

Bigger is Not Better: Unexpected Relationship Between Prey Body Size and Macronutrient Composition in Eastern African Mammals



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Introduction

- Reconstructions of hominin diets often assume a positive relationship between proportional body fat and body size in prey species¹⁰
- The assumption that larger game are fatter has been fundamental in understanding early hominin hunting strategies and metabolic requirements (e.g., avoiding rabbit starvation)^{7, 8, 10, 19, 20, 22}
- This assumption is based on estimates derived from non-African species and/or domesticated mammals, as proxies for wild African mammals¹⁷
- We first test the validity that body size is a positive predictor of body fat in relative amounts of muscle in North American mammals**
- Then we test this relationship in African mammals by compiling macronutritional data on edible muscle and on African ruminant carcass proportions**

Methods

- Tested the positive relationship between body size and fat composition in North American mammals by removing the problematic genera (domesticated species, marine mammals and humans)¹⁷
- Compiled relative nutritional and mean live body weight (LBW) data of contemporary Eastern African mammals inhabiting an open savanna-grassland environment from published datasets^{14, 16}
- Standardized protein and lipid percentages of African mammals to 100g of edible dry weight collected from muscle samples^{14, 16}
- Calculated the relative proportions of edible fat available in African ruminants^{5, 15}
- Log-transformed and ran a linear model and regression to assess the relationship between body size and fat composition in African mammals
- Assessed the relative nutritional composition of small (< 5kg) versus large game (>5kg) in African mammals^{1, 4}

The positive relationship between body size and relative body fat in North American mammals stays the same after the removal of problematic genera

