A Century of Conservation Genetics

Comparative study on the African Lion

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Fondly referred to as the "***King of the Jungle***," the African lion is one of the world's most iconic species, of not only Africa but all things wild.

The lion's majestic nature makes it a species held in high regard by many people; however, research and conservation efforts associated with the species are greatly lacking. As the human population in Africa drastically increases, nearly quadrupling over the last 50 years (CIESEN 2005), wildlife has had to adapt to a changing landscape.

Over the past century, lion mortality across its range has been primarily human-related (IUCN 2006a,b). The rise in the human population in and around lion habitat has caused habitat destruction, land conversion and a reduction of the lion prey-base, creating an increase in human-carnivore conflict. While there is no debating that the lion's range has shrunk as a result of human-related changes to the African landscape, the actual impact to the population is not really known.

In July of 2015, Cecil, a regionally famous radio-collared lion from Zimbabwe's Hwange National Park, was shot under suspicious circumstances by an American trophy hunter. The incident quickly received global media coverage generating international interest around the African lion. For a few months in 2015, the public's outcries for the future of the lion were leading media stories.

A petition for the U. S. Fish and Wildlife Service

Previous: Lion skulls at the American Museum of Natural History in New York City, New York (credit: Caitlin Curry). Bottom right: Dr. Paula White darting a female lion in Zambia. Above and left: Male African lions of various ages.

(USFWS) to list the African lion under the Endangered Species Act (ESA) had been in circulation since 2011 (IFAW, 2011) and the recent upswing in media coverage on the species brought about more petitions to bring a decision to action.

On January 22, 2016, the USFWS made a ruling to list the African lion as two subspecies under the ESA, *Panthera leo leo* and *Panthera leo melanchaita* (USFWS 2016).

Subspecies	Population	Listing
Panthera leo leo	Central Western & Central	Endangered
Panthera leo melanchaita	Eastern & Southern	Threatened

This decision was based on what they claim to be the "best available science". However, the current "best available science" may not be showing us the whole picture.

Up until now, the fate of the African lion population has been determined by overall population decline. However, population declines of the African lion are based off "guesstimates" (Nowell and Jackson 1996) of a historical number (Myers 1975) compared to estimates of present day populations (Bauer et al 2015), which vary widely in themselves.

A number of abundance and distribution studies of the African lion have been performed through the use of interviews (Bauer & Van Der Merwe, 2004), spoor counts (Midlane et al 2014), call-ups (Ferreira & Funston 2010; Everatt, Andreden & Somers 2014; Henschel et al 2014), and camera traps (Ferreira & Funston 2010). However, there is no consistency of methodology across regions. And, while genetic studies have been done, they have been primarily phylogenetic in nature with little to no focus on population structure (Antunes et al 2008; Bartnett et al 2006a; Bartnett et al 2006b; Bertola et al 2011; Dubach et al 2013;) or restricted to a particular region (Lyke et al 2013; Miller et al 2014; Spong et al 2002; Tende et al 2014).

My study, being conducted at the Texas A&M College of Veterinary Medicine & Biomedical Sciences under the supervision of Dr. James Derr, is taking an innovative approach to African lion conservation. Rather than comparing finite population "guesstimates", this study is estimating population size based on genetic diversity found within the population, allowing conclusions to be drawn based on the lion population's genetic health.

Using state-of-the-art genetic biotechnology, the study will uncover information necessary to document accurate lion population numbers through genetic diversity. Genetic diversity is directly related to a species' ability to adapt, survive, and thrive within its environment. A loss in diversity is detrimental to the health of the overall population and its long-term survival because it decreases its potential to adjust to an ever-changing environment. The current lack of knowledge about the genetic history within the wild lion population makes it difficult to predict how losses in the genetic diversity might negatively impact its overall health. With the use of genetic biotechnology, genetic information can be accessed from long-dead individuals preserved in museums around the world and their contemporary counterparts through the power of isolating genetic material, or DNA.

Turn of the century naturalists, hunters and explorers have made it possible for us to access historical genetic information by supplying museums and private collections around the world with hundreds of lions from their travels. Tissue, bone, and hide samples are being collected for this study from these collections in the United States, Europe, and Africa. Currently our historical collection consists of 130 specimens dating between the 1880's-1930's and spanning locations where lions still exist, like South Africa, Zimbabwe and Kenya, as well as locations where lions haven't been seen in years, such as French

Equatorial Africa (i.e. Gabon, where the last confirmed sighting was in 1995). Using data from these historical specimens, we will be able to create a baseline for the genetic health of the lion and track changes in genetic diversity over the past century.

The contemporary lion collection consists of modern African lion DNA samples and appropriate data available from previous studies (Antunes et al 2008; Bertola et al 2015; Dubach et al 2005; Driscoll et al 2002; Lyke et al 2013; Miller et al 2014; Morandin et al 2014; Spong et al 2002; Tende et al 2014). Working in collaboration with Dr. Paula White and the Zambia Lion Project, we have already completed mitochondrial analysis of 165 lions from five main areas in Zambia (Curry et al 2015). This sub-study uncovered genetic variation within the African lion population which had never previously been seen. Coupled with high levels of genetic diversity, this finding suggests that Zambia may serve as a bridge connecting populations in southern Africa to eastern Africa, supporting earlier hypotheses that this region may represent the evolutionary cradle for the species.

