IV. CONSERVATION

Improving Conservation Monitoring by Designing Collaborative Research Programs: Lessons from a Camera-Trap Study in Northern Tanzania

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Abstract

Quantitatively documenting the impact of wildlife conservation programs on their target species (i.e., wildlife monitoring) is an important component of non-profit program management. While statistically rigorous monitoring programs exist in the scientific literature, such programs are generally designed entirely within a quantitative framework and thus ignore valuable data and insight from other sources, particularly non-scientific participants. Incorporating this other expertise may, however, improve the outcomes of such monitoring programs. During my summer research with the African People & Wildlife Fund (APW) in Tanzania, I designed a long-term monitoring program for large carnivores. The first attempt failed. No cats were photographed during the two-week pilot phase. After incorporating local ecological knowledge with help from a team of local wildlife monitoring officers, the Village Game Scouts, the study photographed significantly more cats. By allowing for greater participation by scientifically untrained staff, I was able to create a viable and flexible monitoring study.

Introduction

There is growing recognition of the need for systematic wildlife monitoring by conservation non-profit organizations (Nichols and Williams 2006:668; Stokes et al. 2010: e10294; Walsh et al. 2012:335). Monitoring allows conservationists to determine the ecological success of their work. Much scientific literature focuses on the statistical assumptions underlying the design of wildlife monitoring programs (e.g., Pollock et al. 2002:105; O’Brien 2013:71). However, relatively little attention is paid to other assumptions that influence monitoring study design. There are a variety of socio-political factors that may challenge non-profit monitoring studies, including lack of capacity, resources, or organizational support and

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buy-in from staff. Overcoming the last of these, staff support and buy-in, is critical for the maintenance and success of long-term monitoring programs. However, even nonprofits that manage to address these challenges may struggle to quantify or codify their strategies for doing so and thus lessons learned are not readily transferred across geographies or organizations.

When I arrived in Tanzania in June of 2013, I had two parallel goals for my work with the African People & Wildlife Fund (APW), a small non-profit focused on large carnivore conservation in the Maasai Steppe. My first goal was to establish a long-term monitoring program for large carnivores using camera traps. This well-documented method has been used to study many cryptic species, particularly large carnivores (see O’Connell et al. 2013 for further discussion). My second goal was to train APW’s Tanzanian staff to manage the project after my departure.

While designing and piloting the camera trap study I encountered a major applied research challenge for which the scientific literature provided no solutions. I changed the process used to design and implement the study, which in turn corrected the problems we faced in our applied research. The product was a significantly more successful camera trap study design influenced by local ecological knowledge and supported by significant participation by APW’s locally-trained wildlife monitoring staff. This case study exemplifies how both applied research and implementation processes must be understood and invoked to design successful non-profit based monitoring programs.

**Findings**

My responsibilities with APW began long before my plane touched down in Arusha. As a component of my work, I compiled a bibliography of scientific literature on both camera trapping as a method for estimating wildlife populations, and African carnivore ecology (e.g., Karanth and Nichols 1998:2852 and Balme et al. 2009:433). One of our primary study species, the leopard (*Panthera leo*), is remarkably understudied using this method compared to other elusive and individually-marked large cats such as tigers (*Panthera tigris*) in India and jaguars (*Panthera onca*) in Latin America (Karanth & Nichols 1998:2860; Maffei et al. 2013:119). Despite the critical gap in leopard camera trap studies, the general framework for camera trap studies is well-enough established to now be considered one of the premier methods for studying wide-ranging and elusive species (Nichols et al. 2013:2).

This literature review served two purposes. First, it helped me become familiar with camera trap study design and implementation before arriving in country. The most important factor was the spacing and density of cameras across the landscape, which would influence the types of data we would collect and therefore our analyses. From this literature review, I identified a suitable method designed for a study of leopards in South Africa which could also be used to estimate abundance of lions (*Panthera leo*), cheetahs (*Acinonyx jubatus*), African wild dogs (*Lycaon pictus*), and even spotted hyenas (*Crocuta crocuta*). The literature review’s second purpose was to provide source material for training manuals that APW would use to train wildlife monitoring staff in the future. The camera trap study is meant to be a long-term monitoring program that will run for the next 15 to 20 years, and thus the institutional capacity associated with the camera study must be easily transferable. This was particularly necessary given that I
would only be on the ground for 10 weeks. An unintended consequence of this literature review was that the process for designing the study was restricted to the material available in scientific publications, a limitation which would later hinder the collection of monitoring data.

During the first few weeks of my project, I spent time getting to know the wildlife staff at APW. James, the wildlife monitoring officer and my work partner, was primarily responsible for all wildlife monitoring activity such as spoor (footprint) tracking and game counting and would lead the camera trap study after my departure. James received his masters of science in wildlife management from the Sokoine University of Agriculture and speaks fluent English and Kiswahili. The Village Game Scouts (VGS), a government-trained paramilitary team of eight local community members, were responsible for patrolling the village property and ensuring compliance with community-dictated laws about natural resource use. Their primary function was to prevent the creation of charcoal — a major cause of deforestation — but they also assisted on game counts and spoor tracking exercises. They would be integral in the continued maintenance of the camera trap study. Of the eight VGS, none had a college degree, only one was a woman, and only the leader, Robert, spoke English; the rest spoke Kiswahili and other local languages. Despite the disparity in language and scientific training, it was evident to me that the VGS had gained a great deal of ecological expertise on the wildlife that moved through the village land.