Fig.1 North American Mammals Body Fat Composition

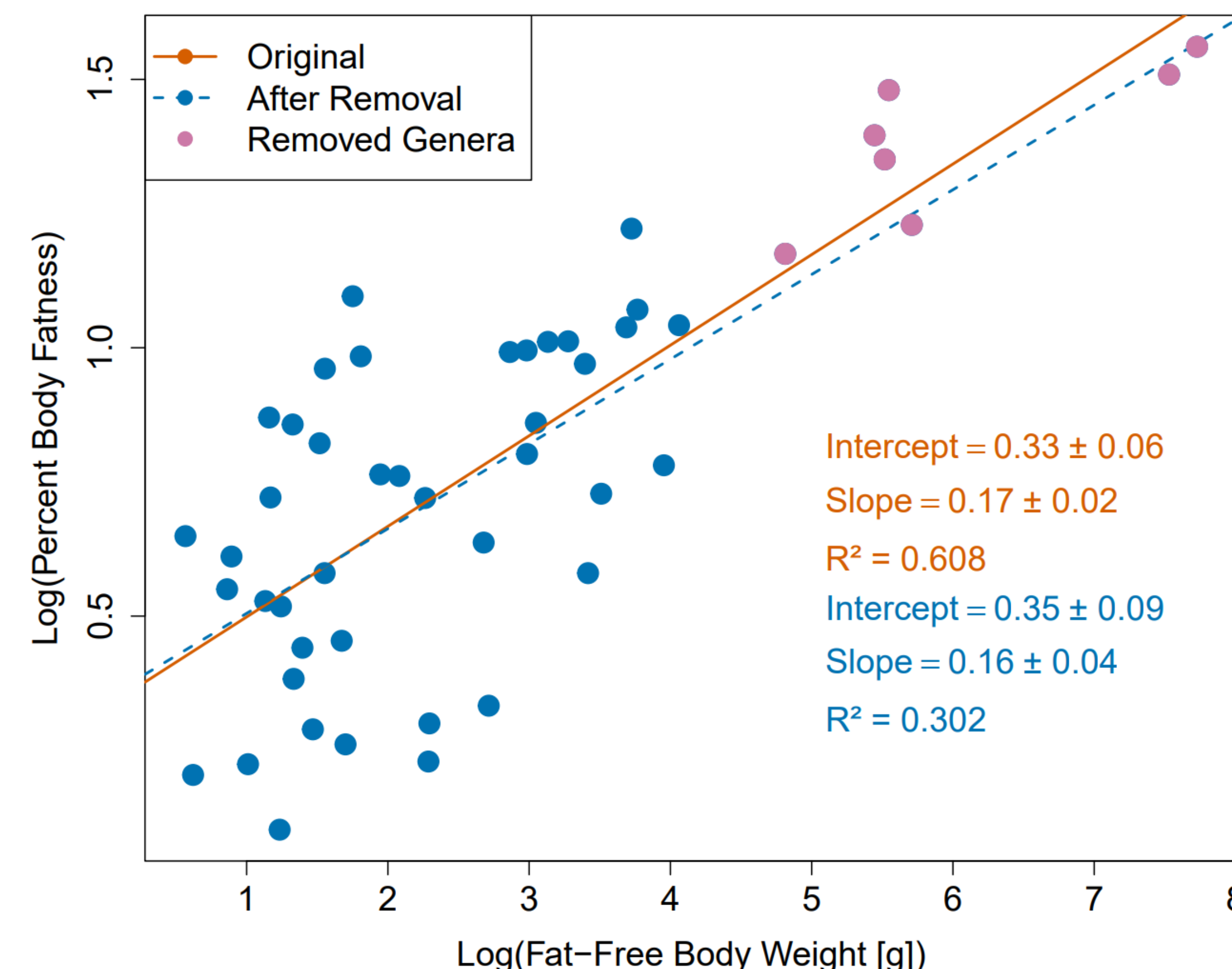


Figure 1: Pitts & Bullard (1968) before and after removing the problematic genera *Homo*, *Equus*, *Bos*, *Balaenoptera* (blue whales), and *Sibbaldus* (blue whales)

There is a negative relationship between body size and relative body fat in Eastern African mammals

