forming bermudas and *Chrysopogon echinulatus* predominating. However, after seven years, good establishment of *Pennisetum* spp., a mid-successional grass, was noted over the hillside. Also, *Themeda anathera* considered the highest-successional grass in that area was scattered throughout the watershed.

The accomplishments of Bansi Dahr's efforts are impressive.

Reflections

Tremendous opportunities exist for technical assistance in soil, range, and forest conservation in developing countries. The work of India's Directorate of Soil Conservation serves as an excellent example of what can be accomplished.

Dahr is "one man among millions" in a land where civilization has existed for several thousand years and where rangelands have deteriorated beyond one's imagination. The constraints for Bansi are different than what North America faces. Our limitations are mostly what we place on ourselves, our group, agency, etc. North Americans are blessed with an abundance of resources. In developing, tired and used countries, the constraints to resource improvement are cultural, religious, political and, of course, financial, not technical, as one might expect. When working with developing countries, it is important to determine if they need, or even want, high tech or sophisticated research to solve their resource problems. Instead, they may need just solid common sense, grassroot level recommendations, and demonstrations that will fit their way of life. The Chinese proverb "Give a man a fish and he will have a fish for a day. Teach a man to fish and he will have fish for many days" could apply to the United States involvement in developing countries—especially in the area of resource management. Bansi Dahr is being accepted because he works at the grass roots level.

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Riparian Zone Inventory

Sandra Braasch and George W. Tanner

Riparian zone management is receiving increased attention on all rangelands. These areas are important for protecting stream habitat and maintaining water quality. The riparian zones are important livestock grazing areas because of accessibility to succulent forage, gentle topography, availability of water, and generally abundant shade which provides temperature relief. Lack of streamside vegetation exposes banks to erosion from rain or running surface water.

Concern has been shown in recent years about the impacts of improper grazing management on riparian and stream ecosystems. Problems frequently attributed to grazing include (1) vegetation deterioration in the riparian zone, (2) streambank destruction, (3) shallower and wider streams, (4) higher stream-water temperature, (5) sediment-covered stream bottoms, and (6) deterioration of fish habitat and population levels (Busby 1979).

During the summer of 1987, a channel stability evaluation system (Pfankuch 1987) and plant habitat classification system (Johnston 1982) were used to study and evaluate the riparian zone along a creek in the Rio Grande National Forest in Conejos County, Colorado (Fig. 1). The Pfankuch channel stability and plant habitat classification system are procedures which can be used to both establish baseline conditions and to monitor riparian zone and stream responses to range management practices. These studies: (1) evaluated the capacity of mountain stream channels to resist detachment of bed and

