Body growth in wild mountain gorillas (Gorilla beringei beringei) from Volcanoes National Park, Rwanda

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INTRODUCTION

Physical ontogeny has figured prominently in approaches to understand the evolution of primate life histories, as investments in body and brain growth influence energy allocation to other functions such as reproduction (e.g., Leigh & Bunnquist 2007). Long-term data accumulating across study sites is demonstrating more diversity than previously recognized in life history characteristics within and among great ape taxa in the wild. However, our knowledge of the physical ontogeny of known-aged great apes remains overwhelmingly derived from captive studies, and from chimpanzees, with a few notable exceptions (e.g., Mathieu et al. in press; Pouyé et al. 2005; Smith & Bouchard 2011; Thiman et al. 2007). As captive environments differ significantly from natural settings, systematic investigations of factors influencing variation in postnatal ontogeny in the wild are critically needed to build a comprehensive understanding of socio-ecological influences on age-life history and establish a more salient comparative framework for understanding human life history evolution.

The major objective of this study was to use non-invasive photogrammetry to generate the first data on body growth in wild Virunga mountain gorillas of known age and age history from Volcanoes National Park, Rwanda.

MATERIALS AND METHODS

We used non-invasive parallel laser photogrammetry to characterize growth of morphological dimensions in wild Virunga mountain gorillas monitored by the Karisoke Research Center, Rwanda.

- **SAMPLE**: 115 individuals (54 males, aged 0.36 – 35.28 years; 61 females, aged 2.45 – 32.29 years) from eight social groups. All individuals were photographed from Nov. 2011 – Mar. 2014. Data are treated cross-sectionally for analyses here.

- **METHOD**: The parallel laser apparatus and protocol follows Rothman et al. (2008), with some modifications. (FIGURE 1. For each individual, we targeted a set of 3-5 photos for each of five linear measurements (modified from Breuer et al; 2007; Anton & Surovell 2009; FIGURE 2). For any single measurement, the mean CV between photos was 0.014 (range: 0.006-0.049; mean CV=0.056 (range: 0.000-0.378) for ear-cresc length. The mean value across photos was analyzed using LOESS regression (Cleveland 1979; Jacoby 2000).

RESULTS

- **For body length**, male and female distance curves overlap from 2.5 – 7 years of age. (Females <2.5 years of age are not represented.) Female growth velocity declines after 7 years of age, and a mean 95% of adult body length is reached by 15 years of age. The male velocity curve shows evidence of a plateau or slight increase in growth rate from 7 – 9 years of age. Males reach a mean 95% adult body length at 13 years of age, based on the LOESS distance curve, full adult size is estimated at approximately 14 years of age for males.

- **Other body dimensions** show similar patterns, though with differences in timing. For example:
  - For **shoulder breadth**, male and female distance curves diverge after 5 years. Female growth velocity declines after 7 years; mean 95% of adult size is reached by 12 years. The male velocity curve shows evidence of a plateau in growth rate from approximately 7 – 11 years. Males reach a mean 95% adult size at 15 years of age.
  - For **ear-cresc length**, males show higher growth velocities compared to females after 2.5 years of age. The male velocity curve shows evidence of a plateau or slight increase in growth rate from approximately 6 – 10 years. Males reach a mean 95% adult size by 12 years of age.

CONCLUSIONS

- Despite limitations of the cross-sectional sample, clear patterns emerge in the growth of wild Virunga mountain gorillas. Across measures, male and female size differences become evident between 5-7 years of age. Thereafter, female growth velocities decline, while males show evidence of a plateau or slight increase in growth rate until 5-9 years of age. Females and males reach a mean 95% of adult body length by 11 and 13 years, respectively. Other measures show variation in attainment of adult size (F: 10-12 yr; M: 15-16 yr).

- When examined in the context of life history: male mean age at first reproduction was 16% of adult female body length. While males have sired offspring as early as 8.5 years, dispersal occurs at a mean age of 15.6 years, after full adult body length is reached. Shoulder breadth and ear-cresc length may increase slightly thereafter. Females reached a mean 95% of adult body length by 9.9 years, mean age at first birth. However, some females give birth considerably earlier, as young as 7.9 years. It is noteworthy that while this coincides with a period of declining growth rates, it is not uncommon for females to invest in reproduction well before their own growth is completed. Longitudinal data collection is ongoing to explore individual variation in growth and life history.

- While comparative data are scarce, an interesting contrast characteristics wild mountain and western gorillas. Male mountain gorillas reach adult body length by 14 years of age, as estimated here by LOESS regression. This is 3.5 years earlier than reported for male western gorillas at Mikeno-Bai, Congo (Breuer et al. 2009). Continued data collection at both sites is planned to explore these differences.

- It is also worth noting that linear growth trends for mountain gorillas resemble those described previously for body mass in captive gorillas by Leigh and Shea (1996), with some differences. In the latter study, male and female mass trajectories diverge at 6-7 years of age, peak mass velocity was attained at approximately 3 years, and females reached adult size by 9.5-10 years; the latter is earlier than found here for most linear measurements of mountain gorillas.

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