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Cover Photograph: An elusive melanistic Coyote (*Canis latrans*) photographed on 23 May 2014 at Berry College, GA. This rare phenotype appears to be confined to southeastern Coyote populations. Photograph © Melanie Abney.

Melanistic Coyotes in Northwest Georgia

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Melanistic Coyotes in Northwest Georgia

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Abstract - Melanism is rare in *Canis latrans* (Coyote), but we detected the phenotypic trait several times in northwest Georgia. We observed up to 9 melanistic Coyotes during a 9-year period, 2003–2012: 5 from trail-camera photographs, 2 from live-captures during a radio-telemetry study, and 2 from hunter-kills. The ancestry of southeastern Coyotes is unclear, and we suggest that a genetic study including melanistic individuals could increase understanding of the potential influence of *C. lupus* (Gray Wolf), *C. rufus* (Red Wolf) and/or *C. lupus familiaris* (Domestic Dog) on the Coyote's genetic makeup and evolutionary history.

Introduction

The benefit conferred by camouflage is the most common explanation for melanism in mammals, although physiological functions have also been hypothesized (Caro 2005). Dark-colored *Canis* spp. (wolves) are more prevalent in forested than in open habitats in western North America, suggesting selection for a phenotype (melanism) that allows for greater crypsis during predatory behavior (Anderson et al. 2009). A similar selective advantage has been hypothesized for *Panthera onca* L. (Jaguar) and *P. pardus* L. (Leopard) living in forested habitats (Majerus 1998). Melanism can also act to conceal prey species. Kiltie (1989, 1992) found a higher percentage of black hair on *Sciurus niger* L. (Fox Squirrel) living on the dark substrate caused by periodic burning in pine savannas than on non-blackened ground, which led to reduced predation of Fox Squirrels by *Buteo jamaicensis* Gmelin (Red-tailed Hawk). The potential physiological advantages of mammalian melanism are less clear, but thermoregulation via the absorption or reflection of sunlight is most often cited (Caro 2005).

Canis latrans Say (Coyote) exhibits variation in coat color, but melanism (i.e., black pelage), particularly within their historic western range, is quite rare (Beckhoff and Gese 2003). For example, Young and Jackson (1951) cited only one known instance of a melanistic individual in an intensive survey of western Coyote populations, and no black Coyotes have been seen during the past 24 years of studies in Yellowstone National Park (R. Crabtree, Yellowstone Ecological Research Center, Bozeman, MT, pers. comm.). Melanism was more common in *C. rufus* Audubon & Bachman (Red Wolf) populations, and the trait was once used to distinguish Red Wolves from Coyotes where the two species overlapped (Gipson 1976, Halloran 1958). A study of Red Wolves in Arkansas in the 1930s found a 25% incidence of melanism (Black 1936). Gipson (1976) identified 12 melanistic individuals of a total 548 (2.2%) Coyote-like wild canids in Arkansas in the 1970s.

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Melanism in canids has been traced to the K^B allele, which is characterized by a 3-bp deletion mutation in the melanocortin pathway (Anderson et al. 2009). The dominant K^B allele was found in 111 of 113 black-colored *Canis lupus* L. (Gray Wolf) from Yellowstone and the Canadian Arctic, and in all 6 black-colored Coyotes sampled from Minnesota and West Virginia (Anderson et al. 2009). Anderson et al. (2009) concluded that the mutation first appeared in *C. lupus familiaris* L. (Domestic Dog, hereafter Dog) nearly 50,000 years ago. Hybridization and the resulting introgression among Dogs, wolves, and Coyotes spread the trait throughout the *Canis* genus. Rutledge et al. (2009) alternatively suggested that the K^B allele originated in black *C. lycaon* Schreber (Eastern Wolf) of eastern North America rather than in Dogs. Barsh et al. (2009) cited shorter extended haplotypes and more point mutations associated with the K^B allele in Dogs, as well as its broader worldwide distribution as evidence of its origins.

The Coyote was historically restricted to regions west of the Mississippi River, but it has expanded its geographic range during the past several decades to include most of North America, and it is now found throughout the United States. The extirpation of the congeneric Red Wolf eliminated the Coyote's primary non-human competitor and facilitated its southeastern range expansion (Thurber and Peterson 1991). European settlement of the eastern US led to land-use changes that resulted in deforestation and increased the amount of edge and open lands, which also facilitated Coyote range-expansion (Gompper 2002, Parker 1995). Immigration into the southeast likely began in the 1950s with human-released Coyotes, but it was not until the mid-1970s that Coyotes started to appear in Georgia (Hill et al. 1987, Parker 1995) as they followed a natural colonization pattern from west to east. A decade later, Coyotes were prevalent only in the southern portion of the state, although Hill et al. (1987) documented occasional Coyote sightings in several northwestern Georgia locations, including near the current study site. In this paper, we report on several sightings of melanistic Coyotes in northwest Georgia.

