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Estimation of body temperature of Bornean orangutans (*Pongo pygmaeus wurmbii*) from fecal temperature measurements

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Monitoring health status is a critical aspect of primate conservation, yet can be difficult to noninvasively investigate in the wild. Internal body temperature, a marker of health in endotherms, has been tested in humans and chimpanzees using two different fecal temperature methods: using the peak internal temperature (PIT) or applying a sigmoid curve (SC). We tested both methods on wild and rehabilitant Bornean orangutans to determine if either is a feasible methodology for arboreal mammals. The SC method involves a series of temperatures for each sample that we fitted to a sigmoid curve, whereas the PIT method involved a single peak temperature recording. Estimates from the two methods were not significantly different in either our wild ($T(88)= -2.0781$, $P=0.0406$) or rehabilitant ($T(29)= -2.8404$, $P=0.0082$) samples. Adult rehabilitant body temperatures ($N=9$; $34.62 \pm 1.32°C$) were estimated to be hotter than those in the wild ($N=107$; $33.59 \pm 1.66°C$), although not significantly different ($T(115)=1.9859$; $P=0.0493$). In our model, testing a number of factors, we found height of fecal drop ($P=0.0071$), fecal weight ($P=0.0198$), and time of day ($P=0.0029$) to significantly affect body temperature estimates. Our field sample ($N=107$) indicates that wild orangutans have an internal fecal temperature, ranging between 29.5 and 37.3°C, lower than mean temperatures for chimpanzees or humans. This supports the finding that orangutans have lower metabolic rates than do most other eutherian mammals. Lower body temperature may serve as a metabolic adaptation of orangutans to survive extended periods of low food availability when energy needs to be conserved.

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