Current and historic population sizes across the species' range can be determined by looking at the differences in the DNA. And, by tracking changes in genetic diversity over time through the combination of DNA from contemporary lion populations and lion populations that existed over 100 years ago, we can identify the existing wild lion populations that are most at risk and make recommendations to guide management actions accordingly to safeguard their future genetic health.

Ultimately, this project has the ability to set the record straight amongst the emotional cries about the downfall and genetic vulnerability of the African lion. Science is the cornerstone of wildlife management, and this research could provide much needed insight into an issue where feelings often trump fact.

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Top: Sampling lion skulls at the American Museum of Natural History in New York City, New York. Middle: Taking measurements of a modern lion skull from Zimbabwe. Bottom: Using a cryogenic mill to process bone for DNA extraction (credits: Caitlin Curry).

Credits: Caitlin Curry

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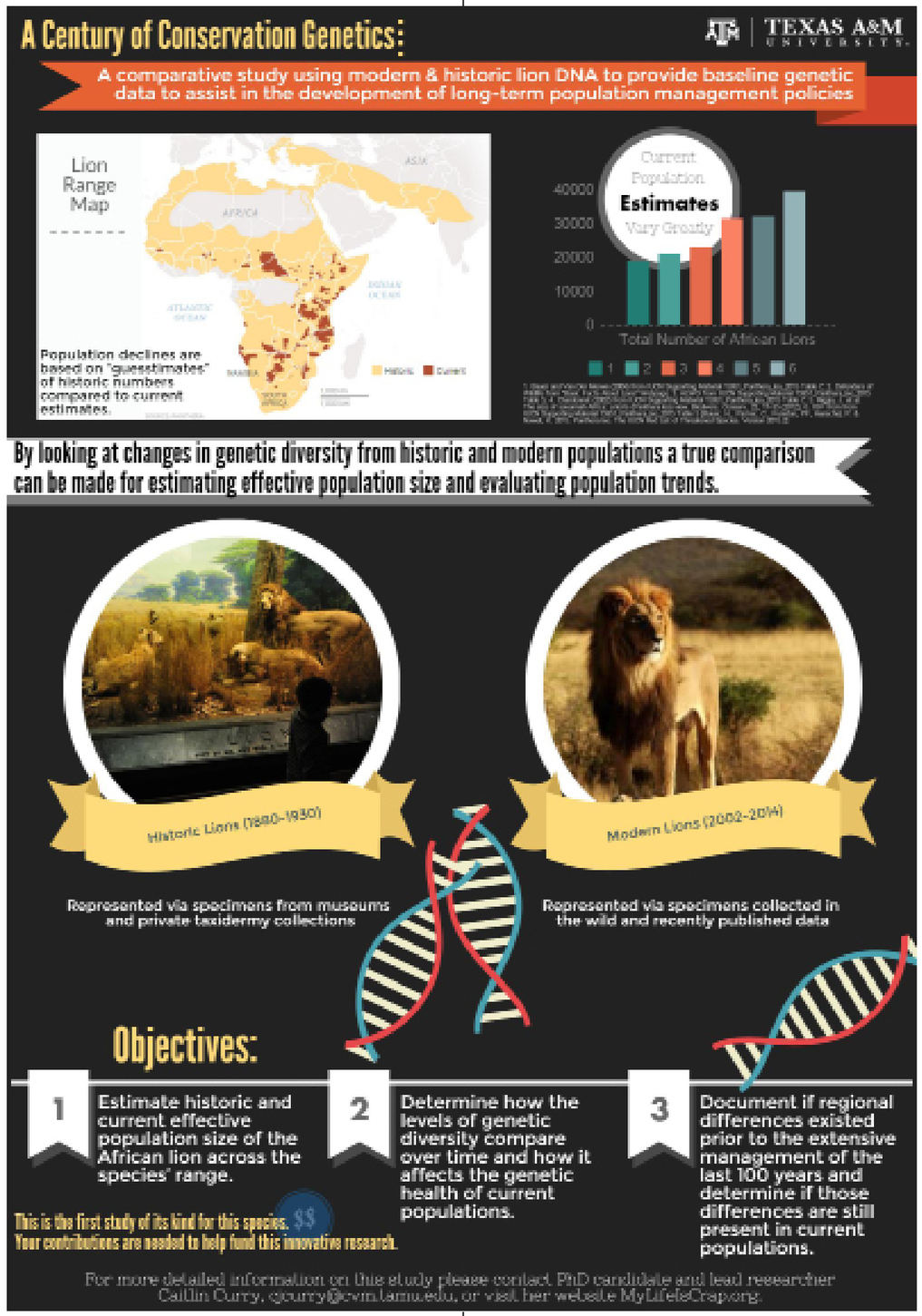

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