

Sample Biology Paper

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The Fate of the Cheetah: Predestined for Extinction or Just Unlucky?

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Biology 337: Population Biology

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27 April 2003

*[Note that the title page includes a short, descriptive **title** (the shortest summary of the paper), the student's **name** and **institutional address**, information about the **course** for which the paper has been submitted, and the **date** of submission.]*

ABSTRACT

Cheetahs (*Acinonyx jubatus*) have been analyzed for their level of genetic variability over the past few decades. Tests such as skin grafts, protein electrophoresis, DNA sequence analysis, and spermatozoa analysis have demonstrated that the cheetah genus has low genetic variability. Conservationists have concluded that the lack of genetic variability is the reason for the decline in the cheetah population, but other problems could also account for the decline. The loss of habitat increases contact with humans and other predators, such as lions (*Panthera leo*) or hyenas (*Crocuta crocuta*), which may contribute to the endangered status of the cheetah. Here I examine two hypotheses for cheetah population decline: genetic make up and ecological pressures, and I conclude that ecological pressures are the causes of the cheetah's decline.

*[The student includes an abstract, or **informative summary** of the paper. This abstract must “stand alone,” meaning that it must be self-contained or understood without reading the entire paper, and it does not cite references. Note that the student uses the **active voice** in the Abstract and throughout the paper (e.g. “I examine two hypotheses” rather than “Two hypotheses are examined”) and has provided the scientific (Latin) name of each species when its common name is first mentioned (here in the abstract and again in the paper itself—see below). Because scientific names are in Latin, they are italicized, with the genus name capitalized (e.g. *Acinonyx*) and the specific name not capitalized (*jubatus*). Note also that the student has used a “**running head**,” which includes the page number, on all pages except the title page.]*

INTRODUCTION

The cheetah (*Acinonyx jubatus*) has a sleek, elongated, thin body, short ears close to the head, and semi-retractable claws, which enable it to reach speeds of 112 km/h, making it the fastest terrestrial animal (Caro 1994). During the Pleistocene, four species and four subspecies of cheetah ranged across North America, Europe, Asia, and Africa, but at the end of the Pleistocene all species of cheetah outside of Africa became extinct, along with several of the earth's other large mammals (Menotti-Raymond and O'Brien 1993). Cheetahs now occupy

central, east, and south Africa, and they numbered approximately 15,000 individuals in 2001 (Freeman et al. 2001), which puts *Acinonyx jubatus* on the endangered species list under Appendix 1 of the Convention on International Trade in Endangered Species (Convention on International Trade in Endangered Species of Wild Flora and Fauna 1973).

There are several possible explanations as to why the cheetah population is dwindling. Several tests and analyses performed on current populations of South African (*A. j. jubatus*) and East African (*A. j. raineyi*) cheetahs have shown the two subspecies to be monomorphic (O'Brien et al. 1983, 1985; Merola 1994; Freeman et al. 2001). Several genetic loci known to be polymorphic (highly variable) in most mammals are homozygous in cheetahs (O'Brien et al. 1983, 1985). One hypothesis for monomorphism in cheetahs states that during the Pleistocene extinction, the cheetah experienced a population bottleneck (O'Brien et al. 1987; Menotti-Raymond and O'Brien 1993). A bottleneck occurs when a population experiences a substantial reduction in numbers as a result of disease, natural disaster or over-killing, leaving a few individuals to increase the population. This situation creates successive generations of inbreeding within the population. A second, and possibly more plausible, hypothesis proposes that not one, but a series of bottlenecks produced the type of monomorphism exhibited in cheetahs today (Menotti-Raymond and O'Brien 1993). This second hypothesis proposed by Menotti-Raymond and O'Brien (1993) dates two bottlenecks: one during the Pleistocene (approximately 10,000 ybp) and one within the last 100 yr. There are other hypotheses for the endangered status of cheetahs today, and these include increased disease susceptibility (Evermann et al. 1988; Heeley et al. 1990), poor breeding success with high infant mortality rates, and predation by lions (*Panthera leo*) or hyenas (*Crocuta crocuta*) (Caro 1994). The question is whether genetics or environmental factors are the cause of the modern cheetah's

decline. Here I discuss both sides of the question, concluding finally that though both play a role, it is environmental factors that have the greatest influence on the cheetah today.

*[The first paragraph of the Introduction is very important. It “sets the stage” for the rest of the paper by introducing the topic and providing some historical background. The next paragraph indicates what the paper will present. In addition, the student explicitly discusses hypotheses for the phenomenon of interest. Note that, to avoid plagiarism, the student has cited all information not her own, and that the citations are by **author and year** (e.g. Evermann et al. 1988) rather than end notes (“et al.” means “and others” and is used when there are three or more authors. When the student cites two or more references together, they are listed in chronological order (i.e. oldest reference first and most recent reference last). Note as well that scientific papers **do not quote** sources (unless the exact wording is the point being made). Instead, the student reports information from sources in her own words and cites her sources as described above. In addition, scientific papers use metric measurements such as meters (m), hectares (ha), and kilograms (kg) rather than English measurements such as feet (ft), acres, and pounds (lb).]*

Monomorphism

Low genetic variability within cheetah populations has been one of the primary focal points for cheetah research. Years have been dedicated to assessing the extent of monomorphism and analyzing the possibilities of how the species became so depauperate in genetic variability.