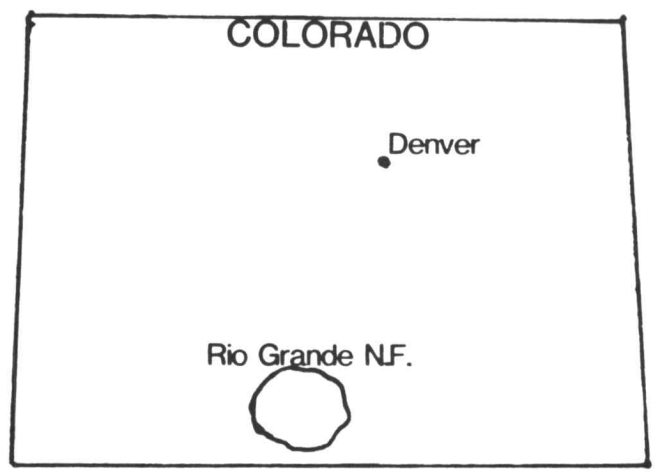

Fig. 1. *Location of Rio Grande National Forest, Conejos County, Colorado.*

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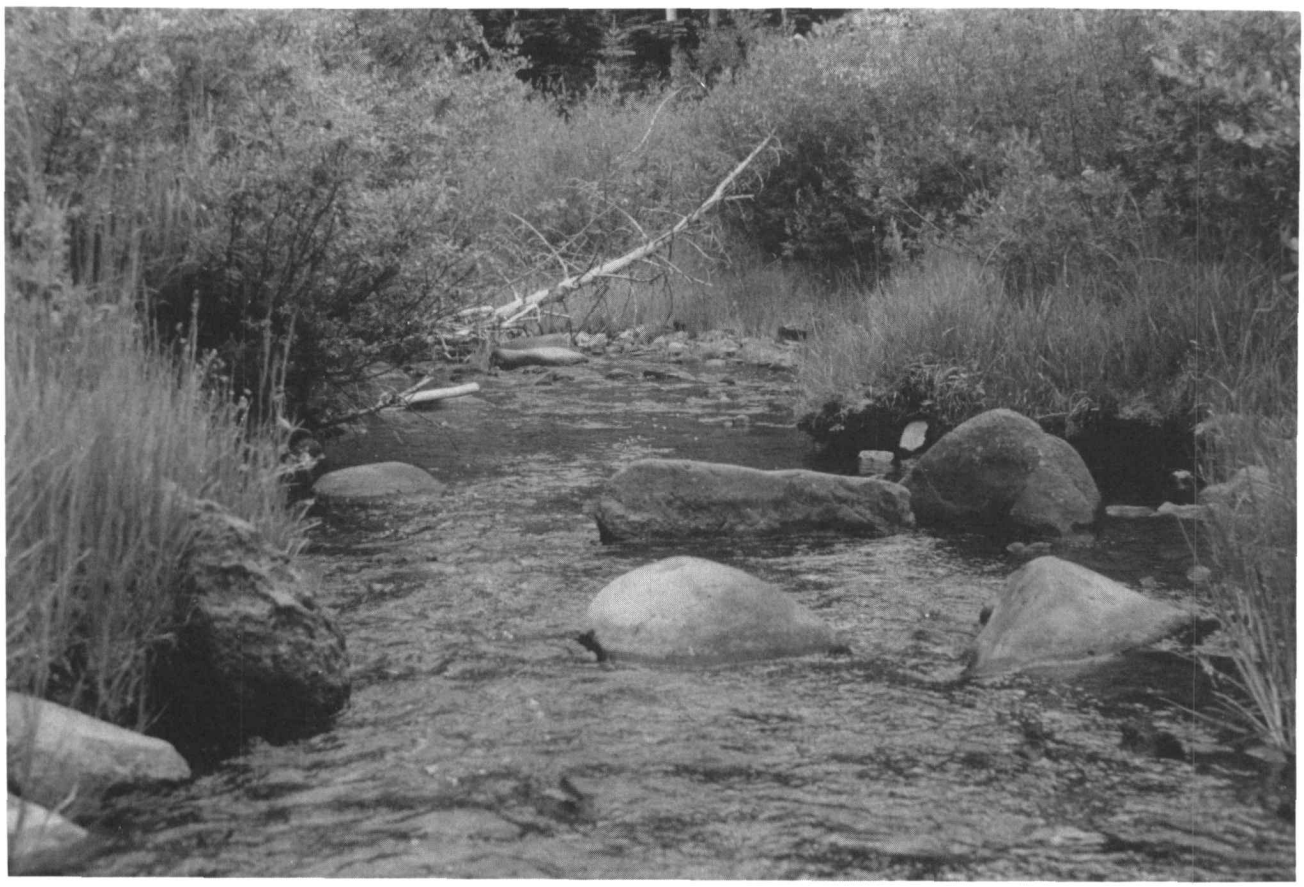

Fig. 2. *View of Jim Creek study stream.*

bank materials, (2) provided information about the capacity of streams to adjust to and recovery from potential changes in water flow and/or increases in sediment production, and (3) evaluated the successional stage and range condition of the riparian plant community. These studies provided a better understanding of the relationships between livestock grazing and riparian zone protection/preservation and the enhancement of fish habitats.