Fig 2. African Mammal Body Fat Composition

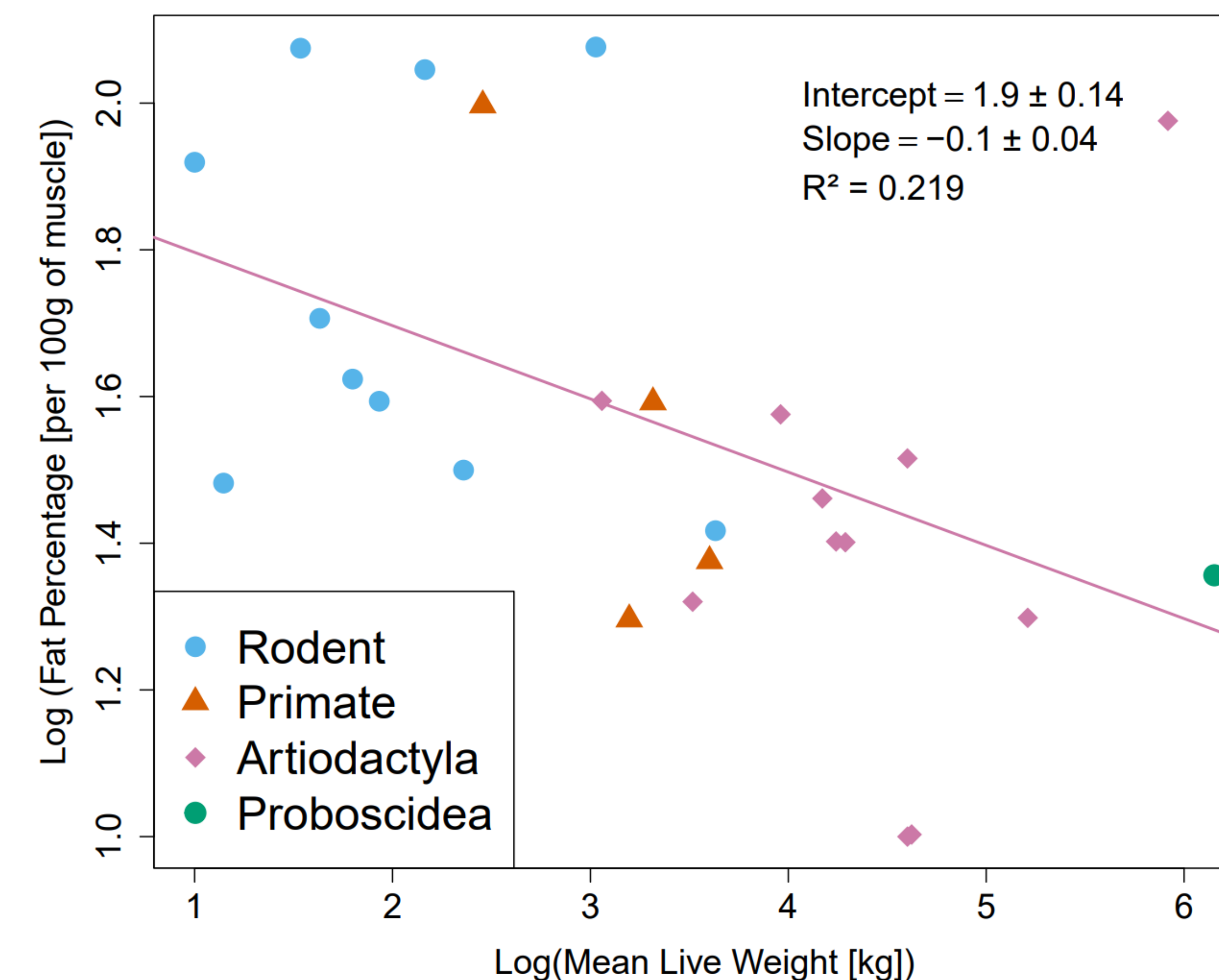


Figure 2: African mammals (small and large game) body fat percentage (per 100 grams of edible muscle) vs mean live weight (kg)

The relationship between relative fat composition and body size remains negative when considering the edible carcass in Eastern African ruminants

