate, and two postgraduate students in conservation ecology in a country where expertise in conservation science is greatly lacking. Data from this study forms a critical baseline, informs conservation intervention plans and prioritisation, and provides an innovative socio-ecological model for assessment and conservation of intensely hunted speceis. Small Mammal Conservation Organisation, SMACON (an NGO I co-founded) is employing this model to save the endangered short-tailed roundleaf bat from the brink of extinction.

Introduction: (up to 400 words)

Hunting is a leading threat to tropical biodiversity, where offtake levels are estimated at more than six times the sustainable rate. A preliminary survey I conducted in 2 south-eastern Nigerian communities in 2017 showed intense bat hunting/bat meat consumption, targeting *R. aegyptiacus* with offtakes reaching 1500 bats per cave per hunting effort. In addition, this bat species reproduces slowly, severely limiting recovery from population decline. The Egyptian fruit bat is a keystone seed disperser and pollinator but susceptible to population declines due to slow reproduction and a fragmented population. Unlike most fruit bats, *R. aegyptiacus* is cave dependent, facilitating intense hunting which can cause breakdown of bat-plant ecological networks, limiting Non-Timber Forest Products. In spite of such high offtake levels, their impact on populations and roosting ecology remains unknown, especially in Protected Areas (PAs) that are increasingly being converted to 'empty forests' despite serving as the last refuges for biodiversity. In addition, the human behavioural dimension of bat hunting is poorly understood, making it difficult to plan conservation intervention programs for these maligned species.

This study was conducted in two states in southern Nigeria (Cross River and Edo) where bat hunting has been reported. We surveyed two Local Government Areas in Cross Rivers state (Boki and Obanliku) and one in Edo state (Akoko-Edo), covering a total of six communities (Enwan, Anape, Okpazang, Buanchor [comprising Nkanacha, Okuni and Mbayang]). Although the study site is part of Africa's largest bat diversity hotspot, it is bordered by agricultural communities who also depend on these forests for Non-Timber Forest Products (NTFPs). The overarching aim of this project is to ensure the conservation of *R. aegyptiacus* in southern Nigeria with specific objectives to:

- Assess the sustainability of *R*. *aegyptiacus* populations under current hunting levels in southern Nigeria.
- Identify the drivers of bat hunting/ bat meat consumption behaviour in southern Nigeria
- Identify the environmental predictors of R. aegyptiacus abundance at roost sites.
- Locality-specific conservation outreach and development of CITES proposal for this species

Project Results & Impact: (up to 800 words)

Objective 1: Assess the sustainability of *R*. *aegyptiacus* populations under current hunting levels in southern Nigeria.

I surveyed 41 caves across two Local Government Areas (LGAs) - Boki and Obanliku, in Cross River state Nigeria. 36 of these caves were occupied or previously occupied by *R. ageyptiacus*. Five additional caves showed no signs of *R. aegyptiacus* activity. I conducted emergence counts at all occupied caves with abundance ranging from 1 - 54,800 individuals. All professional bat hunters (n=19) hunting at these caves were also interviewed using standardized questions to identify caves visited and quantify annual hunting

offtakes. Offtakes were as high as 4000 individuals per caves in one hunting effort. Teeth were extracted from 162 bats (for aging) and deposited in the Histology Department of University of Benin Teaching Hospital, Nigeria for cementum analysis. Age analysis have been delayed due to the COVID-19 pandemic. Once the age distribution is available, hunting sustainability will be modelled.

I also modelled the relationship between *R. aegyptiacus* abundance, environmental variables, and hunting pressure. Results suggest that bats are avoiding more intensely hunted caves or were hunted to local extinction. This study demonstrates the negative impact of high hunting pressure, and also provide the first direct measure of hunting pressure in bats.

