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STUDY PLAN: Temporal changes of ungulate forage availability on winter range in lower Big Creek.

Since at least 1986, lamb mortality within the first 2 months of life has been very high (> 90%) for a bighorn sheep population wintering along lower Big Creek. The immediate cause appears to be Pasturella haemolytica. This pattern apparently continued in lower Big Creek in 1991 with high lamb:ewe ratios observed in June but by late July no lambs were observed and dead lambs were found without signs of predation or injury. However, lambs were observed in August and September 1991 in upper Rush Creek and along the Middle Fork Salmon River just above the confluence with Big Creek (ratios = ~50 lambs:100 ewes). A pregnant ewe was removed from lower Big Creek in March 1991. Her lamb, born in captivity, contracted a heavy infection of Pasturella while in captivity but survived. Selenium levels in this ewe were found to be the lowest measured in bighorn in Idaho. Selenium, while poisonous in forage at high doses, is an important trace element for immune system function. This ewe and lamb were released in lower Big Creek in October 1991.

The 5 year period of high lamb mortality coincides with drought which has persisted in central Idaho since 1986, although large amounts of precipitation in early summer 1991 may have broken this pattern. Cheatgrass, an annual exotic, has been present in the native bunchgrass ranges of Big Creek for decades but recent persistent drought may have given cheatgrass a competitive advantage over native bunchgrasses. Cheatgrass initiates growth in spring earlier than native grasses but soon flowers and desiccates thereby providing forage only briefly. Native bunchgrasses initiate growth later than cheatgrass but retain nutritive value into the following winter.

Bighorn population numbers have remained stable (200-250 sheep) in Big Creek over this period based on annual Idaho Dep. of Fish & Game helicopter surveys. Elk numbers in the Big Creek drainage have steadily increased to record high numbers in recent years. Population trends of mule deer are unknown.

The picture, then, is of a bighorn population of relatively stable numbers (suffering little mortality from hunting) which is experiencing high early-summer lamb

mortality for the past 5 years. This lamb mortality is coincident with persistent drought and an expanding elk population. Cheatgrass also may be expanding its coverage into native bunchgrass ranges to the detriment of the native grasses. We hypothesize that susceptibility of lambs to disease is in response to multiple factors that reduce range carrying capacity for sheep. These factors are greater competition with elk for available forage driven by reduction in high-quality forage (bunchgrasses) as a result of drought and increases in cheatgrass. Another factor may be that persistent drought has reduced availability of forages that concentrate selenium thereby reducing dietary selenium intake below that necessary to maintain normal immune system function.

This study plan outlines measures of temporal changes in forage availability (biomass) on a winter range in lower Big Creek which supports significant numbers of bighorn, elk, and mule deer during winter and spring. Coincident with measures of forage biomass depletion over time, temporal changes of bighorn, elk, and mule deer densities on this winter range will be obtained to provide animal density measures as covariates with forage depletion rates. Temporal changes of nutritional value of key forage grasses will be obtained if possible. We view this study as an initial component of a larger study to determine range carrying capacity for the Big Creek bighorn population.

METHODS

I. FORAGE UTILIZATION OF GRASSES (bluebunch wheatgrass [Agsp], Idaho fescue [Feid], Sandberg's bluegrass [Posa], and cheatgrass [Brte] only)

Objective: To determine how much of each plant is taken during each time interval

a. Method for determining weight distribution of a plant:

Clip 10 plants of each species on a site similar to selected study site (be sure they represent typical plants). Cut each plant into 2 cm lengths, weigh each segment to nearest 0.01 gm. Be sure to record each segment according to its height from ground, i.e., 4-6 cm segment, 6-8 cm segment, etc. This procedure will provide an estimate of weight distribution for a plant, for each species, as follows:

DISTRIBUTION ON PLANT	WEIGHT OF SEGMENT	CUMMULATIVE TOTAL WEIGHT
base-2 cm	x.xx gm	1.00
2-4 cm	x.xx gm	0.95 (ex.)
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top 2 cm x.xx gm 0.05 (ex.)

b. Method for selecting and examining study sites:

Selection: Select 3 sites where sheep have been seen to graze, which are representative of vegetation in vicinity:

Brte site, somewhere near or below first bench where Brte is > half of the composition; Feid site, somewhere above third bench; Agsp site, select site above first bench with no Brte in it; Posa can be examined on the above 3 sites.

Mark sites with stakes (painted bright color on top) at each corner, sites are squares (25 x 25 m, 625 m^2)

Examination: Study will begin in January 1992 and continue through April 1992 (majority of ungulates have left winter range by then). Examine each site once every 10-14 days if possible. Check 50 plants (or total number of plants if < 50) of each selected grass species on each site (so even if site is designated Brte; Brte, Agsp, Posa, etc. would be checked also). Plants will be selected on a random basis from across site. Record grazed and ungrazed plants to obtain proportion of grazed plants by species. Locate grazed portions and measure height of grazing from base for each plant by species. Since portions of a plant may be taken, estimate to nearest 0.10 the porportion of the plant removed at the height interval. If all the plant is taken to the height interval, record as 1.00 of interval + above

When each site is established, the total number of plants of each of the above species will be counted on each study site. Do this by partitioning the site into 25 25x1-m strips and count number of plants for each species within each segment. This will then be used to calculate the total biomass that was available at the start of sampling, and was available sequentially at each time interval. For Brte, place 20 20x50-cm plots randomly across site and count culms of that species. This means you will have an estimate for Brte, and total counts for the other species, assuming that you can count all plants of the other species using this method. If you cannot, then estimate for each species as for Brte.

