

Final Report for Leakey Foundation Grant “Comparative Ecology of Two Chimpanzee Communities in Kibale National Park, Uganda”.

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In my dissertation, I examined the influence of a heterogeneous landscape on the ecology, habitat use patterns, and demography of a population of chimpanzees (*Pan troglodytes*) in Kibale National Park, Uganda. This population is unevenly distributed in social groups of widely varying size and density. Additionally, an ecological gradient exists within the park such that environmental factors considerably vary both within and among sites in ways that are potentially important for chimpanzee ecology, behavior, and fitness. Kibale thus provides a unique opportunity in which to investigate relationships between fine-scale habitat variability and behavioral and population ecology of a large-bodied and wide-ranging frugivorous primate. More specifically, I sought to address two primary questions in my dissertation research. First, what ecological factors influence primate abundance across fine-scale habitat gradients at multiple spatial scales? Second, what are the consequences of fine-scale habitat heterogeneity for proxies of fitness in primates?

I partitioned this research into three main sections addressing the following three issues. First, what is the extent of habitat heterogeneity between two Kibale sites (Ngogo and Kanyawara) varying in chimpanzee density by an order of magnitude of 3x (but separated by only 10 km), and what are the most relevant characteristics of this heterogeneity? Second, what is the extent of habitat heterogeneity within a single Kibale site (Ngogo), and how does this influence chimpanzee habitat use? Finally, how does foraging efficiency (as a proxy of fitness) vary between these two Kibale sites.

To address the first two questions, I conducted extensive botanical sampling at each site. I enumerated and measured trees and figs within randomly placed vegetation plots (52 plots of 50X50 m at each site). To address the third question, field assistants and I conducted direct focal follows of individual chimpanzees at both Ngogo and Kanyawara. We collected data on the time individuals spent feeding in a discrete food patch, the rate at which they consumed items during feeding bouts, and the distance they moved between feeding sites. I also collected representative samples of several of the most commonly consumed plant items in the Ngogo chimpanzee diet, preserved these samples in the field, and had them analyzed for macronutrient content in a biochemistry lab in Berlin, Germany (Leibniz Institute for Zoo and Wildlife Research). Published data from Kanyawara were available, so I conducted nutritional analyses at Ngogo only. These data together allowed me to quantify foraging efficiency of chimpanzees at each site as net caloric input relative to output for each combination of feeding bout and traveling bout from one feeding site to another.

Through this research, I was able to demonstrate that ecological heterogeneity relevant to chimpanzees exists at multiple spatial scales in Kibale National Park, and that the influence of this heterogeneity on chimpanzee grouping patterns and population ecology is scale-dependent. Within-site floristic heterogeneity has resulted in chimpanzee grouping patterns that track the availability of either high food abundance resources (i.e., foods available primarily during times of habitat-wide fruit abundance) or asynchronously-produced low food abundance resources (i.e., fruit resources primarily available during times of low habitat-wide fruit abundance and produced asynchronously among individuals of the same species), depending on the time scale analyzed.

Conversely, between-site heterogeneity has led to a higher population density of chimpanzees at a site with a high basal area of synchronously-produced low food abundance resources (Ngogo) than at a site in the same forest with a relatively low basal area of these resources (Kanyawara).

Finally, I discovered that foraging efficiency differs considerably between chimpanzees at Ngogo and Kanyawara. Chimpanzees at the high density site (Ngogo) had higher average net caloric intake rates over several time scales, and these values were less variable among days and months at this site (Figures 1 and 2).

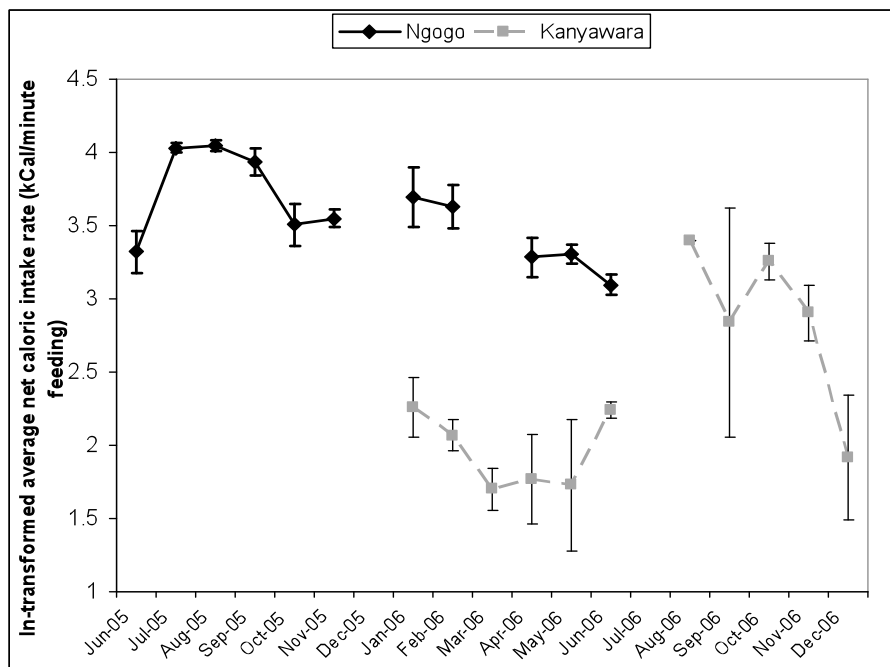


Figure 1 – Inter-site comparison of net caloric gain rates across months (kcal/min feeding/day, ln-transformed) ±1 standard error

