The need for science in the range livestock industry: How ranchers evaluate and use science in land management

Cassie Cady

I thank Clayton Marlow for inviting me to be a part of this SRM symposium. I am a rancher and student of ranching and have worked on the Checkerboard Cattle Company (CCC), where I’m co-manager, since 1976. The ranch is located on the North Fork of the Musselshell River, in the Castle and Little Belt Mountains, Montana. Headquarters are over 5200 feet in elevation and the terrain rises from there. We are surrounded on several sides by US Forest Service (FS) lands. The ranch has evolved with the use of these federal lands even in the late 1800’s (before the FS existed) and continues to hold FS leases on 5 allotments with about 60% of our cattle grazing on FS allotments during summer months.

I tend to view science as an aid in our efforts to ranch sustainably. Ideally, to be most useful to me, science should be easily understood, unbiased, and repeatable. However, separating well designed, rigorously tested science from that which is opinion or observation can be difficult. We see information that has the appearance of science but seems to have been selected to bolster specific, preset agendas rather than presenting objective results that can be reproduced. Unlike information derived from conjecture, results from scientifically conducted studies can readily be seen. Performance of our AI calves, for example, is physical evidence that the science used to produce the technology is valid. It will take four years from the moment of successful AI conception until we can get carcass data on the first calf born to that heifer. Four years seems a long time to wait. But we’ll take the time so that we can determine the quality of product we are raising. We’ll use the data to make culling and bull selection decisions and to market our calves. Unlike livestock genetics, the validity of scientific premises in range and forestry is slow to reveal itself and more difficult to assess. In an effort to improve the grass resource we are raising on the ranch, we’ll also take the time. We use range inventory data to help us in making range management decisions. We set goals, weigh what we learn from outside sources against our own experiences, and choose a course of action. We try one thing and if it doesn’t work we try another. We monitor results to determine if and how our actions work toward our purposes and needs; and then we adjust as needed to respond to changing conditions. To evaluate the results of our range management on the ranch, we use grazing records, monitoring photo-points, and permanent transects. In addition, we have established permanent monitoring transects on some of our FS allotments. We have also relied on the historic range monitoring done in our allotments by Lewis and Clark National Forest personnel. However, in recent years, this Forest has begun to use an ecosystems approach, called Ecodata, to make management decisions. We are concerned that they are using this process as though there have not been livestock grazing on the allotments for decades.

I’d like to describe the implementation of the Ecodata methodology used by the Lewis and Clark National Forest and have you judge the validity of the science used in this example. That’s your job. First I’ll review the Ecodata process as it was implemented on our grazing allotments and identify several concerns that arose as Ecodata was implemented, citing examples that we documented. These examples raised questions about the quality of science used by the Forest Service. Finally, I’ll draw some conclusions about our first hand experience and make some recommendations to this audience.

Timeline

In 1987, Region I of the USFS made a decision to use the Ecodata system it had developed for analysis and classification of natural resources. Ecodata is described as “A sampling method designed for multi-resource inventory and monitoring application that can be used in conjunction with other data collection procedures, such as range inventory. Ecodata sampling methods provide for description of vegetation types.” (Final EIS, Chapter 8, p. 4) It was implemented in an attempt to establish a standardized method for vegetation inventory and monitoring and, secondarily, to “promote the integrated use of vegetative data by all types of resource managers” (Winslow, 1995). I don’t understand all the complexities of the Ecodata system, but in this method plant communities are classified based on species composition by percent plant canopy cover; ecological status is described as floristic similarity of current vegetation to potential vegetation (climax).

Because the Lewis and Clark National Forest (LCNF) of Region I consists of widely-dispersed districts, this Forest elected first to combine allotments located closely to each other into “allotment groups” to facilitate Ecodata assessment. This would allow Forest Interdisciplinary Team (IDT) specialists to concentrate resources in assessing several allotments at once, rather than focusing on one allotment at a time.

