

Project Summary

Rocky Mountains Cooperative Ecosystem Studies Unit

Project Title: Testing Mineral Licks Used by Bighorn Sheep in RMNP
Discipline: Natural
Type of Project: Technical Assistance
Funding Agency: National Park Service
Other Partners/Cooperators: University of Colorado at Boulder
Effective Dates: 8/1/2008 - 3/31/2009
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Investigators and Agency Representative:

NPS Contact: Mary Kay Watry, Biologist, Rocky Mountain National Park, 1000 Highway 36, Estes Park, CO 80517, phone: 970-586-1285, mary_katy_watry@nps.gov

Investigator: John Drexler, Laboratory for Environmental and Geological Studies (LEGS), UCB 399, Boulder, CO 303.492.5251, drexlerj@colorado.edu

Project Abstract:

Big Horn Sheep in RMNP use two well known mineral licks within the park. The herd on the west side of the park utilizes a mineral lick in the crater on Specimen Mountain. The Mummy herd uses a mineral lick at The Sheep Lakes in Horseshoe Park. The western herd is stable while the eastern herd has been slowly declining for 25 years. The two mineral licks are formed by very different geological processes and from previous studies we see that the mineral content is indeed different.

Research Questions/Objectives:

1) What role do these minerals play in the biological and physiological processes of sheep which may benefit or harm sheep?

1) What is the chemical make-up of each mineral lick? Why do sheep use the mineral licks, are the two licks being used for the same purpose?

Mammals utilize mineral licks to fulfill a number of dietary restrictions. The most common element that sheep seek out is sodium, which is generally in low concentrations in vegetation. Other common elements such as magnesium and calcium may be sought out. In some cases mammals are seek out mineral licks for trace elements such as selenium. Clays may even be utilized to help counter the effects of toxic anti-herbivore compounds in plants. Mammals use mineral licks for most of the year, though pregnant ewes and calf's visit the mineral licks most often. Pregnant and lactating females need to provide nutrients for both themselves and calf's necessitating frequent visits to mineral licks. In addition, Big Horn males use the mineral lick in early summer to recover from the fall rutting period.

The two mineral licks in RMNP are in areas with vastly different bedrock geology. Therefore the mineral content is probably very different in these two licks. Indeed the bedrock for in the west and east is different enough that it may cause forage to differ in its nutritional profile. Therefore the two herds may visit the mineral licks to fulfill different nutritional requirements.

2) What role do these minerals play in the biological and physiological processes of sheep which may benefit or harm sheep? Is the mineral lick at sheep lakes tied with the decline of the mummy herd?

Because both herds utilize mineral licks, detrimental changes in the chemical composition may cause a decline in the herd's population. If the mineral lick in implicated in the decline of the mummy herd, it may not be easily detected, even with careful chemical analysis. A systematic change in the bid horn's diet, whether from forage sources or from the mineral lick could contribute to the Big Horn decline. Declines in nutrients may explain the problem of yearling recruitment. The contamination of the mineral lick may also explain the decline of the big horn herd. A number of changes, mostly anthropogenic have the right

timeframe to explain the decline of the herd: Changes in precipitation and temperature related to global warming may change vegetation growth and nutritional profile; the failure of the dam that created the fall river flood may have removed some of the material from the sheep lakes; atmospheric acid deposition may have leached some of the calcium from the sheep lakes; Atmospheric deposition of heavy metals from anthropogenic sources may accumulate in the sheep lakes (A phenomenon that is well documented in ombrotrophic bogs)

3) *How did these mineral deposits form?*

The formation of the two mineral deposits is undoubtedly different: The sheep lakes probably fill kettle holes and are underlain by an impermeable layer of glacial till thus acting as a bog in the accumulation of minerals; The crater is composed of volcanic rock and the mineral licks are within a layer of tuff where there may be hydrothermal alteration. Understanding the formation of these two deposits will be aided by chemical analysis but will remain incomplete until physical investigations are carried out. This question is not the main focus of this study, though it is worth addressing to the extent possible.

Methods and Testing Procedure

Phase 1: Chemical analysis of both mineral licks: Park staff will take samples from both mineral licks including the soil from the sheep lakes and the volcanic rock from the crater. Two samples will be taken from each lake and the control samples will be taken from the nearby till and alluvium. Two samples will be taken from the crater mineral lick and two from the nearby volcanic rock. The LEGS lab at CU Boulder will test samples with ICP-MS to determine the elemental composition. The exchangeable ions will be tested by digesting the soil and analyzing with ICP-AES, this will include a limited selection of elements that are likely to be nutritionally important to Big Horn Sheep. In addition, the clay mineralogy will be determined with XRD.

Phase 1A: Chemical analysis of Forage: Testing of Big Horn Sheep's preferred forage is warranted to determine whether the mineral lick and forage are meeting the nutritional needs of the sheep. Park service personnel will take six samples of forage from each side of the park and CU Boulder will analyze them with ICM-MS for bulk chemical composition.

Phase 2: If needed, analysis of sheep lakes to determine the chronology of heavy metal contamination: If heavy metals are detected in mineral licks in the park in Phase I, a metal speciation test will be conducted by John Dexler/LEGS to determine whether the heavy metals are bioavailable to Big Horn Sheep. If the detected heavy metals are in a form that is harmful or toxic to sheep, Park staff will determine the chronology of contamination by taking two cores at the selected lake with a PVC pipe. The park will prepare the core and CU Boulder will split analyze it for radiocarbon dating and heavy metal concentration. The goal is to determine the chronology of heavy metal contamination and possibly a connection to human mining activities.

Outcomes with Completion Dates:

Task One: July 2008 - Park staff collections samples, delivers them to CU - Boulder.

Task Two: July 2008-September 2008 - CU Boulder performs testing and analysis.

Task Three: September - January 2009 - CU Boulder provides park with detailed report on the testing and analysis in printed and electronic format.

Keywords: Mineral Licks, Bighorn Sheep, Rocky Mountain National Park, University of Colorado at Boulder