

CARDIAC TELEMETRY, NATALITY AND GENETICS
OF A RECOLONIZED POPULATION OF BIGHORN SHEEP
AT A WILD HORSE RANGE

Kevin Coates
Sanford Schemnitz
Department of Fishery and Wildlife Sciences
New Mexico State University
Las Cruces

Introduction

Data were collected from 05-88 to 12-88 in continued research to aid in the development of a management program for Rocky Mountain bighorn sheep (Ovid c. canadensis) at Bighorn Canyon National Recreation Area (BICA). A principle goal of the management program at BICA is to promote the continued expansion of a recolonized population throughout ancestral habitat in the area (BICA 1984).

In previous research at BICA (Coates and Schemnitz, 1988), we identified 3 factors as potentially limiting to herd expansion: visitor and (or) vehicular disturbance of bighorns (esp. reproductive ewes), competition with horses for grasses, and possible genetic constraints on recruitment resulting from small founder-group size. The purpose of this report is to present progress toward completing the following objectives:

Objectives

1. Implant and monitor cardiac transmitters; determine the physiological response of bighorns to roadside disturbance; develop recommendations to mitigate disturbance from interactions with visitors and from proposed road improvements.
2. Determine the genetic diversity of the bighorn herd as compared to other native and introduced bighorn populations.
3. Analyze seasonal food habits of bighorns and horses; analyze the dietary overlap of these species; analyze fecal nitrogen of bighorn diets.
4. Determine numbers, age/sex composition and natality for the BICA bighorn herd; analyze seasonal numbers of horses on the Dryhead Unit of Pryor Mountain Wild Horse Range.

Methods

Animal Capture

We chemically immobilized sheep for the purposes of implanting long-range cardiac transmitters (ECG-1, J. Stuart, Grass Valley, CA), and to sample tissue for genetic analysis. Sheep were darted using a mixture of ketamine/xylazine hydrochloride.

The transmitter, housed in a 6 X 1.25-in. lucite cylinder with fixed, stainless-steel end cap/electrodes, was surgically implanted (Philo et al. 1981) in 1 of 2 locations on the left side of the chest. The transmitter was first placed intercostally, but was later moved laterally near the sternum.

The experimental reversal agent, yohimbine, was used to reduce recovery time (Hurley 1985). We administered prophylactic injections of Vit E/Selenium, penicillin, and a diuretic to minimize capture stress (Jessup et al. 1984).

Cardiac Response

Bighorn sheep are not exploratory in their movements and rarely migrate to new areas. Therefore they must adapt to emotional and (or) psychological stressors rather than disperse to avoid them (Geist 1971). The general adaptive syndrome (GAS) according to Selye (1950) is a stepwise physiological response by which energy reserves are liberated to meet the increased energy demands of stress. According to Selye, the first stage of GAS is the alarm response, which is followed by the resistance stage. Under chronic conditions, the resistance stage may be terminated by adrenal exhaustion.

During the resistance stage glucocorticoids are secreted to meet increased energy demands through sugar metabolism. Glucocorticoids also are thought to be moderators of the immune system (Harlow et al. 1987). Bighorn researchers and managers agree that chronic stress lowers immunocompetency, and is responsible for widely observed epidemics of pneumonia.

Wildlife biologists have long sought a technique to quantitatively analyze stress in free ranging animals. Harlow et al. (1987) presented data which demonstrated a strong relationship between cardiac response and changes of blood-cortisol levels in chronically stressed bighorns.

Methods

Cardiac transmitters will be implanted in 4 ewes this winter, and cardiac response and behavioral data will be analyzed through June 1989. The cardiac transmitter used for this project has a range of up to 5 km, with an average lifespan of 12 months (Follman et al. 1982).

Analytical observations will begin 24-48 hours after animals are released. Heart rate (HR) will be noted at 10-minute intervals during continuous surveillance (1-4 hours) to determine heart rate ascribed to undisturbed activity patterns. Heart rate will be analyzed continuously during standardized-harassment trials to determine changes in HR elicited by various stimuli.

Stimuli to be used in harassment trials include: road-side passes by different types of vehicles (e.g. passenger car, light-tow vehicles, commercial trucks), road-side passes by vehicles at various speeds, and various approaches by humans (with/without dog, on/off road, HR response at incrementally closer approach distances). When opportunity arises, HR will recorded spontaneously during interactions with visitors, traffic, and wild horses.

Stressors will be categorized as high, medium, or low depending on the magnitude and duration of the HR response. Recommendations will be developed to mitigate disturbances causing high and medium HR responses.

Numbers and Age/Sex Composition

Herd size, age/sex composition and natality were determined from duplicate counts. One helicopter survey was conducted in June to count bighorns. Incidental to the flight, seasonal numbers of horses were determined on the Dryhead Unit of the Pryor Mountain Wild Horse Range (PMWHR).

Food Habits and Dietary Overlap

Bighorn and horses fecal collections were obtained during summer and fall for seasonal food habits and fecal nitrogen analyses. Two independent sets (replicates) of fecal collections were obtained for the analysis of ewe food habits and fecal nitrogen during each season. One fecal collection (2 pellets from each of > 10 defecations) was obtained for analysis of ram food habits and fecal nitrogen during each season. Replicate fecal

Methods

Collections were obtained for the analysis of horse food habits during both season. Dietary overlap of sheep and horses was calculated by Kulczyński's Formula (Oosting 1956).