In May of 1992 Forest Service (FS) personnel met with the 19 Castle Mountain permittees to let them know that the first allotment group to be studied by the new method would be the Castles. To facilitate information gathering and dispersal, and to deal with the FS as a group, permittees reinstated a defunct organization called the Castle Mountain Livestock Association (CMLA). As secretary/treasurer of the CMLA, I’ve been involved in the dealings between the CMLA and FS from the beginning. The CMLA position has been proactive in the process of trying to help the FS accomplish what it wants. We asked the FS for its goals and for the chance to be a part of the IDT. Initially, the FS had no goals to share and told us that the IDT would develop goals as it went along. In January of 1993, the CMLA was finally allowed to sit in on the IDT meetings as observers, not participants. The IDT meetings
were long but it was fascinating to observe from the inside the federal government at work. I came away with a much greater appreciation for the difficulties government employees wrestle with in dealing with policies and special interest groups. Permittees wrestled too— with learning about the NEPA process. Ecodata, seral states and with judgment about the value of the land management proposals presented within the IDT team. We asked that if we could not actually participate, could an independent, third-party range scientist sit in on the IDT as advisor and participant. We were told that a ranger or range con would be happy to meet with any experts to discuss their questions. We asked for the data generated by the Ecodata survey and were given the entire record. We also asked to be able to submit an alternative for evaluation and were given permission to do so. In September, 1993, we submitted an alternative in which costs of proposed structural improvements were $1600 less than those proposed in the FS Preferred Alternative (Alt 10); in addition, we requested no reduction in AUMs. In a comparison of the ten alternatives evaluated in the Final EIS, the CMLA alternative (Alt 5) came in 9th - just above the No Action Alternative (Alt 1) in analysis of the categories of Upland Status (% use), Vegetation < DPC (desired plant community), Fisheries Trend (decline), Sensitive Fish (decline), and Wildlife Riparian (decline). The No Grazing alternative (Alt 2) showed the greatest resource improvement (more rapidly) over any of the other alternatives in all categories. Alt 10 (Preferred) called for a reduction in AUMs and was believed by the FS decision-maker to be a good compromise of cost of improvements, protection of resources, and livestock grazing. The CMLA questioned the justification of spending over $164,000 on structural improvements and taking reductions in AUMs.

The CMLA began to ask for help from outside range experts early in our participation. In September of 1992, we hired Rangehands, Inc to do a cursory review of the Castles to point out the problems they saw. They described problems in livestock distribution (not numbers), and, in a few allotments, season-long grazing. At a range monitoring field-day in June of 1993, John Lacey and Robin Tierney, PhDs in range science from MSU, reread an old Parker three-step site and found the extremely low. Consequently the CMLA requested a Section 8 process in 1994 and attempted to initiate a CRM process in 1996. Neither of these processes were successful. The FS released its Castle Mountain DEIS in August of 1995; the Record of Decision (ROD) / Final EIS—Castle Mountain Range Analysis (FEIS) was released in February of 1997.

The Final EIS, (Chapter 3, p.2) describes the methodology of classification of plant communities by site type (productivity), community type (seral stage), etc. “Plant communities were assigned to the map polygons based on the similarity of the polygon field description to the classified plant community description.” (Italics added) A map showing polygons looks like a jigsaw puzzle, with each puzzle piece representing a community classification (grassland, riparian, conifer, broadleaf, etc.). Each polygon is numbered and the number is logged into Ecodata with specific information relative to habitat characteristics, size and so forth. Polygons may vary in size from one acre to over 500 acres.

Definitions

The following definitions used by the FS may differ somewhat from what is generally understood and accepted. They are taken directly from the Final EIS.