Study Area

The study was conducted along Jim Creek located in the La Jara watershed within the Rio Grande National Forest in Conejos County, Colorado. Elevation ranged from 9,900 feet near the Jim Creek cow camp to 11,640 feet in the northwest corner of the allotment. The study stream is bordered on the west by slopes of 30-50% and on the east slopes of 20-40% (Fig. 2).

The riparian community along Jim Creek is dominated by Thurber fescue, timothy, sedges, Kentucky bluegrass, meadow barley, yarrow, and cutleaf daisy. Overstory and midstory wood species include gooseberries/currants and willows. In some stretches of the the drainage, blue spruce and Douglas fir come down to the stream bank.

The adjacent upland communities support Kentucky bluegrass, wheatgrass and bluegrasses. Stands of subalpine fir, Engelmann spruce, and ponderosa pine, interspersed with cinquefoils, woods rose, Richardson geranium, flannel mullein, and thistles occur throughout.

Mean daily air temperature ranges from 75° F in July and August to -30° F in January. Precipitation occurs mainly in the form of winter snowfall. Approximately 35% of the 30 to 45 inches of annual precipitation results from rain during July and August.

Both cattle and sheep began grazing on this range around 1885. It was an important lambing area until after establishment of the Rio Grande National Forest in 1908. Grazing records show that the allotment was under season-long grazing until 1962 when it was placed under a "seasonal-deferred" rotation grazing plan. Since 1972 the allotment has been managed under a four-pasture, rest-rotation system with 145 cattle and two horses for a 3.5-month season beginning 20 June and ending 5 October.

The Rio Grande cutthroat trout originally occupied the upper Rio Grande River and its tributaries, but is now restricted to a few headwater streams within their original range. Following the construction of La Jara reservoir in 1910, brook trout from the reservoir hybridized with the Rio Grande cutthroat causing true breeding populations to be scarce. Because of this, the Rio Grande cutthroat was placed on Colorado's threatened species list in 1960. In 1977, steps to re-establish the traditional Rio Grande cutthroat in the study site's watershed were unsuccessful.

Methods

The riparian zone was characterized at 13 locations placed intermittently along a 2-mile reach of Jim Creek using a) the Pfankuch Channel Stability Rating which considered the physical aspects of the stream channel, and b) the Plant Habitat Classification which considered the vegetative aspects along the stream bank. The Pfankuch Channel Stability Rating procedure calls for the stream channel at each location to be subdivided into three zones; the upper and lower stream bank, and the stream bottom (Table 1). Within each of these zones various attributes listed in Table 1 are evaluated visually and

Table 1. Characteristics included in the Pfankuch Channel Stability Rating Evaluation.

Upper Bank	Lower Bank	Stream Bottom
Landform slope	Channel capacity	Rock angularity
Mass wasting	Bank rock content	Brightness
Debris jam potential	Obstructions flow	Consolidation
Vegetation bank protection	Cutting	Bottom size
	Sediment deposition	Clinging aquatic vegetation

ranked numerically according to a scorecard provided by the procedure. These numerical rankings are summed within separate zones and compared to a standardized condition class scale, ranging from poor to excellent condition, described in Table 2. Soil damage was included

Table 2. Standardized numeric ratings for determination of stream channel condition class when using the Pfankuch Channel Stability Rating procedure.

	Condition Class			
Bank/Channel zone	Excellent	Good	Fair	Poor
Upper bank	<10	11-20	21-30	31
Lower bank	<13	14-26	27-39	>40
Stream bottom	<15	16-30	31-45	>46
Total	<38	39-76	77-114	>115

to evaluate that portion of the physical substrate not evaluated by the Pfankuch method. In addition, other channel characteristics (length, sinuosity, gradient, dominant particle size, entrenchment/confinement, and channel type classification) were evaluated.

