



Time-Lapse Photography to Monitor Riparian Meadow Use

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Abstract—Riparian zones are key areas of most western landscapes. The kinds and amounts of natural and human activity occurring on these sites are often in dispute as many riparian areas in the mountain West are remote or have limited seasonal access. Impacts by wild ungulates, domestic livestock, or recreationists can result in relatively similar damages to streamside environments. Competing interests often blame other uses for perceived resource damage. These questions of use can become serious management issues.

Time-lapse photography is proposed as a use documentation method to help guide management decisions. An example of the time-lapse method is presented to illustrate one of many potential uses. Examples of equipment and equipment costs are also provided. Servicing of the monitoring equipment may be needed at only infrequent intervals, depending on the kind of imaging sequence required and the equipment used.

Keywords: domestic livestock, wild ungulates, recreationists, competing uses

Riparian areas of the mountain West are the center of much natural and human activity. Numerous conflict possibilities arise because of human desires for forage, wood, precious metals, recreation, and pleasurable surroundings. One of the most widespread of these conflicts, or at least the perception of conflict, is between domestic livestock and native fauna. Potential conflicts involve a wide array of native fishes (Armour and others 1991), amphibians (Reaser 1996), land birds (Saab and others 1995), and big game (Hurlburt

and Bedunah 1996; Lacey and others 1993). The relative economic values of the competing uses are often an issue (Bernardo and others 1994; Cory and Martin 1985). Concerns of comparative resource damage are also important (USDA-USDI 1997). In some cases it has been found that livestock have not had the assumed impact on wildlife habitats and populations (Sedgwick and Knopf 1987, 1991), yet damage from recreational activities has been severe (Cole and Marion 1988; Saab 1996).

As questions arise concerning animal and recreational use of riparian locations, information may be particularly difficult to obtain for those locations that are remote. Interpretations of use are often speculative. If a riparian area has the appearance of deteriorating conditions, the cause must be determined if managers are to address the problem. Thus, a typical use of time-lapse imaging would likely be to record the relative amounts of *different* uses on a riparian meadow. For example, researchers in an Arizona study were able to separate the relative use of forest openings by cattle, elk, deer, and turkey using Super 8 time-lapse photography activated for daylight use by photoelectric cells (Ffolliott and others 1977). Time-lapse photography can provide a visual record of large animal and recreationist activity through time within prescribed portions of riparian meadows.

An Example of Time-Lapse Application

The objectives of this particular application were to determine where cattle were spending their time on a meadow, what their apparent activity was, and if interpretations from these observations correlated with ground measures of grazing effects.

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Methods

The study was conducted along Stanley Creek, Sawtooth National Recreation Area, Sawtooth National Forest, Idaho, as part of a controlled grazing experiment (Clary and Booth 1993). Time-lapse photography was used to document the positions of cattle within several pastures. Pastures 1 (medium stocking), 4 (light stocking), and 5 (medium stocking) were documented for 2, 4, and 3 years, respectively. A total of 10 to 23 days of picture sequences were obtained per pasture. Photographs were obtained using a 35-mm SLR camera, with a motor drive and a 250-exposure magazine back controlled by an intervalometer (fig. 1). The camera was positioned in a protective case on hill slope sites approximately 12 to 30 m above the meadow level. Photographs were taken at 20-minute intervals during daylight hours. Each animal in view on a projected transparency was classified for location on broad plant community-soil groups—streamside (13 percent of the area), wet graminoid (12 percent), dry graminoid (53 percent), dry shrub (9 percent), and mixed types (13 percent). Enlarged comparison photographs of the same views, taken late in the summer when vegetation color could be used to differentiate between wet and dry sites, were used to interpret cattle locations on projected transparencies. The activity of each animal was classified into one of three categories: standing with head down (assumed to be actively grazing), standing