There are several ways in which the genetic variability of cheetahs has been tested over the past 2–3 decades: skin grafting, protein electrophoresis, DNA analysis, and spermatozoa analysis (O’Brien et al. 1983, 1985; Merola 1994; Freeman et al. 2001). Researchers use the results from these tests to support the hypothesis that cheetahs are moving toward extinction as a result of genetic factors.

*[In this paragraph, the student narrows the subject of the paper more specifically, in this case on monomorphism (i.e. “one form”). The student also uses a **second-level head** to indicate to the reader that a new subject is being addressed. The student then goes on to highlight the major ways that this phenomenon has been studied and, in subsequent paragraphs and section, to describe these methods in more detail as well as to add her own **interpretation and analysis**. It is very important for the student to add her own interpretation and analysis. Without this addition, the paper is little more than a compilation of the ideas of others; with the addition, the student has included her own voice to the topic. Subsequent sections of the paper are indicated with appropriate first- or second-level heads. Note that first-level heads are in full caps are*

centered, whereas second-level heads are in bold face, have initial caps only, and are left justified. If third-level heads are required, they can be added as well; third-level heads are placed at the start of the paragraph (i.e. are indented), the first word is capitalized (along with any proper nouns), it is in Italics, and it is followed by a period and an “em” dash (i.e. a long dash). An example of a third-level head appears below.

Third-level head.—The paragraph begins immediately after this head.

Note also that a range of values is indicated by an “en” dash (a medium dash); 2–3 should be read as “from two to three,” so it would be redundant to use the word “from” before the range, i.e. write “2–3” or “from 2 to 3.” Finally, note that the student has cited two papers written by O’Brien et al.—take note of how these two papers are listed in the citation and how both commas and semicolons are used to distinguish items in the parenthetical list of citations.]

CONCLUSIONS

After reviewing the different hypotheses on the decline of the cheetah it seems clear to me that ecological pressures play a larger role in the decline than genetics. Genetically, researchers have already found the cheetah to be lacking in variability; the skin grafts, protein electrophoresis, DNA analyses, and spermatozoa analyses, presented here demonstrate that the species is highly inbred (Reeve et al. 1990). However, studies such as reported by Merola (1994) suggest that the cheetah is not unique and that other carnivorous species that are not endangered exhibit less variation than *Acinonyx jubatus*.

It is the combination of several outside factors that have become so detrimental to the cheetah. These cats would seem to have the adaptations they need to survive in a specific niche, but the loss of habitat and poaching kill more of these animals than birth defects or disease. Without these environmental factors, the cheetah’s lack of genetic diversity would not be a major concern.

The loss of habitat to agriculture and urbanization has created a grave situation for the cheetah. The encroaching human populations have caused the cheetah to come into repeated contact with natural predators, as well as the predators with guns. If cheetahs were unhindered by

the loss of habitat the species might be able to persist (Carson 1990; Merola 1994). However, the damage humans have inflicted upon the natural world is only getting worse. Without wildlife preserves and breeding facilities for reintroduction or zoo restocking programs, cheetahs will perish, but will they still be wild once they are limited to preserves?

*[The student has two goals in her Conclusions. She wants to emphasize the **importance of ecological factors** and she wants to **suggest ways to ensure cheetah survival**. Her suggestions are discussed in the last paragraph of the paper. Note that this last paragraph is as important as the first one was. This last paragraph should contain the “**take-home message**” and must provide a strong end to the paper as a whole.]*

ACKNOWLEDGMENTS

I would like to thank Emily Davis and Lisa Rossi for their support, suggestions, and patience throughout the research and writing of this paper. I am also grateful to my classmates in Population Biology for their thoughtful comments during writing workshops. Finally, I thank Beloit’s reference librarian for her tireless efforts to secure the sources I needed for this paper.

*[It is important to acknowledge the contributions of others. Such acknowledgments should be provided with the **informed consent** of the individuals acknowledged.]*

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*[All sources cited in the text must be included in the References section. Only cited sources are included. References are listed in **alphabetical order** by authors’ last names and all references must be **complete**, i.e. must include the names and initials of all authors, the year of publication, the full title, and the name of the journal, its volume and the page range. References typically use “**hanging indentation**,” in which the first line is not indented but all subsequent lines are indented. Note that Internet sources require additional information, including the URL and access date. Note as well that valid Internet sources are electronic journals or electronic publications of professional societies; **other web pages are typically not acceptable references**. Be sure to check with your instructor about using *www* sources.]*