

**URINARY STABLE ISOTOPE RATIOS INDICATE NUTRITIONAL STRESS IN BONOBOS**

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In recent years, stable isotope analysis has become a powerful tool for animal ecologists in a number of different fields. While the major focus of research has been on topics such as identifying trophic levels, dietary composition or migration, only recently have stable isotopes been incorporated into the study of nutritional stress. Using bone, muscle tissue, blood and hair as materials, these past studies proved the utility of stable isotope analysis as an indicator of nitrogen balance. However, it is unknown if nutritional stress can also be monitored by stable isotope ratios in urine. Here we present the results of a food restriction experiment carried out on a group of captive bonobos (N=7). We measured changes in energy availability and body weight and determined stable isotope ratios in 280 urine samples by mass spectrometry analysis. During two weeks of food restriction, energy intake of the entire group was gradually reduced until at the end of the restriction period the animals had on average a 30% lower daily energy intake. Urinary  $\delta^{15}\text{N}$  increased and C/N ratios decreased, as did individual body weight. During the following two weeks, energy availability was gradually increased. Body weight increased and was associated with a simultaneous decrease in urinary  $\delta^{15}\text{N}$  and an increase in C/N ratios. Our results indicate that urinary  $\delta^{15}\text{N}$  as well as the C/N ratio are suitable to monitor moderate longitudinal changes in food availability and body weight. We therefore conclude that the measurement of urinary stable isotope ratios of wild apes could be a promising method to identify variation in individual energy status.

Keywords: nutritional stress, stable isotopes, bonobos, urine