Viewpoint: The Way Things Are

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Now that some of us have put the "balance of nature," "climax," and "equilibrium" behind us as Dr. Box (*Rangelands,* Dec. 1992), suggested in his "Viewpoint," it is time to start working on a new model as Dr. Laycock has been doing.

The new model should be simple but able to demonstrate the infinite complexity of the range ecosystem. A model based on differential equations would satisfy this. It also should include plant progression and regression. Clement's biggest mistake was assuming there was a climax condition instead of recognizing that nothing ever stays the same. It is either going up or going down.

The dynamics of cheatgrass in the Northern Great Plains illustrates this point. When the range is distributed or wounded, you need a scab, and cheatgrass is an excellent scab. When perennial grass seed germinates, seedlings are weak competitors in the first year. If they are grazed twice they are dead, which is 1 good reason why range should be rested every other year. But in the second year the perennial grass is at full power and will out-compete cheatgrass. If the perennial grass is not harvested at that point the stand stagnates and cheatgrass increases.

In a wet fall, cheatgrass will invade the 1-year and 2-year-rested pastures. But there will be much less of it in the 2- year rested pasture.

Dyksterhuis's increasers and decreasers should also be retained and used to analyze rangeland. His system was good—it's just that people other than Dyksterhuis labeled decreasers "good" and increasers "bad". This was never meant to be. The listing was only to establish the point of range site progression or regression.

Dr Laycock's "steady state" and "threshold" model has excellent potential. It must be remembered that a steady state is predicated on: (1) seeds and roots, (2) diversity, and (3) velocity of the system. If you decrease or pollute the seed supply with invaders, decrease diversity, or increase the velocity of the system, you push the system toward and/or through thresholds into different steady states.

Stability is the ability to withstand disturbance. Following severe disturbance, nonlinear systems such as range return to the beginning (roots and seeds). This is different than a linear system, which continues on from where it stopped when the disturbance ceases. An example of this is the difference between a dial clock and a digital clock. When the power is cut to a digital clock, it returns to midnight when the power comes back on. When the power is cut to a dial clock, it will continue on from where it stopped when the power resumes.

Range returns to the beginning when it is disturbed by fire, buffalo, or drought. In the drought of '34 and '36, 92% of the grass at the Fort Keogh Research Station by Miles City, Mont., died regardless of whether previous use had been light, moderate, or heavy. Therefore it is important to have a large, diverse seed source. Some eastern Montana and western North Dakota farmers believe a seed population of 1 million per acre is desirable for small grain. In range, because of seedling mortality and because of the need for seeds of all the diverse species, I recommend the hypothetical figure of 1 billion!

Diversity of species is of prime importance. Plant progression and regression is a truth which follows closely the Biblical truth "the first will be last and the last will be first." When a particular late successional plant dies or is killed, it is replaced by an early successional plant. Without this process there is bare ground and no protection for seedlings of late successional plants.

With a high degree of diversity there is always a species to fill a niche left by some disturbance. For instance, in 40 years of watching the range on 1 hill top in eastern Montana, I have seen 1 flush of scarlet globemallow and 1 flush of milkwort. The flush of globemallow occurred 1 year after the drought of '88. I'm not sure of the circumstances responsible for the flush of milkwort, but both of these forbs were dominant for less than 1 year.

The third thing that stability hinges on is the velocity of a natural system. Normal velocity of natural systems is boom-bust. Any tampering with the boom-bustiness accelerates the velocity of the system, forcing increased nonlinear behavior and possible extinction.

By giving range peak rest, which in the Northern Great Plains is 2 years, followed by severe grazing, one enhances the boom-bustiness of the system. This also prevents mode locking.

Mode locking is a principle of chaos that states if you lock a biological system into 1 mode you enslave it, preventing it from adapting to change. Enslavement for range is continual rest, continual use, and take half—leave half. These systems leave range susceptible to grasshoppers, drought, fire, black grass bugs, noxious weeds, etc. In the longer run these factors also tamper with the boom-bust cycle.