If it is reasonable to assume that high foraging efficiency that varies relatively little over time influences the potential for reproductive output of resident females (as well as survivorship of all individuals), then these results can aid in explaining the disparity in population density between the sites. In sum, this dissertation revealed that

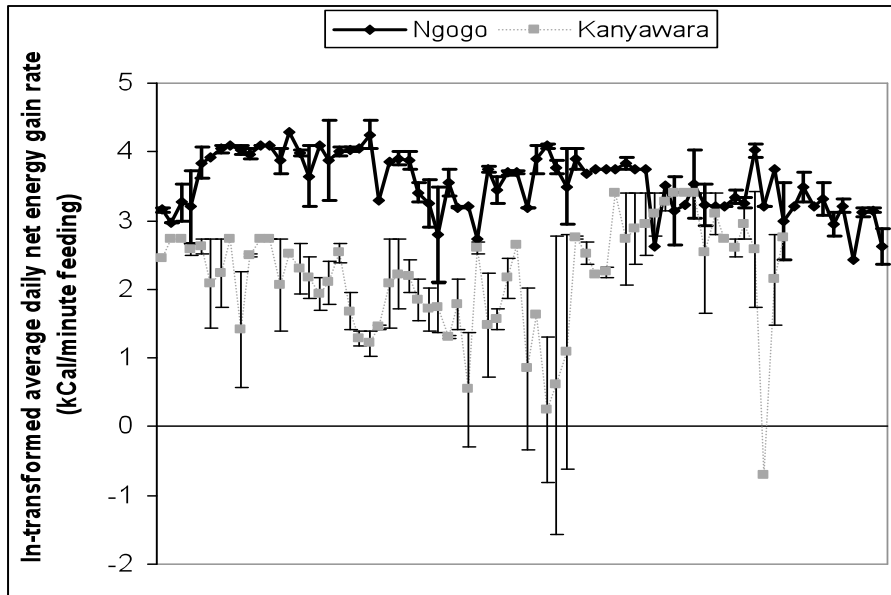


Figure 2 – Inter-site comparison of average net caloric gain rates across days (kcal/min feeding/bout, ln-transformed) ± 1 SE. Note that the days represented are different for each site – the plots were shifted along the x-axis to appear overlapping to facilitate comparisons.

behavioral responses of chimpanzees to a heterogeneous foraging environment are dictated by different factors than are longer-term fitness responses to heterogeneity at a larger spatial scale.

Several studies attest to the importance of scale in interpreting habitat influences on animal grouping patterns and population dynamics. Many of these previous studies found that environmental factors influencing habitat use within an established home range differed from those influencing population density and/or site selection among home ranges. Similarly, the results presented here suggest that the interpretation of which habitat factors most directly limit chimpanzee habitat use and population ecology are different depending on the scale of analysis.

Although informative, these results require further examination to be fully substantiated. For example, an obvious limitation of this study was its sample size. In order to more fully address the role of fine-scale habitat heterogeneity on the population

ecology of chimpanzees (including demographic patterns and population structure), an expansion of research to more sites within Kibale will be necessary.

Additionally, more intensive and detailed nutritional analysis is necessary to further substantiate several of the findings of my dissertation. Data on the caloric content of plant material consumed by chimpanzees was critical to the establishment of quantitative foraging efficiency measures in my dissertation. However, in several cases these data were derived from unfortunately small sample sizes, due to inherent constraints of collecting and preserving plant material that was, in many cases, rare and not easily obtained. The findings of my dissertation would therefore benefit greatly from a continuation of the plant collection and analysis protocol I used in my research.

Publications resulting from my dissertation fieldwork include:

Potts KB, Watts DP, Wrangham RW. 2011. Comparative feeding ecology of two communities of chimpanzees (*Pan troglodytes*) in Kibale National Park, Uganda. *International Journal of Primatology* 32: 669-690.

Potts KB. 2011. The long-term influence of timber harvesting on the resource base of chimpanzees in Kibale National Park, Uganda. *Biotropica* 43: 256-264.

Hohmann G, Potts KB, N'Guessan A, Fowler A, Sommer V, Mundry R, Ganzhorn J, and Ortmann S. 2010. Plant foods consumed by *Pan*: exploring the variation of nutritional quality across Africa. *American Journal of Physical Anthropology* 141: 476-485.

Potts KB, Chapman CA, and Lwanga JS. 2009. Floristic heterogeneity between forested sites in Kibale National Park, Uganda: insights into the fine-scale determinants of density in a large-bodied frugivorous primate. *Journal of Animal Ecology* 78: 1269-1277.