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Michael D. Brawner, PhD student

Advisor: Rebecca C. Terry, Assistant Professor

Specimen Loan Request

To: Philip Lavretsky, Curator

Museum: University of Texas at El Paso Biodiversity Collections

Collections: Ornithology

Material: Paired study skins and skeletal elements (sternum)

Species: American Kestrel (*Falco sparverius*)

Quantity: 19

Purpose: Compare measurements of body size between skin and skeletal elements

Duration of loan: One month

Storage of loan: Delta Designs Series 800 storage cabinets

Analytical methods: Non-destructive measurement and 3D imaging

Scientific merit: Provide robust justification of the use of museum study skins to study the temporal dynamics and ecology of body size in bird species

Signed: Michael D. Brawner

Signed: Rebecca C. Terry

Project objectives:

My research seeks to understand the regulation of body size gradients in endothermic animals across large spatial and temporal scales and the evolutionary and/or ecological consequences when such patterns are altered. Body size is one of the most fundamental attributes of an organism, and changes in the mean or variation of this trait in a species or population could have wide ranging population, community and ecosystem level consequences. I use a variety of data sources and techniques to explore questions related to this topic among North American raptor species including museum specimens, historical banding records, morphometric analysis and stable isotope biochemistry. Specifically, I am testing long-standing hypotheses on biogeographic patterns and the relationship between body size, niche dynamics and population dynamics. Central to this research is accurately representing body size in a repeatable, precise way that allows comparisons among populations in both space and time. If preserved bird skins can provide a reliable measure of body size, the abundance of specimens housed in museums around the US represent a potentially large and critical source of data for this work. ***It is the objective of this project to determine how body size measured from preserved study skins compares to body size measured from skeletal elements of the same individual.*** Since skeletal elements are less subject to variation over a fully mature individual's lifetime, we assume that measurements from skeletal elements are a truer representation of structural size. We will employ traditional measurement techniques in combination with 3D imaging to answer this question.

How to define body size is not a trivial question. Over the years, a wide variety of body size proxies have been used to characterize this trait ranging from single morphometric characteristics, often based on correlative analyses to another morphometric trait, or combinations of morphological characters that define a "body size score". Each of these has its drawbacks which can be driven by, among other things, seasonal patterns in traits due to life history stages or selective forces acting in different directions among traits. In studies of birds, wing length or tarsus length are often used as a proxy for body size, but there is evidence that single characteristics are insufficient for determining body size. A common alternative method has been to use the first principle component from a principle components analysis performed on several morphological characteristics as a more robust measure of characterizing structural body size. With the exception of a handful of species, the relationship between measures of external characteristics (e.g. wing, feather, beak, tarsus length, or combinations thereof) and internal skeletal elements (likely more representative of overall structural size) have not been examined. In order to justify the use of museum specimens as a source of body size data in our own research on the historical significance of body size in American kestrels (*Falco sparverius*), and to add to the literature regarding this understudied topic, we propose an individual, paired comparison of size measurements from study skins and the sternal elements of American kestrel specimens. We, therefore, request the loan of ***nineteen specimens*** from the University of Texas at El Paso Biodiversity Collections (UTEP), identified from the Arctos online database as having both prepared study skins and skeletal elements, for ***non-destructive measurement and 3D imaging***; see list at the end of this document. Specifically, we are interested in the sternal element of each individual bird.

Our choice of the American kestrel to explore spatial and temporal patterns of body size is based on several criteria we deemed important for this analysis. Our study species needs to be widespread in distribution so as to encompass a wide geographic range of environmental variability, as well as experiencing different rates of environmental change through time among different populations. We chose a generalist species to explore how population and individual level diet specialization may influence patterns of body size. Because we are also interested in exploring the consequences of changes in body size, we selected a top trophic level predator with the potential to exert large influences on food web dynamics. Furthermore, with respect to studies on temporal trends in body size, raptors are a surprisingly understudied group. Finally, given our explicitly historical approach, we also required that our study species be temporally and spatially abundant in the museum record databases. The American kestrel fulfills each of these criteria. Moreover, concern over American kestrel populations has risen in recent years as a yet unexplained, multi-decade, downward population trend continues among North American populations of this species. By exploring temporal and spatial patterns of body size in relation to various biotic and abiotic factors that could be influencing the American kestrel, our work stands to make several novel contributions to the ongoing research and management efforts of this species, and to the rich literature on body size ecology more generally.

Storage of loan request

The Terry Lab is equipped with museum grade, ***Delta Designs Series 800 storage cabinets*** that are lockable and fire and water resistant. The Series 800 model cabinets are raised up on 2.5" pedestals to protect specimens in the event of a flood and meet rigorous specifications in terms of low rates of air exchange (important for housing study skins) and construction from non-reactive materials (no outgassing of compounds detrimental to skeletons and skins). A separate tray(s) will be reserved for specimens loaned from each individual museum as we are requesting loans from multiple institutions. Upon completion of measurement and imaging, the loans will be repackaged in their original shipping boxes for return.