By enhancing the boom-bust cycle of range you also enhance competitive fitness and robustness. Competitive fitness is defined in regard to the survival rate of noxious weed seed. In hypothetical figures, if survivability of a noxious weed seed is one in a million, the range site is competitively fit, but if the survival rate of a noxious weed seed is one in a thousand, the range lacks fitness. Robustness is the relative speed at which range site revegetates following a disturbance.

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Truths are divine principles which regulate all things, or in other words, we do not control truth but truth controls us. Rules on the other hand set perimeters to what can happen to us. Three rules that I think necessary for excellence in range management are:

1. Severely graze the pasture.
2. Let it recover.
3. Keep pastures small enough that the animals cannot sustain themselves on regrowth.

In summary, Dr. Box made some good points on why we should adopt a new model and Dr. Laycock's model of different steady states connected by thresholds is a good starting point. But don't throw the baby out with the bath water! Plant progression and regression and increasers and decreasers reflect the boom and bustiness of nature. One can however throw out the "good" and "bad" labels and the concept of climax (plant Utopia).

Also since the range ecosystem is nonlinear, one should model using the principles of the science of choas to demonstrate: beginnings and ends; truths and the benefits of simple rules; the complexity of the thousands of variables in range science and the simplicity of range management (given the right conditions a pea-brained buffalo makes a good range manager. When you run out of food, move on.)

Tall Larkspur Poisoning in Cattle: Current Research and Recommendations

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Tall larkspurs (*Delphinium barbeyi, D. occidentale,* and *D. glaucesens*) are the most serious cause of cattle deaths on mountain rangelands in the western U.S. (Ralphs et al. 1988). We have documented annual death losses from 4 to 15% per year on Forest Service allotments in Utah, Colorado, and Montana. The presence of tall larkspur on mountain rangelands also contributes to enormous forage losses, as cattle grazing is deferred or curtailed to avoid death losses on these highly productive ranges.

Tall larkspur research has been a priority at the USDA Poisonous Plant Research Laboratory since 1985. The larkspur research team is composed of range scientists, veterinarians, chemists, toxicologists, and neurophysiologists. Research objectives are to: (a) identify and isolate toxic alkaloids, and determine structure:activity relationships; (b) determine the toxicity and mechanism of action of toxic alkaloids; (c) identify environmental factors that influence toxic alkaloid levels in plants; (d) understand cattle consumption patterns in pen and field grazing trials; and (e) evaluate management alternatives to prevent or reduce larkspur poisoning in grazing cattle.

Toxic Alkaloids and Mechanism of Action

The toxins in tall larkspur are diterpenoid alkaloids. Tall larkspurs contain 18–20 different individual alkaloids which vary greatly in toxicity (Manners et al. 1992, 1993). The most toxic major alkaloid is methyllycaconitine (MLA), to which we have assigned the relative toxicity of 100. Deltaline, the most abundant alkaloid, often makes up over 50% of the total alkaloid concentration. Deltaline is relatively nontoxic, with a relative toxicity of 5. At least 1 minor alkaloid is as toxic as MLA, and several other alkaloids are of intermediate and low toxicity compared to MLA.

Levels of total alkaloids and MLA vary greatly from site to site and year to year. The MLA concentration in *D. barbeyi* is shown in Figure 1; these samples were collected from an area where 30 of 180 cows were poisoned near Steamboat Springs, Colo., in late August, 1991. In mid-June, 1991, Colorado MLA levels were highest as concentrations were about 1.4% in leaves of vegetative and newly budded larkspur. Cattle began eating larkspur in early August during the pod stage. Levels of MLA in leaves and pods declined in mid-summer, then increased as larkspur matured. Cattle increased consumption during the late season when there was an increase in toxicity, with disastrous results. Interestingly, tall larkspur from Oakley, Ida., during 1988 contained no or low MLA (range 0 to 0.01%) during the entire summer. We don't understand why such large location or year differences exist, but these differences probably explain much of the variation in cattle losses.

How much larkspur does it take to kill an average cow?

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