CRANIOMETRY OF THE EQUIDAE PART I: TWO-DIMENSIONAL SHAPE ANALYSIS

Robert L. Evander

Department of Vertebrate Paleontology, American Museum of Natural History, Central Park West at 79th, New York NY 10024

ABSTRACT

Morphometric analysis of landmark data on fifty-three drawings of fossil horse skulls reveals that the first principal component of horse skull shape variation involves a simultaneous decrease in the relative size of the braincase, an increase in the relative size of the maxilla, an increase in the relative length of the malar crest, a deepening of the nasal incisure, and the movement anteriorly and inferiorly of the maxillary alveolus relative to the orbit and braincase. Two other principal components of shape variation also emerge. These results identify the Frick collection of fossil skull illustrations as an important graphic database of fossil mammal form.

INTRODUCTION

One particular advantage of studying the fossil horses of the Frick Collection is a portfolio of extraordinary illustrations. These illustrations were drawn by a succession of artists employed by Childs Frick to illustrate his collection. The longest serving of these artists were Hazel DeBerard (retired 1958) and Raymond Gooris (retired about 1985). Although none of the illustrations are signed or dated, it is likely that the choice of specimens was made by Morris Skinner during the 1960's, and that the bulk of these illustrations are therefore the artwork of Raymond Gooris. The Frick fossil horse portfolio includes approximately 350 line drawings, mostly of horse dentitions. Significantly for this study, the Frick portfolio also includes fifty-two lateral aspects of relatively complete mature horse skulls.

When Frick artists illustrated a specimen of the size of a horse skull, they began by outlining the principal features using a suspension pantograph. Two of these instruments survive at the American Museum of Natural History, where they were transferred as part of the donation of the Frick Collection. A suspension pantograph is simply a large pantograph in which the various linkages of the instrument are suspended from a central tower. The suspension mechanism allows for large excursions by both the stylus and the pen of the pantograph; and at the same time allows nimble movements of the heavy, solid metal arms of the instrument. This large excursion was necessary because all of the fossil horse illustrations share a scale of 1:1. That is, all of the illustrations are drawn to the actual size of the specimen. To enable the positioning of these large specimens, the Frick Laboratory had a special lift constructed. Only a couple of feet square, this lift allowed the positioning of the specimen just below the stylus of the pantograph and just off the table upon which the artwork was positioned.

The pantograph produces an image that is in zero-point perspective in artistic terminology, or that is a parallel projection in mathematical terminology. This means that x-y coordinates of features on the illustrations are accurate records of their x-y coordinates in two-dimensional space. Thus, because Childs Frick dictated a correct choice of illustration techniques 70 years ago, we have a portfolio of 50-year-old horse illustrations that are amenable to morphometric analysis by the most modern of analytical techniques.

PROCEDURE

The fifty-two illustrations (Table 1) were scanned into Adobe Photoshop as grayscale images at 600 dpi using an Epson 1640XL large-format flatbed scanner in the Microscope and Imaging Facility at the American Museum. Five of the illustrations proved too large for the bed of the scanner. These five illustrations were scanned in two parts, and the parts merged using Adobe Photoshop. Because my primary intent at the time of the scanning was the creation of a computer portfolio of publication-ready illustrations, all of the figures were rotated to a uniform orientation and scaled to a bed size of 14.5 centimeters. These orientation and scale manipulations were performed using Adobe Photoshop. The original 600 dpi image density was maintained.

The electronic files were converted from Photoshop documents (.psd) to JPEG images (.jpg) using Adobe Photoshop. Each of the images occupied roughly 1,000