The dominant type of plant (lichen, grass/forb, shrub, and tree) and the successional stage of the Potential Natural Community (PNC) were determined by visual inspection at each sample site before evaluating the condition of the riparian plant community. The Plant Habitat Classification procedure uses a scorecard which provides a numerical ranking system for evaluating species composition, structure and density, as well as damage within the overstory, midstory, and understory of a site

Table 3. Characteristics included in the Plant Habitat Classification Evaluation that are numerically scored to estimate condition.

Stratum		
Overstory	Midstory	Understory
Density of tree overstory	Shrub composition	Understory composition
Damage to tree overstory	Density of shrubs (crown closure)	Ground cover
	Damage to shrub midstory	Damage to under-understory plants
		Damage to soils

(Table 3). Overstory species composition and structure define the successional stage of a site but are not used as actual evaluation criteria. The condition of the other parameters of the overstory, midstory, and understory were ranked numerically, summed for each sample site, and compared to a standardized scoring system for condition class for that successional stage. The overstory was evaluated according to tree crown closure and degree of browsing and damage to seedlings and saplings. Shrub species composition, crown closure, and browsing damage were evaluated in the understory. The understory vegetation was evaluated according to species composition, ground cover, grazing damage, and soil exposure. The appropriate numeric condition categories as established by the Plant Habitat classification procedure for a sawtimber dominant PNC, such as that which occurred along Jim Creek, are excellent (31-36), good (22-30), fair (14-21), poor (5-13), and very poor (0-4).

Results and Discussion

Results of the Pfankuch bank/channel stability inventory gave a cumulative fair-plus total rating (Σ = 80.9) for the upper bank, lower bank, and stream bottom (Table 4).

Table 4. Pfankuch bank/channel stability ratings measured at 13 locations along the Jim Creek study site, Rio Grande National Forest, Colorado. Data were collected July-August 1987.

	Numeric Rating		
Zone	Average	Min-Max	Std. Dev.
Upper Bank	21.5	19-26	1.9
Lower Bank	29.6	25-35	3.4
Stream Bottom	29.7	27-34	1.7
Total	80.9	72-90	1.7

Variation among the 13 sample sites was not great, and none of the scores approached poor condition. The Plant Habitat Classification inventory gave the vegetation a rating of good condition ($\bar{x}$ = 25.9; range = 24-29; standard deviation = 1.5). These evaluations were influenced by both beaver and cattle impacts.

Beaver impacts were located up-and-down-stream from

their dams. As might be expected beaver activity (channel obstructions) had a greater effect on the physical aspects of the stream than on the vegetation. Beaver activity reduced the ability of the stream to transport sediment in some areas by reducing the speed of water movement. Objects within the stream channel, such as large rocks, embedded logs, limbs, twigs, and bridge piling, changed the direction of flow and, sometimes, altered the velocity as well. These obstructions produced adverse effects by increasing normal stream velocity when the width/depth ratio was reduced.

Beaver dams produced favorable impacts by decreasing normal stream velocity and causing the formation of ponds. Dams raised the water level up to 5 feet higher than base levels of stream in areas without beaver activity. These newly created riparian communities were larger in size and, it was not uncommon for a 80-foot riparian zone to be extended 10-15 feet in width as the water level rose with dam formation. Beaver dams trap nutrients which nourish an abundance of aquatic life and terrestrial vegetation along with creating pools for fish habitat.

Beavers appeared to have no adverse impacts on the riparian vegetation. Overall beaver activity increased the availability of subsurface water which aided in the vegetative development of the riparian community (Munther 1981).

Cattle impacts were noted along some areas of the stream, generally more so on the physical aspects of the stream than on the vegetative aspects. Cattle activity was most notable on the lower bank where bank cutting, stream deposition, and eventual channelization were evident. Bank cutting, which is one of the first signs of channel degradation, appears to be caused by cattle foraging along the banks. Stream deposition occurred where the active bank cutting placed deposits of fresh, coarse sands and gravels on old and even some new bars. Channelization was evident in some area through these new deposits. No significant adverse impacts of cattle activity on the vegetative aspects were noted except the presence of some undesirable, exotic weeds such as thistle and flannel mullein.

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