- **potential natural community (PNC)**
  - The biotic community or composition of plant species that would naturally occur under minimally disturbed conditions (i.e. little occurrence of grazing, fire, mechanical disturbance or non-native plant invasion). (Chapter 8, p.9)

- **key areas**
  - The areas or portions of the range that are preferred by livestock and are grazed to the allowable use first. For cattle, these areas are generally riparian areas of gentle gradient and near water. The Key area guides the management of the entire area of which it is a part. (Chapter 8, p.6)

- **Allowable Use**
  - The amount of forage planned to be used to accelerate range improvements. (Chapter 8, p.1)

Is this audience familiar with these definitions? Are scientific data available to support these definitions?

In the first place, natural resources are dynamic and have historically received disturbance - in the form of fire, grazing, and mechanical impacts by millions of hooves, wind and water. Also, my concern as a rancher is that application of an allowable use standard may not move plant communities in key areas to a higher seral state as required by the FS. In his essay entitled The Illusion of Ecosystem Management, Allan K. Fitzsimmons describes ecosystems as being a fabrication of the human mind. He states “While the ecosystem concept may be helpful as a tool for researchers to better grasp the world around us, it is far too ambiguous to serve as an organizing principle for the application of federal law and policy. As spatial units, ecosystems represent a geographic free-for-all.” Range experts in this audience should be among those to debate the accuracy of these terms and the suitability of “ecosystems management”. As you do, please consider the following.

Agency Approach

Historically, data collected in the Castles included readings of 30 Parker three-step transects in the 1950s, ’60s and ’70s. In addition to the Parker data, records of numbers of livestock, on/off dates (total AUMs) and dates of moves through pastures within the allotments are kept annually. Paced transects describing range condition have been done in several areas over the years and those results are available, but few actual utilization measurements are available. All Parker transects...
are located on upland sites. The majority of transects were rated in good condition, some in fair condition, a few in excellent, and none in poor. However, the fifty years of Parker three-step data have been dismissed by the LCNF as being unable to be integrated or correlated into Ecodata, and so are no longer used. None of the other historical data were used in the development of the following methodology.

Under the Ecodata process, estimates of allotment stocking rates are calculated based on four factors:

1. existing condition relative to desired condition,
2. actual use relative to allowable use,
3. maximum carrying capacity estimates, and
4. effective carrying capacity estimates.

1. Existing condition relative to desired condition.
The FS began in 1991 by mapping the allotments into polygons. The assessment of each polygon is based on a one-snapshot-in-time estimate. For each polygon FS personnel do an ocular observation to determine:

   a. dominant species (determined by percent plant canopy cover)
   b. site type (ST) based on productivity on uplands or susceptibility to damage in riparians (where ST1=most productive, ST3=least productive)
   c. community type (CT) or % of floristic similarity to PNC (where CT1=PNC, CT2=high seral state, CT3=mid, and CT4=low)
   d. average slope of polygon.

The “desired future condition (DFC)” is plant communities in high or higher (PNC) ecological status with some exceptions. Exceptions include those polygons in low seral state which are not expected to improve because they contain large amounts (greater than 20%) of introduced species such as timothy, Kentucky bluegrass, and brome. Therefore, the emphasis is to move polygons that are determined to be in mid-seral state to high seral. The manner in which seral states will be improved is by applying allowable use standards.

2. Actual use relative to allowable use.
Historic use data and trend were not considered in the process of developing the new standards. Allowable use standards were developed based on published grazing studies and FS Handbook guidelines. Following are standards of allowable use for different plant community types and different grazing systems as listed in the Final EIS.

### Desired Plant Community

<table>
<thead>
<tr>
<th>Desired Plant Community</th>
<th>SL % Use</th>
<th>DR % Use</th>
<th>RR1 % Use</th>
<th>RR2 % Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNC</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>High Similarity</td>
<td>35</td>
<td>45</td>
<td>55</td>
<td>65</td>
</tr>
<tr>
<td>Mid Similarity</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>Low Similarity</td>
<td>45</td>
<td>55</td>
<td>65</td>
<td>75</td>
</tr>
</tbody>
</table>

* SL= season long; DR= deferred rotation; RR1= rest rotation1; RR2= rest rotation 2.

