Bienn. Symp. North. Wild Sheep
and Goat Council 7:206-209.

# USE OF RODENT MIDDENS AS MINERAL LICKS BY BIGHORN SHEEP

KEVIN P. COATES,[1] Department of Fishery and Wildlife Sciences, Box 4901, New Mexico State University, Las Cruces, NM 88003

SANFORD D. SCHEMNITZ, Department of Fishery and Wildlife Sciences, Box 4901, New Mexico State University, Las Cruces, NM 88003

JAMES T. PETERS, Bighorn Canyon National Recreation Area, USDI National Park Service, Box 487, Lovell, WY 82431

Abstract: We documented regular use of rodent middens as mineral licks by bighorn sheep in south-central Montana. Rodent middens used by bighorns were located in numerous caves (karst holes) used by bighorns as night beds and(or) thermal cover. The concentrations of 6 soluble ions were determined from samples of rodent excreta from middens. Ion concentrations in rodent excreta were compared to concentrations in weathered soil collected from outside the cave (non-lick) and from soil collected inside the cave below the rodent middens (lick soil). Concentrations of calcium, magnesium, potassium, and sodium were 100 times greater in excreta than non-lick soil. Selenium concentrations were highest in lick soil and lowest in non-lick soil. Otherwise, ion concentrations were highest in excreta, intermediate in lick soil, and lowest in non-lick soil. Phosphorus concentrations were low in all samples. Essential minerals are more available at rodent middens because of higher levels in excreta and soil excavated by rodents. In addition, availability of essential minerals may be enhanced due to the secure habitats in which middens are located.

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Bighorn sheep (Ovis canadensis) were reintroduced into the Northern Bighorn Mountains by the Wyoming Game and Fish Department (WYGFD) in 1972 and 1973. Thirty-nine bighorns were removed from the Whiskey Basin population near Dubois, Wyoming, and repeated releases of 6-8 animals were made from a pickup truck (WYGFD 1982).

In the winter of 1974-1975 a small band of bighorns dispersed from the release area and re-established a population in historic habitat at Bighorn Canyon in south-central Montana. Dispersal involved a movement of approximately 10 air miles, a lake crossing, and recolonization on a wild-horse range. The population had increased to 25 animals by 1985 (Coates and Schemnitz 1985), and 67 animals by 1988 (unpublished data).

During a study of the herd from 1985-1988, use of rodent middens as mineral licks was noted. We are reporting this unusual phenomenon.

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[1] Present address: Box 403, Libby, MT 59923

ACKNOWLEDGEMENTS

Principal funding for the bighorn study was provided by the National Park Service Research Center, University of Wyoming, Dr. K. Diem, Director. The Montana Department of Fish, Wildlife and Parks defrayed costs for laboratory analysis, and we thank C. Eustace for his support.

## STUDY AREA

Bighorn Canyon National Recreation Area (BICA) encompasses 48679 ha, centered around a 114 km-long reservoir and precipitous canyonland in south-central Montana and north-central Wyoming. Portions of BICA are managed jointly by the NPS and the Bureau of Land Management (BLM) as the Pryor Mountain Wild Horse Range (PMWHR). The 17,402 ha PMWHR supports a population of 120 free roaming horses (Equus caballus) (BLM 1984). Access to the southern portion of BICA and the PMWHR is by secondary highway.

Abrupt changes in topography and geology create a mosaic of vegetation consisting of wetlands, shifting riparian communities, desert shrubland, juniper woodland, sagebrush steppe, coniferous forest, and mixed prairie (Knight et al. 1987). Vegetative dominants of the study area include curlleaf mountain mahogany (Cercocarpus ledifolius var. intercendens), Utah juniper (Juniperus osteosperma), sagebrush (Artemisia spp.), greasewood (Sarcobatus spp.) and a sparse understory of bunch grasses (Lichvar et al. 1985).

Annual precipitation varies from 15-20 cm at the southern portion of BICA to 46 cm at the north. Soils in the south include sandy clay loam in natural riparian areas, limestone and sandstone in the precipitous canyonland, and dolomite in nonprecipitous area. Elevations vary from the mean reservoir level of 1109 m to 2682 m at the East Pryor Mountains. Grey limestone cliffs rise vertically > 335 m from talus slopes at the shoreline of the reservoir (BICA 1981). Eroded sandstone soils and karst topography (irregular limestone region) provide abundant escape cover for bighorns.