Field-site Description

Our observations were the result of a broader Coyote-ecology study conducted at the11,340-ha Berry College campus in Rome, GA within the ridge and valley ecoregion (Fig. 1, Hodler and Schretter 1986). The campus is comprised of a combination of buildings, agricultural fields, managed *Pinus* sp. (pine) stands, natural mixed hardwood-pine forests, wetlands, creeks, and a 21.5-ha reservoir. Forested areas are dominated by *Quercus* spp. (oak), *Carya* spp. (hickory), and pine trees. A remnant population of montane *Pinus palustris* Miller (Longleaf Pine) is being restored and maintained with periodic prescribed burning. Roughly 230 ha of the Berry College land are undeveloped, with 85% of that area classified as timbered upland. Lowland, bottomland, slopes, and old fields make up the remaining undeveloped land, and 1596 ha are devoted to campus buildings, water, roads, and utilities (D'Angelo et al. 2006; F and W Forestry 2007; William Yoemans, Berry College Land Resources, Mt. Berry, GA, pers. comm.). Approximately 300 ha are used for livestock operations (cattle, sheep, horses). Suburban development borders

the study site to the south and east, and large, protected forest areas (Rocky Mountain Recreational Area and Chattahoochee National Forest) lie to the north.

Methods

To learn more about the presence of Coyotes within the study site, we deployed a TrailMAC remote 35-mm camera (Trail Sense Engineering, Middletown, DE) for a total of approximately 40–50 nights from March 2003 through April 2005. We placed the camera in areas where we had observed Coyote scat or footprints. In March 2006, we began a Coyote radio-telemetry project by setting 20–30 modified off-set Bridger #2 foothold traps scented with Coyote urine and Steppenwolfe II® (Minnesota Trapline Products, Pennock, MN) throughout the study site for each of 4 nights. We repeated the 4-night trapping effort in March 2007and fitted each Coyote captured with a 280-g VHF radio-collar with mortality sensor (Advanced Telemetry Systems, Isanti, MN). We collected blood samples and recorded sex, weight, and general body condition. Each individual was assigned to an age class—pup, yearling, young adult, older adult—based on body size, time since previous breeding season, and tooth

Figure 1. Map showing the location of the primary Coyote research study site, Berry College, Rome, GA, and a secondary location, Ringgold, GA, where a melanistic Coyote was detected.

wear (Bowen 1982; Gier 1968; R. Crabtree, pers. comm.). We conducted additional camera-trapping in conjunction with our radio-telemetry study for 34 nights in June–July 2006 using 7 Digital Game Camera 100s (Moultrie Feeders, Alabaster, AL). The care and use of all animal subjects was approved by the Berry College Institutional Animal Care and Use Committee (IACUC protocol #2005/06-04), covered by Georgia Department of Natural Resources scientific collecting permits #29-WTN-07-40 and 29-WTN-06-111, and followed guidelines approved by the American Society of Mammalogists (Gannon et al. 2007).

Results

We obtained multiple images of Coyotes on 5 separate occasions during 2003–2005; of these, 2 individuals were melanistic. Our camera recorded photographs of a melanistic Coyote on 10 April 2003 (Fig. 2a) and again on 2 February 2005. We do not know if the photographs taken in 2003 and 2005 were of the same individual, but we assume that multiple photographs taken on the same date were of the same individual. Therefore, we photographed 1 or 2 melanistic Coyotes from 2003 to 2005 during 40–50 camera-trap nights. In January 2005, we observed the bodies of 2 other melanistic Coyotes shot by hunters on separate occasions within 15 km of the study site after learning about the kills from local media reports and state wildlife officials. We obtained 10 photographs of Coyotes during our June–July 2006 camera-trapping effort (34 nights), although none were melanistic.

We captured a total of 8 Coyotes during live-trapping efforts for our radio-telemetry study; 2 were melanistic with a white chest patch. We captured a young adult male weighing 11.8 kg (Fig. 2b) on 25 March 2006 and monitored it until 3 October 2006; a trapper recaptured him 64 km north of the study site on 17 January 2007. We captured an adult female weighing 15.0 kg on 5 March 2007 and monitored her until 22 March 2009 (see Supplemental Video File 1, available online at http://www.eaglehill.us/SENAonline/suppl-files/s13-2-1171-Mowry-s1, and, for BioOne subscribers, at http://dx.doi.org/10.1656/S1171.s1); her fate was undetermined.