Fig. 3 African Ruminant Relative Carcass Fat Composition

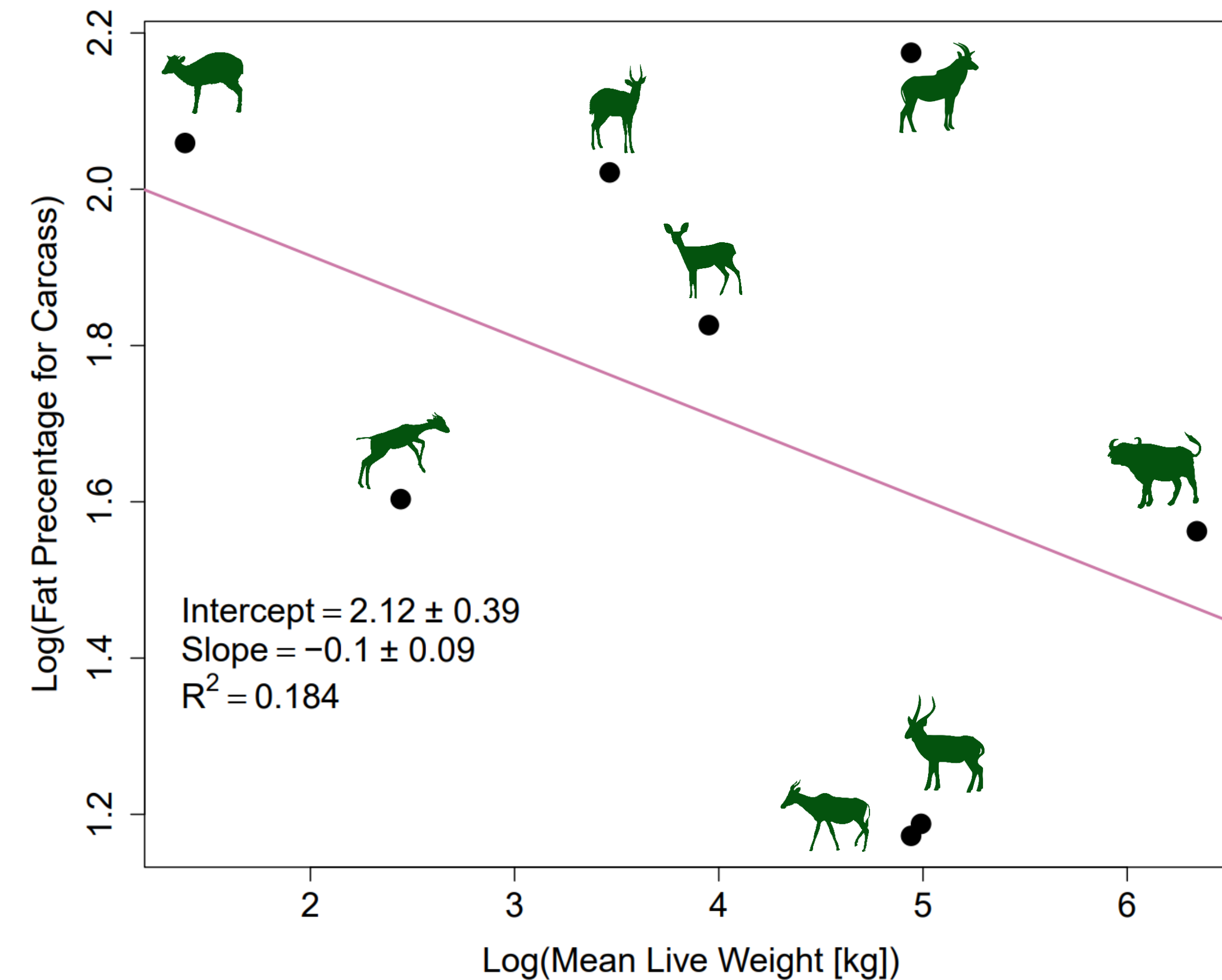


Figure 3: Relative carcass fat composition of African ruminants calculated from the edible portion (not including ash or moisture) of muscle, viscera, stomach contents, flesh, bone, and marrow (Van Zyl et al. 2004; Blumenschine et al. 1986; Ockerman et al. 2014). Average % of tissues for ruminants are based on gazelle, impala, and wildebeest samples (Blumenschine et al. 1986)

Relative body fat composition from muscle in Eastern African small game is higher and more variable than within large game