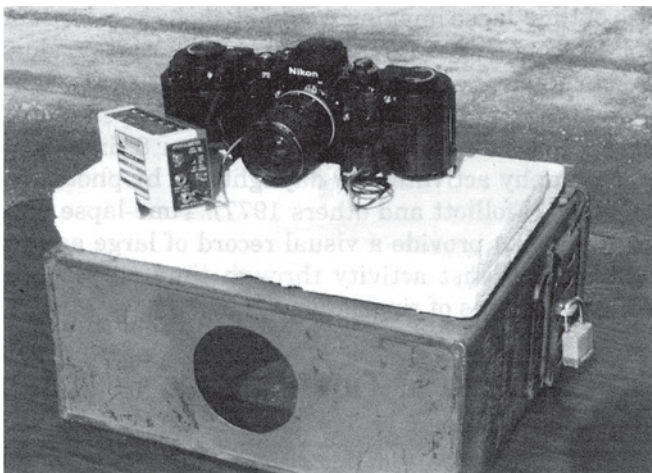


Figure 1—Camera set-up used in the example study. Camera has 28-85 mm zoom lens, motor drive, 250-exposure magazine back, and intervalometer. When mounted for use, the camera is inserted through the back (originally the lid) of the modified ammo box such that the camera lens and the light sensor of the intervalometer have access to the glass window. The box is then closed and sealed.

with head up (assumed to be ruminating or resting), or laying down (assumed to be ruminating or resting).

Cattle location data would typically be analyzed by Chi-square (Byers and Steinhorst 1984), however, the frequency of the time-lapse photographs did not provide completely independent observations for the location of individual animals. Therefore, cattle locations per transparency were expressed as number per unit area or density. Analysis of variance was conducted using a General Linear Model PC software package. Pastures and years were included in the analysis as explanatory variables to account for differences in animal stocking densities, but the variables were not a focus of the analysis. The experimental unit was number of animals per hectare per plant-soil site per photograph. Probabilities of 0.05 or less were considered significant.

Results and Discussion

A difference in the distribution of cattle among site categories was readily apparent. The cattle were concentrated within the dry graminoid area (fig. 2) composed mainly of the tufted hairgrass community type with substantial elements of the Kentucky bluegrass community and the thickstem aster-Idaho fescue community. Animal densities in the dry graminoid meadow locations were over an order of magnitude greater than the mean of the remaining sites ($P < 0.01$) (table 1). The head down, head up, and laying down positions all followed similar trends, although the proportion of total cattle present that were laying down was greater on the dry graminoid sites ($P < 0.05$).

Cattle are known to be selective among range sites for standing, lying, and walking activities. The location of these activities may have only limited association with herbage production and consumption (Dwyer 1961; Weaver and Tomanek 1951). The cattle concentration on the dry graminoid portion of the meadow was greater than would be assumed from forage utilization for that area. Average forage utilization ranged from 44.0 percent in the tufted hairgrass community (part of the dry graminoid site) to 28.4 percent in the water sedge community (part of the streamside site) (Clary and Booth 1993). Livestock select bedding sites that have a degree of environmental comfort (Arnold and Dudzinski 1978). The high animal density on the dry graminoid area was apparently in part because they were resting and ruminating more on dry graminoid sites. The wet graminoid, streamside, and mixed types likely had a lower animal presence because of the higher soil moisture contents of these sites, some of which were quite boggy (Clary and Booth 1993). Reasons for avoidance of the upland shrub type may include the physical presence of small shrubs, remaining stubs of dead plants, and some surface stones that can make walking more difficult and lying down less comfortable. Once on