The average use over the rotation cycle assumes a four-pasture, one year system for RR1 systems and a five-pasture, two year system for RR2 systems.

(Final EIS, Chapter 1, p.11)

In his *Plant Requirements for Prudent Grazing*, Martyn Caldwell concluded that “proper use factors ... imply a level of precision and understanding of range plants and community dynamics that, for the most part, do not exist.” He went on to say that “…the traditional condition and trend analysis is probably the only suitable management alternative until a quantitative understanding of range plant function permits a more refined basis for management.” Are scientific data available to verify that the above standards will move plant communities to a higher seral state? Will, in fact, 45% utilization move a FESIDA/AGRSPI community that is in mid-seral state (15% FESIDA, 5% AGRSPI) to high (20% both species)?

3. Maximum carrying capacity estimates.
The FS determined forage production by clipping plot samples using a Daubenmire quadrate of 1.4 sq ft. Most sampling was done by seasonal trainees. No permanent plots were established so sample sites cannot be accurately revisited. Nearly every sample was taken from a different polygon in several different allotments. Although data was collected at the end of a drouthy period, weather records were reviewed by the FS to determine that precipitation was within a range of average conditions. From the clipping data forage production tables were developed for each of 94 plant community types. Results of clipping and weighing of 905 samples of forage taken from 1991 through 1995 (and augmented with published data from Mueggler and Stewart, 1980) were compiled into a publication (unique to the LCNF) to be used in mapping polygons. Very few historic clipping studies were available and so historic forage production records were not used in development of these tables. FS personnel can look at a polygon (in any of the mountain ranges within the LCNF), place it into a specific classification, and look it up in Range Vegetation Classification 1996, to find ecological status and forage production in pounds per acre for each site type/community type given in the respective tables.

Maximum carrying capacity may be determined by one of two ways, neither of which use long term historic grazing records. Note that, in each of these methods, grazed AUMs are calculated, not measured.

a. production basis:
   1. total usable forage (lbs/ac) = forage production (lbs/acre) * % allowable use
   2. total pounds available = total usable forage * acres
   3. maximum AUMs = total pounds available / 780 lbs (forage required by a cow for a month)

b. utilization basis:
   1. maximum AUMs = % weighted average allowable use * %actual use
   # AUMs actually grazed in that year

4. Effective carrying capacity estimates.
   “Effective carrying capacity” becomes the number of AUMs estimated to be able to be grazed by the time allowable use is reached on key (heavily used) areas and may be estimated by one of two methods.

a. PAUT formula:
   This distribution formula using the average slope of a polygon (determined in the field) and average distance from water (determined from maps) is applied to adjust from maximum capacity in an attempt to take into consideration uneven use within a pasture due to slope and distance from water. No consideration was given by the FS for historic grazing capacity based on allotment use records. The following formula was developed using data from 140 polygons in 14 pastures in 4 allotments and is unique to the LCNF:
1. predicted pasture utilization
\[ \text{PAUT} = \left(\frac{-3.8}{\sqrt{\text{PASL} \cdot \text{PAWA}}} + 13.2\right)^2 \]
\[ \sqrt{\text{POSL} \cdot \text{POWA}} = \text{POUT}/9.2 \]

Where:
- \( \text{PAUT} \) = predicted pasture utilization (in percent)
- \( \text{PASL} \) = pasture weighted average slope (in percent)
- \( \text{PAWA} \) = pasture weighted average distance to water (in miles)
- \( \text{POSL} \) = key area polygon slope (in percent)
- \( \text{POWA} \) = key area polygon distance from water (in miles)
- \( \text{POUT} \) = key area polygon allowable use (in percent)

2. maximum carrying capacity = \( \frac{\text{max carrying capacity} \cdot \text{PAUT}}{\text{ave. allowable use of all polygons in a past. (weighted for forage production)}} \)

3. effective capacity (AUMs) = \( \frac{\text{max carrying capacity} \cdot \text{PAUT}}{\text{ave. allowable use of all polygons in a past. (weighted for forage production)}} \) \( \times \) [the AU factor for cow/calf (c/c); or .76 for yearlings]

4. head months = \( \frac{\text{AUMs}}{1.32} \)

This is a method also used by the FS to adjust maximum capacity. Because few historic actual-use measurements are available, and those available are located primarily in key areas (very few available for more lightly used areas), a one-time utilization rating of “suitable” polygons is applied.