[a. Estimate changes in canopy cover green growth of principal grasses within permanent subplots. Establish 30 random subplots (20 X 50 cm) within each permanent community site (6 total). Subplots are placed at 1 m intervals along transects, oriented upslope, with transect starting points at random distances apart (minimum distance apart = 2 m; see attached figure). The number of subplots along each transect is determined by how many will fit along each

transect within the community site boundaries. Mark corners of each subplot (2 corners) with lag bolts (painted for high visibility). Determine canopy cover of AGSP, BRTE, FEID, and POSA for green vegetation only in Daubenmire (1959) cover classes: 0%, 1-5%, 6-25%, 26-50%, 51-75%, 76-95%, 96-100%. Measure the height of green leaves on an average plant of each species within each subplot. Canopy cover and green leaf height should be estimated at 10-14 day intervals within each community site.

b. Develop predictive model for relationship between canopy cover and biomass for principal grasses. On a site similar to each community type (3 total, i.e. BRTE, AGSP, FEID), estimate canopy cover of 4 principal grasses (AGSP, BRTE, FEID, POSA) and green leaf height of average plant of each species within 30 20 X 50 cm plots. Clip each plot of principal grass species, separating by species. Oven-dry, and weigh to nearest 0.01 gm. Regression equation will be determined from canopy cover class mid-points regressed against biomass for each species by height classes. Make sure there are at least 30 canopy cover estimates, heights, and biomass weights for each of the 4 principal grasses.]

II. ESTIMATING BITE SIZES AND INTAKE RATES

Objective: to determine how much forage is taken in per bite, per feeding period, and per day. This may be used to estimate an energy budget, to estimate forage used, and to estimate how many 'bites' are available on a unit of land.

Methods:

a. bite size: Direct observation, preferably close to an individual, but with binoculars and spotting scope if necessary. Focus on a plant being eaten by a sheep, record number of bites, location of plant, and size of bites. Mark plant by referencing adjacent rocks, etc, or follow tracks in snow and examine plants eaten after sheep leave area. (this latter method will get location of bites, but not necessarily size and number). Count number of culms of each plant that is taken in a bite, then clip from a [nearby plant of the same species, but outside the study sites, the same amount, oven-dry and weigh to nearest 0.01 gm. Divide the biomass estimate of each plant by the number of bites taken to equal bite size in grams] Do the counting and weighing procedure for at least 20 plants of each species. This assumes that bite size doesn't change during winter of study unless you notice that it does. If you do notice a change, do the count and weigh procedure again. [I know this doesn't help with your frustration but it's the only way to determine voluntary intake. Try doing it on one plant at a time. Don't worry that you're disturbing the sheep. That shouldn't affect bite size, just feeding time.]

b. number of bites/feeding bout: focus on an individual sheep at it starts to feed [(classify feeding as head down position only; don't include head up position even though sheep is chewing or moving to next plant)] and count the number of bites it takes for a 10 minute period or until it quits feeding [(whichever comes sooner). Subtract times when individual is obviously disturbed by observer.] Do this for several individual sheep. The object is to determine number of bites/unit time. Focus on other individuals and determine the length of time they feed at each bout. Do this for at least 20 individuals every 60 days. # bites/minute x length of feeding period = total # bites/bout.

c. number of feeding periods/day: Randomly select one-hour periods of study distributed throughout the daylight hours. Spend at least 1 hour watching one or more focal animals and record activity (feeding, moving, standing, bedded). [Even though sheep may feed for long periods, with feeding classified only as head down position, there should be enough breaks to provide samples of feeding times (I've included a stop watch).]

III. ESTIMATING TEMPORAL CHANGES OF UNGULATE DENSITIES AND USE PATTERNS

Objective: To determine temporal changes of range use of elk, mule deer, and bighorns on the winter range and temporal changes of densities of the 3 ungulates.

Methods: Distribution of each species (bighorn, elk, mule deer) will be mapped (on aerial photographs using acetate overlays for each one-hour period) at daily intervals over the same period beginning in January as described previously. Observations will be conducted for a one-hour period randomly selected within a given day during daylight hours following a pre-established random schedule. If visibility is poor due to weather conditions, a random daylight time will be selected for the following day. Observations will be taken from a vantage point which allows observation of the entire winter range. Numbers of each ungulate species will be obtained and their location on the winter range when first observed marked on aerial photographs. A group is defined as individuals concentrated within 100 m of each other. Three observation periods should be obtained within each 10-14 day period.