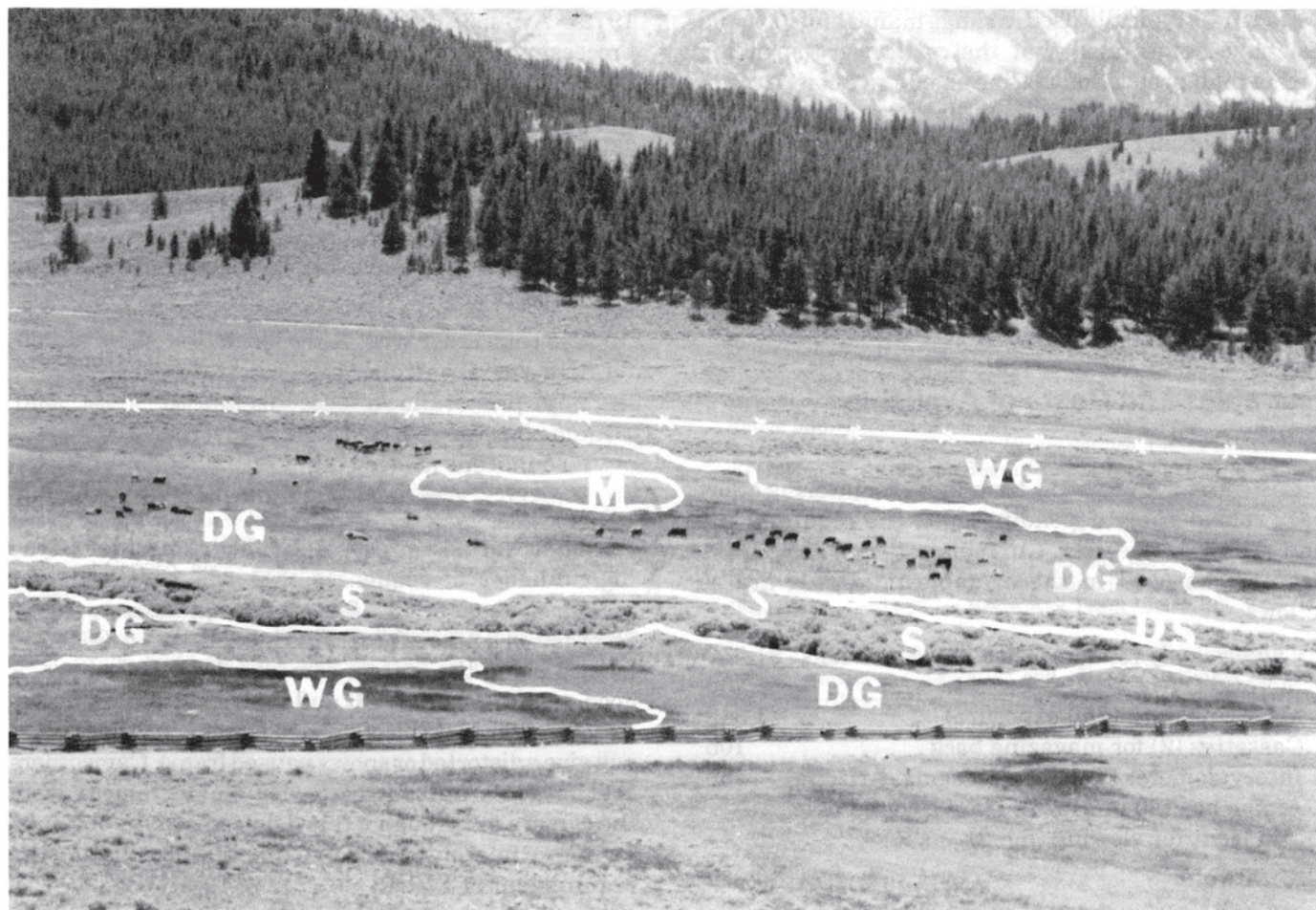


Figure 2—Time-lapse photograph of pasture 4 illustrating the concentration of cattle on the dry graminoid (DG) portion of the meadow. Other sites are dry shrub (DS), wet graminoid (WG), mixed types (M), and streamside (S).

Table 1—Cattle densities (animals ha⁻¹) within broad vegetation-soil categories as determined from time-lapse photographs.