Objective 2: Identify the drivers of bat hunting/ bat meat consumption behaviour in southern Nigeria

To disentangle the behavioural dimensions of bat hunting/bat meat consumption, I employed a mixed-method research framework that included focus group discussions, interviews and questionnaires. To aid development of interviews and questionnaire items, I conducted six focus group discussions in each LGA. I administered 19 bat hunting questionnaires based on the Theory of Planned Behaviour (TPB) framework to professional hunters in Boki and Obanliku LGAs. In addition, these hunters were also interviewed in Pigin English (an English creole spoken across Nigeria). A total of 867 TPB bat meat consumption questionnaires were also administered verbally (i.e. an assistant reading the questionnaire to illiterate respondents) across study sites (381 in Boki, 251 in Obanliku and 235 in Akoko-edo). Trained undergraduate research assistants are currently coding questionnaires and transcribing/translating interviews data. The TPB predicts human behaviour by evaluating what social constructs (attitude, social norms, and perceived behavioural control) drives a specific behaviour. Effective intervention plans rely on manipulation of these behavioural constructs. Preliminary data summary suggests that income, availability, and taste as important socio-economic drivers of bat hunting/bat meat consumption across localities. Interactions and strength of the components of behaviour (attitude, subjective norm and perceived behavioural control) will be modelled using Structural Equation Models (SDM).

Objective 3: Locality-specific conservation outreach and development of CITES proposal

As a first step to reduce bat hunting at the study sites, conservation education/outreach programs were conducted in three villages in Buanchor community (Boki LGA). These villages include Mbayang, Okuni and Nkanacha. Education/outreaches were also conducted at the schools in these villages.

Community outreach followed the rural participatory framework and relied on locality-specific ecosystem services data generated from the survey. Adults were engaged in a town hall meeting, during which I covered the ecosystem services of bats using local examples such as *dawa dawa*, an important local spice produced from seeds of the *parkia* sp. tree that is bat pollinated by bats. In additiona, I addressed the consequences of ecological collapse when important pollinators like *R. aegyptiacus become functionally extinct or locally extirpated.* Following these sessions, participants then contributed in a discussion to evaluate conservation intervention options to reduce bat hunting/bat meat consumption. Two major outcomes from this these town hall meetings are:

1. Bat hunting was banned by community leaders in Buanchor community.
2. Cane-rat farming was identified as an alternative livelihood project to significantly reduce bat hunting/ bat meat consumption. This project will be undertaken by Small Mammal Conservation Organisation (SMACON), an NGO that I co-founded. We will fund-raise for the project and deploy it in

partnership with the community within a) in a participatory conservation business partnership with framework. It will make "tasty" meat available at an affordable rate and provide some local employment that should also contribute to the local economy.

Educational items showing local examples of ecosystem services were designed to inspire attitude change and correct misconceptions recorded in the social instruments. Materials used included colourful banners and 400 T-shirts carrying conservation messages.

School conservation outreaches were conducted at both primary and secondary schools. Students made bat crafts with papers and were given exercise books carrying bat conservation messages using local examples. Students/pupils were also educated about bats, and afterwards participated in a question and answer session.

Pre and post Knowledge, Perception, and Attitude data showed a significant improvement in the knowledge of locals about bats and their importance in the ecosystem.

Results from this study shows evidence of transboundary movement of the Egyptian fruit bat meat, and I have initiated discussions with former vice-Chair of the CITES Animals Committee, Rodrigo Medellin to including this bat in CITES appendix. I have also met with Nigerian CITES representatives at the Federal Ministry of Environment for this purpose. A proposal will be drafted after I publish this evidence in a scientific journal.

Lessons Learned: (up to 800 words)

Which project activities and outcomes went well and why?

Several aspects of the project were successful, from field surveys and conservation engagements to capacity building. Firstly, emergence counts for the focal species were successful because I employed multiple surveyors each equipped with a night-vision binocular i. e. trained surveyors at cave entrance counting bats entering and exiting caves with the use of night vision binoculars. Secondly, except for two caves, I was able to access all 41 caves and thus could collect microclimate data, allowing me to meet my minimum samples size. Similarly, questionnaire administration was smooth sailing as local respondents were very cooperative and keen to interact with all administrators. They were so eager to help and engage to the point that my team were often offered food and invited to join family meals. Furthermore, it was a huge relief to see how welcoming the community chiefs and leaders were to my team and our proposal to engage them on bat hunting. In addition, school kids thoroughly bought into the educational materials and shared their newfound enthusiasm for bats with my team members. Perhaps the most fulfilling component of the work was training two graduate students (MSc and PhD) and several local and international undergraduate students

Were there any problems that the project encountered or deviations from original project plan

Beyond the success of the project, I encountered several setbacks ranging from trapping and interviews to lack of mobile communication. As large fruit bats cause considerable damage to nets (despite regular

monitoring of <10 mins), my team dedicated considerable hours to repairing nets throughout the field season. For this, I trained my volunteer field assistants. We were unable to access two caves occupied by bats. Although counts were conducted during emergence at these caves, the lack of microclimate data and cave dimensions precludes their use in the statistical models. Recording cave microclimate data at such caves would require a robot with suction pads.