Fig. 4 Relative Fat Composition by Game Size

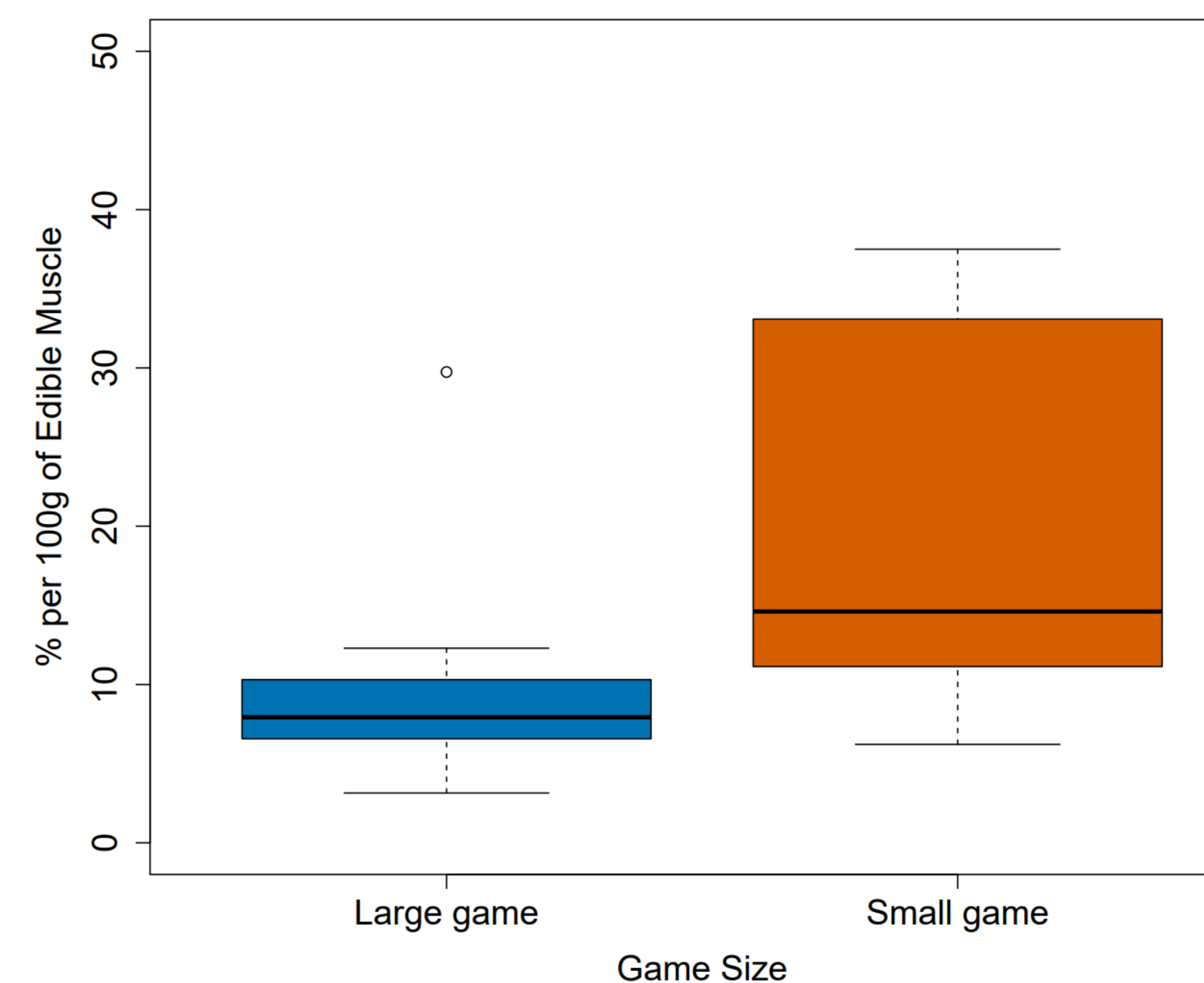


Figure 4: Small game (< 5kg) and large game (> 5kg) relative fat composition calculated from 100g of edible muscle and mean live body weight (kg)

Results

- After the removal of problematic genera, the positive relationship between body size and relative body fat in North American mammals remains supported
- The relationship between body size and relative body fat in African mammals demonstrates a slightly negative relationship indicating that as size increases, their relative body fat decreases**
- When considering all edible components of a carcass, eastern African ruminants maintain a similar negative relationship**
- Eastern African small game (< 5kg) is fatter per 100g of edible muscle than large game (> 5 kg)

Discussion

- The positive association in North American mammals may reflect latitudinal influences, such as increased seasonality and temperature variability at higher latitudes²¹
- For understanding hominin evolution, African mammals offer a more suitable proxy for body composition analysis and dietary reconstruction
- Bigger is not necessarily better when it comes to consuming large quantities of fat in Eastern African mammals**
- Relative nutritional content is the most reported nutritional data, assessing absolute composition may tell a different story
- It is important to revisit the hypothetical diets of hunter-gatherers and earlier hominins with an adjusted framework that considers the data presented here^{3, 9, 10}
- Small game, often overlooked due to preservation bias, show higher fat content per 100g than large game^{18, 20}

References & Supplementary Information →

