Early Detection of Limb Inflammation in Captive Giraffes Using Infrared Thermography and Video-Based Gait Analysis

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Foot and limb ailments are a major welfare concern for giraffes (Giraffa camelopardalis) under human care and are a leading cause of lameness and sedation. Because sedation in giraffes carries significant challenges, zoological institutions require practical, non-invasive methods for early detection of limb impairment. This multi-institutional study evaluated the use of infrared thermography combined with video-based gait analysis to identify hoof inflammation and locomotor abnormalities in captive giraffes.

Data were collected from 43 giraffes housed across six AZA and ZAA-accredited facilities in the United States. Thermographic images of all four hooves were captured using a FLIR® E76 infrared camera, while gait metrics were analyzed through digital video assessment in ImageJ. Relative stride length, stride regularity, and neck range of motion were used as indicators of locomotor impairment. Inflammation was identified using thermal asymmetries of ≥2 °C between corresponding hooves.

Inflammation prevalence increased significantly with age, with all geriatric individuals exhibiting detectable inflammation ($\chi^2 = 23.86$, $p < 0.0001$). Giraffes with inflammation demonstrated shorter stride indices ($\chi^2 = 14.77$, $p < 0.0001$), increased stride irregularity ($\chi^2 = 34.38$, $p < 0.0001$), and greater asymmetry in head and neck movement during locomotion ($\chi^2 = 12.90$, $p = 0.003$).

These findings demonstrate that thermography paired with standardized gait analysis can provide an effective, non-invasive approach for early detection of limb inflammation in giraffes. This methodology offers zoological professionals a practical welfare-monitoring tool that may reduce the need for sedation, improve treatment outcomes, and support long-term management of aging giraffe populations. The techniques developed in this study may also be adaptable for monitoring other large ungulates in managed care.