A VALIDATION STUDY OF FAT SCORING AS AN ESTIMATION OF BODY CONDITION IN *CARDINALIDAE SPP.*

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Abstract

Body condition indices are widely used in wildlife biology and domestic and exotic animal management to assess an individual's health status. While the definition can vary, it most commonly refers to the assessment of subcutaneous fat stores (Lobocha and Hayes, 2012). With its correlation to individual survivability (Blums *et al*., 2005) and reproductive success, (Chastel *et al*., 1995; Bêty *et al*., 2003), accurate body condition scores can be critical in assessing the health of wild and captive birds. One of the oldest and most used tools for assessing avian body condition is fat scoring, where the color and coverage of the furcular and abdominal fat pads are used to estimate fat reserve quantities (Blanchard, 1941; Helms and Drury, 1960). Fat scoring is a quick and effective method of estimating body condition (Kaiser, 1993; Labocha and Hayes, 2012). However, fat scoring is a qualitative measurement and whole-body lipid composition is only accurately determined via chemical extraction which can only be performed on deceased individuals. The goal of this study was to determine the relationship between fat score, morphological measurements and percent body fat measured via lipid extraction in the family *Cardinalidae.* Four species from four genera were used to represent the family: 5 Scarlet Tanagers (*Piranga olivacea*), 4 Indigo Buntings (*Passerina cyanea*), 6 Northern Cardinals (*Cardinalis cardinalis*), and 2 Rose-breasted Grosbeaks (*Pheucticus ludovicianus*). All birds, likely succumbed to injuries associated with building collisions, were collected by *Lights Out DC,* City Wildlife (Washington, DC) and donated to the Smithsonian National Zoo and Conservation Biology Institute (NZCBI). Birds were scored using the ESF system (Redfern and Clark, 2001) (0-8) with the addition of a 0.5 "Trace" score between 0 and 1. Body scoring was done by one NZCBI clinical zoo nutritionist with extensive experience. Also measured were body weight, muscle meter score (Powell *et al*., 2021), tarsus length, and wing chord length. Birds were defeathered and dissected to remove furcular and abdominal fat pads. Beaks and legs (just superior to the intertarsal joint) were removed to aid in homogenization. Lipid content in these areas has been deemed negligible (Wenker *et al*., 2022). Crude fat (CF%) content of fat pads and the dried, homogenized carcass was measured using an ANKOM Fat Extractor. Birds scored between 0.5-6, and total body fat (BF%) on a fresh weight basis ranged from 0.9% to 21.1%. Only fat score had a significant correlation with BF% ($R^2 = 0.8457$ $P < 0.001$). Fat score was significantly correlated with carcass CF% ($R^2 = 0.7619$, $P < 0.001$), fat mass of fat pads ($R^2 = 0.716$, $P < 0.001$), and carcass fat mass ($R^2 = 0.8121$, $P < 0.001$). CF% of fat pads was not correlated with fat score ($P > 0.05$). Carcass fat mass was also correlated with body mass ($R^2 = 0.8121$, $P < 0.001$), but fat mass of fat pads was not ($P > 0.05$). In conclusion, the data show that fat scoring is an accurate estimate of body fat in the passerine family *Cardinalidae* while morphological metrics are not.

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