After sorting out the logistical details of the study, including the custom iron security boxes and cement-based poles on which the cameras would be fixed, James and I agreed to use the methods described in my literature to place cameras across the village land. We created a grid of cells with equal areas of 2 km$^2$, located the GPS location of the intersection of the cells, and placed a pair of cameras at each location as in Figure 1.

We determined the height and angle of the cameras depending on the location to improve the cameras’ potential for capturing images of carnivores, and set the shutter speeds in order to maximize the number of images taken of each individual that passed the lens. While we suspected that some camera locations would not return many photos because they were in places not likely used by carnivores (i.e., the center of a savanna), others were in ideal locations, such as the bottleneck-like pass between two large hills. Since the randomness of the success of each pair of cameras was a critical factor underlying the statistical rigor of the method, we decided that leaving the cameras in unlikely places was scientifically appropriate.

We set the cameras and left them for a full two weeks before checking to see if any photos had been taken. Collectively the cam-
eras recorded 1,530 animal photographs during the test period. To our dismay, however, the photos could not be used to estimate leopard populations. Only six species were photographed in total and there were no photographs of any of the larger predators of interest in our study. Even our “ideal” bottleneck location only returned 800 photographs of dik-dik (*Madoqua kirkii*), a tiny, domestic cat-sized antelope. The scientific study failed to meet our goal of photographing big cats.

Having invested so much time and energy into the project, James and I were disheartened that our cameras were not capturing images of the big cats. It *should* have worked, because it had worked before in other places. That night at dinner, James and the VGS struck up a conversation about the cameras. One of the scouts mentioned casually that the cameras were just not in places where the animals were; the carnivores had specific trails and places where they traveled across the village. After James translated for me, the scout’s statement of our problem set my mind racing. There had to be a way to adapt the camera trap method to account for heterogeneity in wildlife movement across the landscape.

The next day, James and I sat down with Peter (APW’s General Manager and logistics guru) to brainstorm ways to adapt the study. During our discussion, I referenced the scientific literature to examine again the reason for the study’s geographic structure. Having the cameras regularly spaced ensured that no individual animal had a 0% probability of being photographed; i.e., that all individuals with territories in the study area had at least one camera located within their territories. From the literature on leopard ecology, I knew that leopard home ranges were much larger than two square kilometers and thus the cells were appropriately sized (see Stoner 2014:16 for further discussion). For this reason, I argued that the original grid should be maintained. The solution would lie in the placement of the stations themselves. But how to select the new locations?

Peter proposed we use Google Earth as a tool to assess the landscape from a bird’s eye point of view. This would allow us to understand how landscape features might influence carnivore movements. After laying our grid over the study area, we started selecting and flagging potential sites for stations. It quickly became clear that our newest problem would not be finding the locations, but selecting from among many potential locations within each cell (Figure 2).

For several days, James, Peter and I debated the merits of various strategies (i.e., placing cameras at the crossing of streambeds, or at bottlenecks through blocks of forest, or along roads) before I suggested that we allow the VGS to select the locations. Given their extensive patrols around the vil-

![Figure 2](image-url)
lage land, I argued that they had intimate knowledge of the landscape and the wildlife movements. Peter and James agreed to test the VGS' knowledge by allowing them to dictate the location of the camera stations.

The following day, we returned to the field with the scouts and the cameras. After examining all the potential sites in the first cell, I asked Robert his opinion on the best location for the camera station. After he identified the one the VGS thought was best, James turned to the ten-person field crew and instructed them to place the cameras. Robert and the VGS started protesting, asking why we were doing this instead of using our expertise.

“Well, our scientific process didn’t work the first time so now we are going to do what you think is best, since you know this area better than we do,” I said to him. At first Robert seemed skeptical, but after placing the third station he and the other VGS took more authority in the process. They stopped deferring to James and me before selecting a site, and started working directly with the field crew to place and test the cameras.

The results were both definitive and astounding. Another two weeks of testing resulted in more than 12,000 wildlife photographs. The cameras documented 131 photos of leopards and 7 photos of lions, as well as photos of 44 other species of birds and mammals found in the region.

These results allowed us to estimate a density of leopards between 11 and 19 individuals per 100 square kilometers, comparable to well-known national parks in other parts of East Africa. Furthermore, the VGS took on greater responsibility in maintaining the program following my departure from Tanzania. The program had succeeded in meeting both of my goals: to monitor large carnivore populations, and to build capacity amongst the staff at APW.

**Conclusion**

I have presented here a unique case in which a statistically rigorous and well-documented camera trap study failed to achieve its goal of estimating local carnivore populations, while a study that utilized the local ecological expertise of non-profit staff yielded valuable results. We assumed that scientific sources would be enough to inform the study’s design. However in this instance adapting the implementation of the study and allowing for the inclusion of insights of scientifically untrained participants improved the local applicability of the camera trap method and improved its results. It was only by acknowledging our assumption that local knowledge had nothing valuable to contribute and changing our approach to designing the study that I was able to create an effective monitoring program.

**Endnote**

1. Names changed to protect privacy of the participants.

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