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Application of Color Infrared 70mm Photography for Assessing Grazing Impacts on Stream-Meadow Ecosystems[1]

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INTRODUCTION

Black and white photography of medium scales (1:15,840 — 1:30,000) and 9 inch x 9 inch (22.9 cm x 22.9 cm) format has been recognized as an important tool for inventory and evaluation of rangelands (Driscoll 1969 and 1971, Pickford and Reid 1942), with initial use for vegetation mapping and location of prominent cultural features such as fences, powerlines or roads.

More recently, color and color infrared (CIR) photography have been found useful for inventory of natural resources. In an investigation on Nevada marshlands, Seher and Tueller (1973) reported that color photography, combined with on-ground analysis, provided permanent records of seasonal and yearly marsh changes. They found evaluation of land treatment and management practices possible with color photography. The Bureau of Land Management in Montana has found low altitude 35mm color and CIR photography valuable in range inventory analysis, as well as for identifying waterfowl habitat condition and potential (Cosgriffe et al. 1973, Meyer 1973, Meyer and Gerbig 1974). Colwell (1960), using tones and textures on infrared film, found the photography useful for distinguishing vegetation heights in the management of wildland areas. Meyer and Gerbig (1974) noted that CIR film exposed at photographic scales of 1:2000 and 1:3000 was adequate for assessing waterfowl habitat with 35mm camera systems. Other studies utilizing the 70mm CIR system found larger scales (1:600-1:2000) excellent for distinguishing several forb and shrub species (Driscoll 1971).

Driscoll (1969) states that an object's identification in an aerial photograph should be based on characteristics of the object as recorded by the remote sensor (camera and film), and not as viewed firsthand. That is, features of an object as seen with the naked eye may differ in appearance on photographs, depending on the characteristics of film and camera.

Color infrared photography relies on both visible and infrared light reflectance from objects photographed. The degree of absorption or reflectance is dependent upon the morphology and physiology of the object. For

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example, actively growing vegetation registers as red or pink on CIR film, differing in shade with vegetation type and species. Inactive vegetation, while appearing green to the human eye, may appear a dark shade of red or brown on CIR film. Bare ground or rocks will appear white on CIR; litter appears light brown. Water, depending on depth and movement, will appear either light or dark blue, or black if stagnant.

Cooperative investigation between the University of Idaho and the U. S. Forest Service was initiated in 1974 to evaluate the effects of a grazing system on stream-meadow ecosystems in central Idaho. One of the major objectives of the project was to devise procedures for making an evaluation. CIR photography was tested as a means of providing a permanent base for monitoring both vegetation and stream channel changes. Identification of vegetation strata was an additional asset offered by the CIR film.

Project study areas were chosen within the Idaho Batholith, and include portions of the stream-meadow complexes of Elk Creek (Corduroy Meadows), Johnson Creek (Tyndall Meadows), and the South Fork of the Salmon River (Stolle Meadows). Meadows along Elk and Johnson creeks range in elevation from 6400 to 6700 ft (1951 m to 2042 m), and are under three-pasture rest-rotation. Lodgepole pine vegetation borders these meadow areas. Stolle Meadows ranges in elevation from 5300 to 6700 ft (1615 m to 2042 m). Lower elevation areas are enclosed in Lodgepole pine while the upper meadow sites occur within the Spruce-Fir zone. The Stolle Meadow area has been ungrazed for at least a decade.

PROCEDURE

Permanent line transects were employed to gather data on vegetation attributes (composition, and cover), animal behavior and stream channel stability.

Photography (CIR) was obtained with a 70mm camera mounted in a vertical position in a small, high-wing aircraft. The 70mm system has been found to have significant advantages over conventional 35mm camera types. Capabilities of the system, when combined with low-level flight, allow for high resolution stereoviewing with a small, 70mm x 70mm format (Driscoll 1971).

For this stream-meadow assessment, two flights were made; the first on 14 July of 1975 and the second on 24 September of 1975. Since specific study sites had not been selected, the first flight generally covered the three stream-meadow complexes. Scales of 1:2000 and 1:8000 were photographed. The fall flight was restricted to 1:8000 scale, and covered the study sites within each complex more specifically. A Hulcher 70mm camera (Model 102), equipped with a Schneider Xenutan 150mm lens, was used on both flights. Eastman Kodak Aerochrome Infrared film (Type 2443)[3] was exposed and processed by the Remote Sensing Research Unit in the College of Forestry, Wildlife and Range Sciences.[4]

RESULTS AND DISCUSSION

Despite some camera malfunctions on the first flight, the CIR photography has proven extremely useful for the assessment of grazing systems on stream-meadow ecosystems.

Site Evaluation

The knowledge of existing environmental conditions affecting vegetation characteristics is key to successful inventory and evaluation of vegetation with aerial photography.