Favorable growing season. We at CCC wondered what the effects of a drier year would have on forage production figures and so did our own forage production sampling. We clipped, dried, and weighed ten plots in each of six polygons in August and September of 1999. Our sampling quadrat was a hoop totaling 4.8 sq ft of area. Although precipitation for 1999 was lower than normal, we found actual production in those polygons to be higher than stated in the LCNF

<table>
<thead>
<tr>
<th>Allotment Group/Estimate (1992)</th>
<th>CMLA Estimate</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polygon #</td>
<td>USFS</td>
<td>CMLA</td>
</tr>
<tr>
<td>813</td>
<td>1300</td>
<td>2050</td>
</tr>
<tr>
<td>252</td>
<td>1300</td>
<td>2130</td>
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<tr>
<td>907</td>
<td>1300</td>
<td>1490</td>
</tr>
<tr>
<td>781</td>
<td>900</td>
<td>2240</td>
</tr>
<tr>
<td>57</td>
<td>900</td>
<td>1740</td>
</tr>
<tr>
<td>879</td>
<td>800</td>
<td>1500</td>
</tr>
<tr>
<td>181</td>
<td>2000</td>
<td>1160 (post-grazing)</td>
</tr>
<tr>
<td>357</td>
<td>1600</td>
<td>1390</td>
</tr>
<tr>
<td>357</td>
<td>1600</td>
<td>1030 (post-grazing)</td>
</tr>
<tr>
<td>84</td>
<td>2100</td>
<td>2360</td>
</tr>
</tbody>
</table>

Notes: CMLA figures shown are for grass only, in pounds/acre. The FS figures are for total standing forage.

CMLA harvest sampling occurred July 10–11 during a growing season which was characterized by normal precipitation and below-normal temperatures. Cool temperatures delayed vegetation development by approximately 2 weeks. Standing forage crop was not fully developed at the sampling.
We have also found what appear to be mistakes in polygon classification for several polygons. For example polygons containing over 50% timothy were classified as being in mid-seral state. We feel that the application of an allowable use standard did not protect these polygons judged to be in mid-seral state in the original 1997 appraisal. The polygons will be found to be in low when they are reassessed, and the “decline” in seral state will necessitate further reductions in AUMs.

The FS underestimation of forage production translates into automatic, immediate cuts in carrying capacity and permit numbers. Forest Service errors in classification of polygons and reliance on utilization standards may result in future cuts as well. All cuts adversely affect those ranches whose economic stability is tied directly to the historic and customary use of the allotments.

The author is from Martinsdale, Montana.

**Conclusion**

Fairly and accurately applied by skilled, knowledgeable personnel, Ecodata may become a useful tool. But it cannot be validated without historical trend data. Our participation in and close-up review of the LCNF Ecodata procedure as it was applied in the Castles and Little Belts leads us to conclude that it has serious flaws. It not only seriously underestimated the carrying capacity of our allotments, but evidenced poor quality control in field application as indicated by the lack of ability to relocate sample sites, and by having sample sites too small in size, too few in number, and taken in different polygons. We question the scientific validity of the outcomes and the management approach of a process that fails to set measurable goals early on or closely involve the permittees who have utilized the allotments for many decades.

We worry that using low forage production figures, throwing out historical data, and using utilization standards as goals rather than as management tools will set resource managers up for failure. Ranching is a rigorous business encompassing many crucial decisions and requiring application of a variety of disciplines. We look for practical, technological uses of the scientific knowledge that has been compiled to improve production, not hinder it.

**References**


The author is from Martinsdale, Montana.