We were given a photograph of a melanistic Coyote taken on 4 March 2012 approximately 95 km from the study site (near Ringgold, GA) using a Moultrie Game Spy Trail Camera (Ebsco Industries, Birmingham, AL) (Fig. 2c). The number of camera-trap nights associated with this photograph is unknown.

Discussion

We detected as many as 9 melanistic Coyotes within or near our study site in northwest Georgia over the past 9 years, and heard accounts of other melanistic individuals from hunters and trappers. Melanistic Coyotes are also known to exist in other southeastern states, but data on the frequency of occurrence is scarce. None of the state wildlife agencies in the Southeast (Georgia, South Carolina, Alabama, Mississippi, Tennessee, Florida, Arkansas) record such numbers in their annual trapping reports, although there is anecdotal information. For example, the Georgia Trappers Association estimates that out of every 75–100 Coyotes trapped in the

Figure 2. (a) Melanistic Coyote remotely photographed at Berry College, GA; (b) Melanistic male Coyote captured and radio-collared at Berry College, GA on 25 March 2006; (c) Melanistic Coyote remotely photographed near Ringgold, GA on 4 March 2012.

southern part of the state, 2–3 are black (R. Johnson, Georgia Trappers Association, Tifton, GA, pers. comm.). At a fur auction in Russellville, AR in February 2010, 75 Coyote pelts were sold and 1 was melanistic (B. Sasse, Arkansas Game and Fish Division, Little Rock, AR, pers. comm.). Estimates on the frequency of occurrence of Coyote melanism in Mississippi are 0.5% (B. Leopold, Mississippi State University, Mississippi State, MS, pers. comm.). We recommend that trappers and state furbearer coordinators officially note the number of melanistic Coyotes harvested each year to better document and potentially understand this phenomenon.

Way et al. (2010) concluded that eastern Coyotes, which are larger than their western counterparts, represent past hybridization between western Coyotes and Eastern Wolves. Genetic and morphometric data from Texas canid populations also provide evidence of hybridization and introgression between Coyotes, Red Wolves, *Canis lupus baileyi* Nelson and Goldman (Mexican Wolf), and Gray Wolves (Hailer and Leonard 2008; Mech and Nowak 2010). Recently, vonHoldt et al. (2011) found both Gray Wolf and Dog ancestry in tissue samples taken from Coyotes from the Midwest and Southeast (Illinois, Ohio, Virginia, Alabama, Louisiana, and Mississippi), but none of the sampled individuals were from Georgia and, to our knowledge, none were melanistic. A previous study by Adams et al. (2003) found widespread occurrence of Dog mitochondrial DNA in southeastern Coyotes, suggesting a past hybridization event between these 2 canids and subsequent introgression, although none of the 112 samples were from Georgia Coyotes (the majority were from West Virginia, Virginia, and northern North Carolina; the closest was from the Florida panhandle, over 300 km away), and to our knowledge none were melanistic. Physiological and behavioral reproductive barriers (e.g., different estrous cycles, lack of parental care by male Dogs) have traditionally been thought to minimize hybridization between Coyotes and Dogs (Mengel 1971), but ecological conditions such as mild winters and increased food availability in the Southeast might allow for more instances of its success.

An apparently higher regional presence of melanistic Coyotes in our study area hints at the possibility of hybridization with Dogs. The close proximity of suburban areas to our study site means that Dogs are plentiful and interbreeding is theoretically possible, although all of the melanistic canids we observed were Coyote-like with the exception of their darker pelage. Alternatively, the melanistic trait could suggest past hybridization between a dwindling population of Red Wolves, some of which were black, and eastward-expanding Coyotes.

The presence in this area of what is otherwise a very rare or nonexistent phenotype (i.e., melanism) in other Coyote populations suggests that further genetic study could contribute to a better understanding of Coyote ancestry and melanism in this species. An important first step should be to determine the geographic distribution and frequency of occurrence of melanism in Coyotes. Tissue samples from melanistic Coyotes could then be screened for the presence of the K^B allele. The use of high-density single nucleotide polymorphism (SNP) genotyping arrays and other high-throughput genotyping technologies could potentially provide a more detailed look at the regional and local ancestry of Coyotes in the southeastern US (vonHoldt et al. 2011).

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