With CIR photography of 1:8000 scale, vegetal "zones" have been identified within the stream-meadow ecosystems selected for study. These zones are predominantly related to soil depth and available moisture. The streambank area is characterized by a mixture of *Carex* species and rhizomatous forbs and grasses. An intermediate zone exists between the streambank and the drier, outer meadow areas, containing a mixture of *Carex, Juncus,* and *Salix* species. Bunchgrass species and taprooted forbs comprise the majority of vegetation of the outer meadow area. Each zone was identifiable during the growing season and in the fall. Moisture being the determinant for zone separation, growth periods were reflected on CIR through dormant or active vegetation. Seher and Tueller (1973) in their work on marshlands, found that photographic cover analysis could adequately quantify emergent and submergent vegetation. Meyer (1974) was able to classify aquatic vegetation types through CIR photography with a minimum of ground sampling.

Within the stream-meadow complexes, identification of woody shrub species, such as *Salix,* is possible with 1:2000 scale CIR photography. Life form identification (grasses-grasslikes versus shrubs) was also possible with the same scale CIR photos. As other work has shown, larger scale photography (1:600-1:2000) may permit identification of individual species. Driscoll (1971) was able to identify several species of shrubs and larger forbs with CIR photography at scales of 1:600. Seher and

[3]Reference to this film type is not meant as an advertisement.

[4]The assistance of Robert Heller, Dr. Joseph Ulliman, and graduate assistants Hal Anderson and Wayne Miller of the Remote Sensing Research Unit, is greatly appreciated for photographic support of this manuscript.

Tueller (1973) were able to construct CIR photographic keys for identification of 10 major types of marsh vegetation, utilizing plant height, color, and texture.

CIR photographs (1:2000-1:8000 scale) can clearly define alterations in vegetation cover and subsequent changes in bare surface area. The abundance of vegetation or plant material in the form of litter on stream-meadow sites allows for easy detection of bare ground with CIR, both during and after the growing season. Also noticeable in areas dominated by forbs such as mulesears (*Wyethia amplexicaulis*), is the increase of bare ground in CIR photos taken in the fall. While providing an almost continuous cover in July (appearing red dotted on 1:8000 CIR), these forbs become dormant in late summer; by fall the same area shows an increase in bare ground. The resulting image appears light brown or white.

The influx of sediment from direct runoff due to identifiable causes, such as road construction or logging, was identified with CIR photography of 1:8000 scale. For an inventory analysis on Nevada rangelands, Tueller (1975) utilized CIR photography (1:600 scale) for marking areas susceptible to erosion increases. With additional work other possibilities for detection of susceptible erosion areas will be feasible.

Indication of range trend appears as subsequent change in vegetation communities due to treatments or practices. Though not recognizable from existing photography, future CIR photos taken of these stream-meadow ecosystems may reveal changes in life form abundance or perimeters of vegetation zones. The first CIR photos could serve as a base to observe vegetation and erosion conditions through future years.

Stream Channel Stability

The natural process of stream channel alteration has been noted with color photography (Watson and Hoyle 1975). Whether grazing systems influence this process, by enhancing or inhibiting change, is a major source of conflict. Through the use of CIR photography, comparison can be made of any change occurring seasonally or yearly. Channel alterations such as bank slough-off or channel obstruction can be detected on CIR photography. Ground checks and monitoring with subsequent photography enable the manager to evaluate stream channel alteration. Comparison with similar but ungrazed stream-meadow complexes, as has been done with the current cooperative study, aids in determining the effect of a grazing system on stream habitat.

Animal Behavior

Color infrared photography offers insights into the little understood field of animal behavior. In stream-meadow complexes, recognition of fecal material was possible with 1:2000 scale photos. Photography of larger scales (1:600-1:1000) could reveal more identifiable fecal groupings, indicating areas of concentrated use. Seasonal changes of fecal distributions could be especially relevant in meadow ecosystems. Tueller (1975), with CIR photography of 1:600 scale, was able to recognize evidence of grazing pressure through the amount of fecal droppings located on the photographs.

Cattle trails within these meadow areas have also been delineated with both 1:2000 and 1:8000 scale CIR photos, in both summer and fall seasons. The use or avoidance of vegetation zones has been recognized, as well as watering areas. As present photography of these stream-meadow complexes taken in the fall indicates, larger scale CIR photos (1:600-1:1000) could aid in detection of differences between grazed and ungrazed areas within a single complex.

SUMMARY

Color infrared photography of large scales (1:2000-1:8000) can provide the resource analyst with a method for observing the influence of management systems (specifically grazing programs) on stream-meadow complexes. Vegetal stratification and identification can be accomplished, as well as providing a base for further observation of vegetation change. CIR use enables current and future evaluation of range condition and trend. Stream channel stability and alteration can be monitored. CIR photography can aid the manager in his understanding of grazing animal behavior, and provide information on the effect this behavior has on the stream-meadow environment.

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