Loan request duration

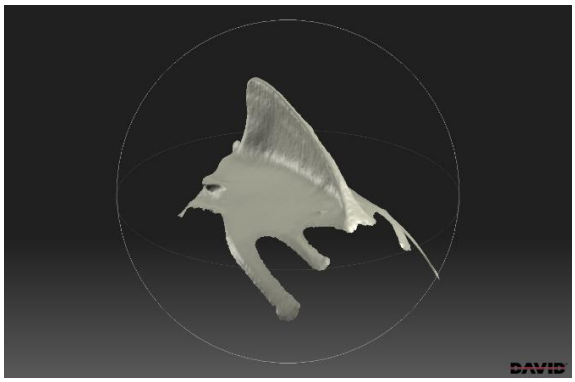
The duration of the loan is not expected to exceed ***one month*** from the date of reception. Given the small number of specimens we are requesting, and the minimal time involved to measure and image each specimen, we do not foresee any scenario that would require us to hold onto the specimens for longer than this time period. In the event that we do experience circumstances that prevent us from processing the specimens in a one-month period, we will notify UTEP curatorial staff of the delay and request a loan extension.

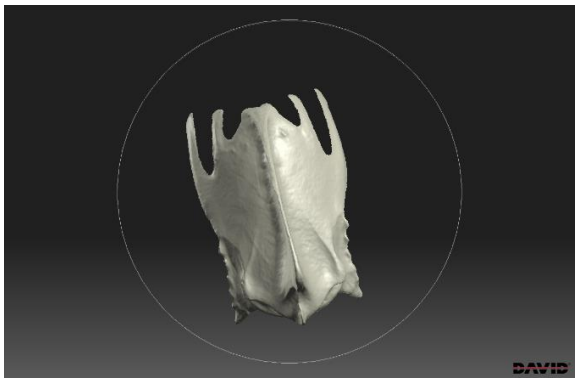
Methods

All our methods are ***non-destructive and require minimal handling***. Measurement and imaging will be performed in the Terry Lab at Oregon State University. Specimens will be removed from storage cases one at a time for measurement and imaging to prevent unnecessary exposure to light and other potentially harmful environmental hazards to study skins and skeletons. Nitrile gloves will be used when handling the specimens to prevent transfer of potentially damaging oils on the hands.

Collection of morphometric data from study skins involves quantifying a set of common field measurements using a butted wing ruler and calipers. I (MDB) have several years of experience taking measurements on a variety of live passerine and raptorial birds, skills which translate easily to study skins, as well as training and experience measuring and handling study skin specimens in the ornithological collections at Oregon State University and University of Washington's Burke Museum. In addition to manually measuring specimens, we plan to image specimens as well so that we have a digital record of each specimen that can be remeasured, digitally, or referenced for other purposes. For imaging study skins, we use a Zeiss KL 1500 infrared-free light source and a Canon EOS Rebel DSLR camera.

We use a David SLS-2 structured light scanner for 3D imaging in the Terry Lab. In structured light scanning, distortions in a projected light pattern caused by the surface details of an object are captured by cameras, and distances to specific points on the object are calculated using triangulation between the camera, projector and object. The three-dimensional coordinates are then used to digitally reconstruct the object in fine detail using multiple pictures from different angles. The result is a 3D digital rendering of the object which allows measurement using other imaging software; see example images below created by MDB using the Terry Lab scanner. During this process, the specimen sits on a cloth-covered surface and is slowly rotated while successive scans are taken and combined into the 3D image. The David system projects a white light onto the object which allows the capture of not only the 3D shape but also surface color (not shown) and texture so that fine details, such as muscle scarring, are apparent.





If requested, we are happy to provide any digital images produced as a result of this work to add as publicly available media to the UTEP collections upon publication of our results. In the event that images do not result in publication within a reasonable time frame, we will provide the requested digital images at the culmination of such time. Publications, abstracts, conference posters, thesis work or other scientific communication generated from the use of the loaned specimens will be provided to UTEP, and ***proper acknowledgement and citation of the collections and specimens*** will be included in all such documents.

We recognize the historical/cultural significance and ecological value of the specimens we are requesting and are grateful for your consideration of the loan. We take great pride in the

care and preservation of our own collections and the specimens we have on loan. If there are any additional considerations regarding storage that we have not addressed in this request, we would be happy to arrange our facilities to try and meet those criteria.

Given the explicitly historical aims of our broader research, the use of museum specimens is a critical resource. From this work, we hope to provide a more robust justification of the use of museum study skins to study the temporal dynamics and ecology of body size in bird species. How changing climate and land use are affecting functional traits such as body size and the ecological effects of shifts in those traits is an increasingly important area of study in our rapidly changing world. Understanding how single external measurements or combinations of measurements from study skins are, or are not, informative about changes in body size is a crucial first step. Additionally, we aim to encourage the active use of museum collections for historical and contemporary ecological research. We believe that active collections-based research and publication is necessary for continued funding of this invaluable resource.

Thank you for your time and consideration,

Michael D. Brawner

Specimens requested

InstitutionCode	CatalogNumber
UTEP	1003
UTEP	1093
UTEP	1699
UTEP	2064
UTEP	2156
UTEP	2331
UTEP	2449
UTEP	2555
UTEP	2635
UTEP	2758
UTEP	2811
UTEP	3012
UTEP	3030
UTEP	3032
UTEP	798
UTEP	799
UTEP	800
UTEP	801
UTEP	196