Vegetation-soil category	Standing, head down	Standing, head up	Laying down	Total
Dry graminoid	14.22 c ^a	3.87 c	9.75 c	27.84 c
Dry shrub	0.48 a	0.05 a	0.07 a	0.60 a
Wet graminoid	0.93 b	0.20 b	0.13 ab	1.26 b
Mixed types	1.20 b	0.25 b	0.14 b	1.59 b
Streamside	0.26 a	0.07 a	0.22 b	0.55 a

^a Numbers in columns followed by dissimilar letters are different at $P < 0.05$.

the dry graminoid area the cattle likely invested more grazing time because the rate of forage intake would be low on the dry, tufted hairgrass sites where leaf heights are very short (Chacon and Stobbs 1976; Kinney and Clary 1994); more grazing time would be required to satisfy their forage requirement (Chacon and Stobbs 1976; Hodgson and Wilkinson 1968).

No determinations of night activities were made, but bedding and night grazing typically occur in the approximate location of the cattle at onset of darkness (Dwyer 1961; Weaver and Tomanek 1951). Thus, total occupancy impact on the dry graminoid area probably exceeded our photo record.

Measures typically used in range management would not have determined that the cattle were spending such a high proportion of time on one site compared to the others. Additional animal time on any site has the potential of increased damage through trampling of forage plants, soil compaction, and woody plant structural breakage. Thus, better interpretation of grazing effects are possible with the additional information provided by time-lapse photography. Examples of equipment and equipment costs, for those interested in pursuing this type of monitoring, are provided below.

Examples and Costs of Available Equipment

Costs associated with a time-lapse monitoring effort vary considerably depending upon the requirements and desires of the user. Current costs for the equipment used in the example presented are as follows:

Camera body (35 mm) with 28-85 mm lens	\$1,550
Motor drive	250
Magazine back (250-exposure)	1,312
Cassettes (2) for magazine back	105
Intervalometer (Telonics, Phoenix, Arizona)	450
Ammo box (20 mm) with glass covered hole in front for viewing (fig. 2)	—
Total	\$3,667

A more economical set-up can be obtained approximately as follows:

Camera (35 mm) with built-in motor drive, 35-80 lens, and 36-exposure capacity	\$600
Intervalometer (Telonics, Phoenix, Arizona)	450
Ammo box (20 mm) with glass covered hole in front for viewing	—
Total	\$1,050
Telephoto lens for either of above cameras (if necessary)	\$300

A drawback with the latter camera setup is the limited film capacity of 36 exposures, although there may not be a need to record images as often as the study example presented (every 20 daylight minutes). A 36-exposure roll would last 1 week if the intervalometer were set to take one photo every 3 daylight hours during long spring days, or about every 2.5 daylight hours during shorter fall days, if general use of the area was the primary interest. In cases where one image every day or every several days would suffice, such as need for a visual record of snow depths, snow melt, water depth, or flooding, a 36-exposure roll of film could last up to several months.

Much of the earlier work utilized relatively economical Super 8-mm movie cameras (Ffolliott and others 1977; Gillen and others 1985; Patton and others

1972). Availability of such cameras, film, and film processing is now limited to mostly foreign sources. Super 8 and 16-mm movie photography has largely been replaced with video camera imaging. Some video cameras were constructed previously with built-in intervalometers, but these models were dropped from production due to lack of demand. Time-lapse segments can be taken, however, using video cameras with a LANC jack and a LANC video controller. The typical costs are:

Video camcorder with LANC jack	\$700-1,000
LANC video controller (MK Enterprises, Blackstone, Virginia)	400
Ammo box (20 mm) with glass covered hole in front for viewing	—
Total	\$1,100-1,400

A potential advantage of a video camcorder is the high number of sequences that can be taken. For instance, about 1,400 5-second sequences could be recorded on a 2-hour tape. This is compared to 36 to 250 frames using the 35-mm cameras described above. A good quality 4-head VCR and television set are necessary for clear viewing of paused frames. A 2-head VCR will give a distorted or snowy paused frame. Camcorders that have internal controls to view single frames within the camera or through a television set can be obtained for approximately \$1,000 and up, thus eliminating the requirement of a VCR.

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