## METHODS

During 1985, immature rams were observed in a limestone sinkhole, eating soil and licking deposits of rodent excrement, at a rodent midden. From June 1986 through June 1988, 3 radio-collared bighorn ewes enabled us to locate and observe the majority of the ewes daily. We found that ewes frequently bedded in sinkholes at the canyon rim. Rodent middens were present in several sinkholes, and tracks indicated that ewes were using the middens as mineral licks.

Samples of excreta and soil from one of the middens were analyzed to determine the concentration of 6 soluble ions. Ion concentrations in rodent excreta were compared to concentrations in dirt collected below the nest which was excavated by rodents (lick-soil), and in soil collected above the sinkhole (non-lick).

## RESULTS

Concentrations of sodium, potassium, calcium, magnesium, phosphorus, and selenium were lowest in non-lick soil. Compared to non-lick soil, concentrations of 5 of the 6 ions were slightly greater to 180X greater in lick-soil, and were 12 -418X greater in excreta. Selenium concentrations were highest in lick soil and intermediate in excreta (Table 1).

Table 1. Soluble ions in rodent excreta, in lick-soil excavated by rodents, and in non-lick soil at a rodent midden used as a mineral lick by bighorns at Bighorn Canyon National Recreation Area, Montana and Wyoming.

| | Ion concentration (mg/Kg) | | | | | |
|---|---|---|---|---|---|---|
| Sample | Na | K | Ca | Mg | P | Se |
| non-lick soil | 9 | 27 | 164 | 16 | 3.5 | <0.01 |
| lick-soil | 1636 | 760 | 3896 | 1648 | 5.5 | 0.40 |
| excreta | 3592 | 9950 | 11906 | 6692 | 44.0 | 0.30 |

Concentrations of sodium, magnesium and calcium were 12-400X greater in excreta than non-lick soil. Concentrations were 24-180X greater in lick-soil than non-lick soil. Phosphorus concentrations were only slightly greater non-lick soil, but were 12X greater in excreta than non-lick soil. Selenium concentrations were 400X and 300X greater in lick-soil and excreta, respectively, than in non-lick soil.

## DISCUSSION

Rodent activity, including nesting and digging, provided excreta rich in sodium, potassium, calcium, magnesium and phosphorus; and also made unweathered, mineral rich soil, available to bighorns. Mineral licks at rodent middens were located in escape cover, thus providing essential minerals in a secure habitat.

In temperate North America, peak use of mineral licks occurs during spring, or with increased vegetative growth (Watts and Schemnitz 1985). The attraction of ungulates to mineral licks during spring has been attributed to disruption of the sodium-potassium balance due to consumption of potassium-rich forage (Weeks and Kirkpatrick 1976).

Spring and early summer rainfall at BICA account for 67 % of the annual precipitation (Knight et al. 1987). Annual production of perennial grasses and shrubs at BICA occurs during this period. Ewes occupied karst topography and frequently used sinkholes with rodent middens after lambing from June through August. Use of mineral licks at rodent middens may therefore be related to sodium craving in response to potassium-rich forage.

LITERATURE CITED

Bighorn Canyon National Recreation Area. 1981. Final general management plan, environmental impact statement, and wilderness recommendation for Bighorn Canyon National Recreation Area, Montana/Wyoming. United States Department of the Interior, National Park Service, Denver Service Center. 317 pp.

Bureau of Land Management. 1984. Herd management area plan: Pryor Mountain Wild Horse Range. BLM-MT-PT-84-019-4321. 63 pp.

Coates, K. P. and S. D. Schemnitz. 1985. Habitat utilization, interspecific interactions and status of a recolonized population of bighorn sheep at a wild horse range. Pp. 13-22 in University of Wyoming, National Park Service Research Center, Tenth Annual Report.

Knight D. L., G. P. Jones, Y. Akashi, R.W. Myers. 1987. Vegetation map of Bighorn Canyon National Recreation Area. University of Wyoming, National Park Service Research Center, Laramie. 114 pp.

Lichvar, R. W., E. I. Collins, and D. L.Knight. 1985. Checklist of vascular plants for Bighorn Canyon National Recreation Area, Wyoming and Montana. Report prepared for Bighorn Canyon National Recreation Area, Fort Smith, Montana.

Watts, T. J., and S. D. Schemnitz. 1985. Mineral lick use and movement in a remnant desert bighorn sheep population. J. Wildl. Manage. 40:610-625.

Weeks, H. P. Jr., and C. M. Kirkpatrick. 1976. Adaptations of white-tailed deer to naturally occurring sodium deficiencies. J. Wildl. Manage. 40:610-625.

Wyoming Game and Fish Department. 1982. Job Completion Report Survey: Bighorn Sheep Population Investigations. WYGFD in-house report. 3 pp.