It was difficult to convince hunters to sit to an interview without providing some renumeration. At least one hunter refused to be interviewed without pay. This was in addition to their general unavailability, being busy most days working on their farms. This translated to spending more time on interviews than previously estimated. In the future, I will plan to interview two hunter per week, versus 2/day as previously proposed. The questionnaires also took much longer than anticipated and were not completed in the first field season. This led to another short field season. Furthermore, administering questionnaires to illiterates was difficult. But to deal with this, I had to develop controlled language and trained my assistants on how to deliver the questions using the standardized language.

Most of the villages lacked mobile network service, limiting communications and impeded my ability to easily find an individual within the village. To alleviate this challenge, I identified a couple of community - based assistants to help find hunters who were not in their homes or had moved away from a previously arranged rendezvous point.

I am not pleased with the outcome of engaging the local CITES desk officer. I had been informed that having evidence as I would gather from this survey should be sufficient to build a case for CITES. But, I promptly learned that was not the case in Nigeria. I was notified that a published paper is the only primary information on which a species can be listed for a CITES recommendation is made. So, the CITES recommendation will have to wait until I have published the results of this research.

Having spent so much time with interviews and questionnaires, my visits to schools got pushed to end of school term, so I missed two target schools. I plan to visit both schools next year (or post-covid).

The most important lesson I learned from this project is the value of working with indigenous knowledge. This was most valuable in the suggested alternative protein. I had originally expected that community members will prefer poultry or cattle as an alternative protein source. The success of alternative livelihood projects is dependent on local buy-in. Our unpublished survey of livelihood projects from the area revealed that local people were not consulted prior to commencement of alternative livelihood projects, neither was the choice of alternative protein source nor management style contemplated between community and NGO. Therefore, for the first time in Buanchor community, we're taking steps to follow a community participatory plan in this intervention plan.

Conclusion: (up to 400 words)

The overarching aim of this project was to ensure long-term conservation of the Egyptian fruit bat in southern via reduced hunting. This will also provide a model for conservation assessment and protection of hunted bat species across West Africa. This study has contributed to a better understanding of bat hunting behaviour and bat meat consumption which forms a critical baseline for conservation intervention for this species. For example, taste, income, and meat availability emerged as important drivers of hunting/consumption and outreach programs specifically targeted these factors. Therefore, a

cane-rat farm has been identified as appropriate alternative protein source and livelihood. This intervention will be executed by SMACON under a participatory conservation business framework. This is a sustainable intervention that will provide comparable taste to bat meat while making meat more available as well as provide employment to community members. Furthermore, SMACON recently received funding support to employ the socio-ecological model developed in this project to evaluate threats to and conserve the endangered short-tailed roundleaf bat.

Hunting is a leading cause of global species extinction, yet its impact on populations and roost use is difficult to quantify, especially in bats where direct measures were previously unavailable. My study provides the first direct measure of bat hunting pressure while highlighting its negative impact on cave bat populations. Always abandoned and non-reusable, hunting sticks at cave entrances provide a direct measure of hunting pressure in south-eastern Nigeria. This data is critical for informing prioritization and conservation of cave bats.

More broadly, capacity building is critical to wildlife conservation in sub-Saharan Africa especially in Nigeria where natural sciences are deemed unattractive. One of my major long-term goals is to build capacity of Nigerian students in conservation ecology and in turn mentor others. During this study, I trained two postgraduate students of the University of Nigeria Nsukka (Chinedu Ngene and Elijah Okwuonu) on field ecology and provided them all needed field equipment to conduct their research. In addition, I also trained three undergraduates (Kelvin Ugwu, Emmanuel Ezema and Oluchi Opara). This aligns perfectly with SMACON's capacity building master plan for Nigeria where students are recruited into conservation science via a volunteer program.