Genetic Analysis

Tissue and (or) blood samples were collected from 3 bighorns. Collections were preserved in phenoxyethanol (Nakinishi et al. 1969). Also, the carcass of a 17-year old member of the founder group was

placed in cold storage.

Progress

Animal Capture and Cardiac Telemetry

Two adult ewes were chemically immobilized. One ewe, a 1987 immigrant, was captured in order to recover an ear-tag. The other ewe was captured for purposes of cardiac telemetry. Upon recovery, the ear-tag indicated that the ewe was a 17-year old member of the original release group. A veterinarian was present, yohombine was administered and precautions against capture stress were followed, but the ewe died during handling.

A cardiac transmitter was implanted in the second ewe we captured. A veterinarian was present and performed surgery, but the transmitter failed to operate and was removed. We concluded that the 7 mv input threshold of the transmitter was not sensitive enough to detect the QRS-wave amplitude of the heart (pers comm. T. Bunch).

The input sensitivity was increased to 0.7 mv and the modified transmitter was unsuccessfully implanted, at the same location, in a domestic ewe. We moved the transmitter to 3 different positions on the rib cage (horizontal, diagonal, and vertical) and changed the electrode polarity at each location (removed and reversed transmitter end for end).

Assistance was received from a medical doctor experienced in the procedures, and a transmitter was successfully implanted near the sternum in a domestic ewe. An incision was made at the caudal end of the sternum, and a minimum amount of blunt dissection was performed to open a shallow pocket between the subcutaneous fat and underlying muscle.

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When inserted into this pocket, the cylindrical configuration of the transmitter and conical shape of the front-electrode cap, helped to form a subcutaneous channel as the package was pushed through the loose-connective tissue. It was critical, in terms of signal transmission, that the transmitter remain in a plane between the subcutaneous fat and underlying musculature.

A transmitter was left in the domestic ewe in order to further evaluate procedures before work with bighorn ewes this winter. Three weeks after surgery the transmitter ceased to operate. We attributed the system failure to formation of scar tissue around the transmitter and subsequent reductions in tissue conductivity. Further tests conducted using an electrocardiograph indicate that transmitter sensitivity should be further increased to 0.4 mv. Capture work and implantations using

the modified transmitter will be performed in December 1988 and January 1989.

Numbers and Age/Sex Composition

Over the short run, herd size increased at the optimum rate (Buechner 1960), from approximately 62 bighorns (58-66) in 1987 to 70 (68-73) in summer 1988. In summer 1988, there were 9 surviving yearlings from a crop of 14 lambs in 1987. However, 3 of those 14 lambs were dead within 5 days of birth. Thus, overall recruitment was still 64% for 1987. Eighteen lambs were born in 1988, but 1 male was killed by a vehicle in August.

In summer 1988, there were an estimated 18 adult rams (> 3 yrs.), and 25 adult ewes. During a single helicopter survey in June, 51 rams, ewes and lambs (16/19/16) were observed. During the survey, 28 horses were observed on the Dryhead Management Unit of the PMWHR. The carrying capacity of the Dryhead Unit has been set at 30-32 adult horses (BLM 1984).

Food Habits and Dietary Overlap

Food habits data for summer and fall 1988 are not yet available. Previously presented food habits data (Coates and Schemnitz, 1988), and new results from fall 1987 are summarized.

From summer 1986 to present, browse was the principal component (46%) of ewe diets at BICA (SE 7.4). Grass composed 36% of the diet (SE 7.3), and forbs accounted for the remaining 18% (SE 5.3).

Progress

Elsewhere in the region, grasses are the principal component of bighorn diets (WYGFD 1982). However, Mexican bighorn sheep (Ovis canadensis mexicanus) show higher preference for browse, which constitutes the mainstay of the annual diet (Watts 1979). Similarity of Rocky Mountain bighorn diets at BICA to Mexican bighorn diets in the Southwest is attributed to similar environmental conditions, low precipitation and dominance of browse in the vegetative communities.

Fecal Nitrogen

Results of fecal nitrogen analysis indicate that ewe diets contain 8.75% protein during summer 1988. Summer is a critical nutritional period, not only for the pregnant or lactating ewe, but also for the developing fetus or lamb. A domestic ewe, in this condition class, requires feed with a minimum 8.4% protein (Short and Golley, 1968). These data indicate that browse supplies the minimum-summer protein requirement for ewes at BICA.

Previous data on diurnal activity patterns (Coates and Schemnitz 1988) during summer 1986 and 1987 indicate that ewes foraged for extended periods with only brief resting periods at mid-day. Ewes spent > 60% of the time foraging from 0600 until 1200 hours. After 1300 hours until sunset, foraging activity increased steadily. By 1730 to 2030 hours ewes devoted 100% of their activity to foraging. Two minor peaks of resting occurred at 1200-1300 hours and 1530-1700 hours.

Extended foraging periods and short rumination times at BICA indicate that bighorns use a concentrate-foraging strategy in which large amounts of browse are "stuffed" and quickly passed (Green 1987). The adequate, but relatively low protein content of the ewe's summer forage at BICA, and data on food habits and activity patterns, are consistent with a concentrate-foraging strategy. Bighorns are typically classified as roughage feeders, which forage predominantly on grasses. Growth of the bighorn population at BICA is thus linked to development of an adaptable foraging strategy.

Genetic sampling:

Blood and tissue samples were collected from 4 bighorns for genetic analyses. Muscle tissue from the immigrant ewe which was captured to recover the ear-tag was collected and frozen. Muscle tissue and blood samples were collected from the ewe which was captured for cardiac telemetry and also from the road-killed lamb.

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