FLORIDA MUSEUM OF NATURAL HISTORY™

BULLETIN

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PART I: Osteology as a Means of Assessing Florida Panther Health

Laurie Wilkins, Julie M. Allen, Joan Coltrain, Shelly Flanagin, Terry D. Allen, & David L. Reed[1]

PART II. Stable Isotope Geochemistry: A Method to Evaluate the Diet of Florida Panthers (Puma concolor) Using Museum Specimens

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Key Words: methods, museum specimens, osteology, health, stable isotopes, diet, Florida panther, *Puma concolor*

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PREFACE

Natural history museum specimens provide a valuable resource to examine aspects of the biology of the living animal long after its death, which is particularly useful for large carnivores that are difficult to study or may be endangered. Voucher specimens record changes in animal populations over time and increase in value as new data, new technologies, or new research applications emerge. For example, animal pelts may now be analyzed for the environmental toxins they store, and skeletons provide a permanent historic record of diet, illness, trauma, or past injury. These in turn reflect physical and physiological processes or environmental conditions affecting the population, and they may be important indicators of dietary deficiencies, environmental toxins, or inbreeding. Knowledge of such processes contributes to management and conservation decisions. Likewise, museum specimens collected over time may show the positive effects of management activities on threatened populations.

The Florida Museum of Natural History (FLMNH) collection of Florida panther specimens *(Puma concolor,* previously *coryi)* acquired through a cooperative salvage program with the Florida Fish and Wildlife Conservation Commission (FWC), represents a unique and valuable assemblage of the large, endangered carnivore. Over 140 specimens of skins, skulls, and skeletons exist from 1950 to the present, and they include every panther that has been recovered since the early 1980s - the beginning of the FWC capture and monitoring program (Belden et al. 1988). These provide a permanent historical record of morphologic, genetic, and demographic changes in the panther population over the past 25 years. Specimens record biomedical conditions that existed but were not necessarily detected *in vivo* by researchers. More importantly, the collection covers the time period before and after genetic intervention and habitat management strategies began for this endangered species.

Previous studies of museum specimens facilitated the description of phenotypic traits unique to the Florida population of puma, which was relatively unknown until a surviving population was discovered more than 25 years ago in south Florida (Belden 1978). Among these unique characteristics are the highly inflated nasals of the cranium, or "roman nose," that had been described by Young (1946) as a distinctive feature of the Florida population, and which later distinguished the panthers of the Big Cypress and western Florida from the genetically distinct Everglades population (O'Brien et al. 1990; Wilkins et al. 1997). In addition, museum specimens dating back to the late-1800s revealed a high frequency of kinked tails and cowlicks (whorls of hair) found in the mid-dorsal region (Belden 1986; O'Brien et al. l990; Wilkins et al. 1997). These anomalies have now become accepted indicators of the highly inbred condition of the original Florida panther population, which together with a high incidence of cryptorchid males, congenital heart defects, and elevated pathogen/parasite loads revealed a highly stressed and at-risk population (Roelke et al. 1993). With the onset of the genetic out-breeding program in 1995, the frequency of kinks, cowlicks and the more deleterious expressions of inbreeding in Florida panthers have decreased, but continue to be carefully monitored and investigated (Land et al. 2005, Pimm et al. 2006, M. Roelke, pers.comm.).

Along with increased health risks due to inbreeding, there is evidence that panther health has varied through time among regions in Florida, possibly due to diet and prey density (Roelke 1990). Likewise, past morphological studies have shown that Florida panthers exhibit a greater-than-expected incidence of skeletal trauma, dental fracture, developmental abnormalities, and osteopathologies when compared to a wild, presumably healthy population of puma from other regions of the country (Duckler & Van Valkenburgh 1998a,b). External skeletal pathologies include arthritis, infection, trauma, and bone lesions of unknown cause. A single internal morphological feature prominent in that analysis was the presence of Harris Lines (HLs), also known as growth arrest lines, which are visible as transverse lines of bone deposition in radiographs of long bones. Generally, HLs can occur in long bones of humans and other mammals, and they are believed to represent renewed growth after a period of interruption (Park 1964; Wing & Brown 1979). Their appearance has been linked to nutritional deficiencies, infectious agents, and/or environmental toxins, all of which are documented threats to panther survival (Roelke 1990; Roelke et al. 1993a,b; Facemire & Guillette 1994; Facemire et al. 1995, Pimm et al. 2006).

Herein we present results of two studies of the FLMNH's collection of Florida panthers. In Part I, we expand earlier investigations by Duckler and Van Valkenburgh (1998a,b) examining osteopathologies and HLs as health indicators. In Part II we analyze stable carbon and nitrogen isotope ratios in Florida panther bone collagen to investigate dietary trends. The sample includes specimens from a range of locations and time periods, and some animals born after the out-breeding initiative in 1995, in which Texas females were introduced into Florida to supplement the existing Florida panther population. Citations for references in the Preface are found in the Literature Cited section of Part I.

- Laurie Wilkins, Julie M. Allen, and David L. Reed, Florida Museum of Natural History.