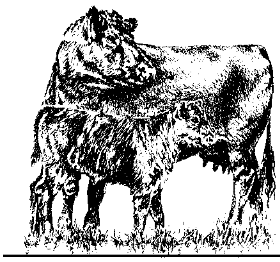


Western Beef Resource Committee *Fourth Edition*

Cattle Producer's Handbook

Range and Pasture Section 514

Range Condition and Trend Paradigms

James E. Bowns and Chad R. Reid
Utah State University Extension

The Society for Range Management (1989) defined range condition as the present state of vegetation of a range site in relation to the climax (natural potential) plant community for that site. It is an expression of the relative degree to which the kinds, proportions, and amounts of plants in a plant community resemble that of the climax community for the site.

The Range Succession Model in use in the U.S. was developed primarily from the writings and concepts of Frederick Clements. Sampson, a supporter of Clements' ideas, proposed that, by measuring changes in plant species composition, the successional concept could be used to determine whether livestock grazing had had a deleterious effect on range land.

Dyksterhuis proposed a formal procedure developed in the North American prairie that was quickly adopted by the Soil Conservation Service (SCS) [Natural Resource Conservation Service (NRCS)] and other land management agencies and the range profession as a whole. It enabled managers to quantify range condition and led to the development of the range site classification and what we now refer to as the Range Succession Model.

At that time (1949) the range condition methodology proposed by Dyksterhuis was innovative and definitely a progressive step based on the climatic climax of Clements. However, until recently, the range profession has never questioned the validity or application of this climax/succession model.

The descriptive adjectives, of the "climax" model—excellent, good, fair, and poor (Fig. 1)—lead to perception problems. "Excellent" was often the ultimate objective of management by the agencies for livestock, wildlife, or any other purpose. The perception of others (environmental groups) is that the only goal of management should be to move all rangelands to "excellent"

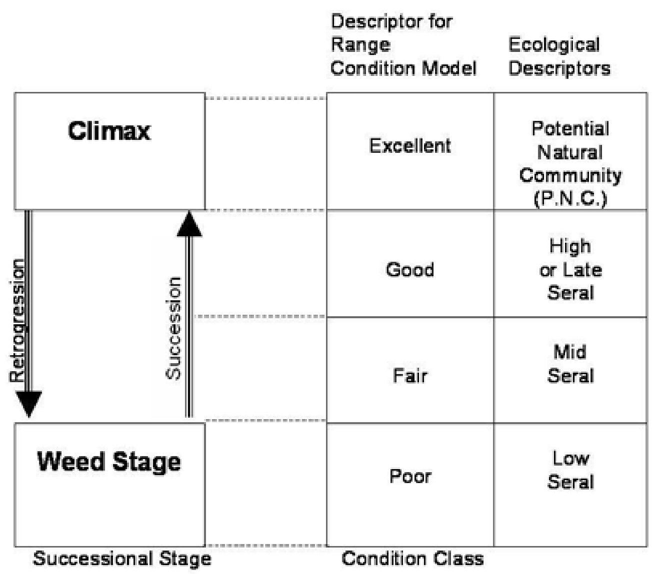


Fig. 1. Relationships between range condition and degree of retrogression and succession from climax condition.

condition. This idea is rampant in the environmental and conservation biology literature, and the range profession has been ultimately responsible.

The U.S. Forest Service (USFS) and Bureau of Land Management (BLM) changed the descriptions into ecological terms of potential natural (PNC), late or high seral, mid seral, and early or low seral (Fig. 1), but it did not alter this perception.

Emphasis on climax led to another perception that a pristine landscape existed in the western U.S. before European man's influence and that all management should be aimed at returning to that condition.

Implicit in the Range Succession Model is that the climax, or PNC, is the only stable state and is "best" in terms of stability, diversity, productivity, and sustain-

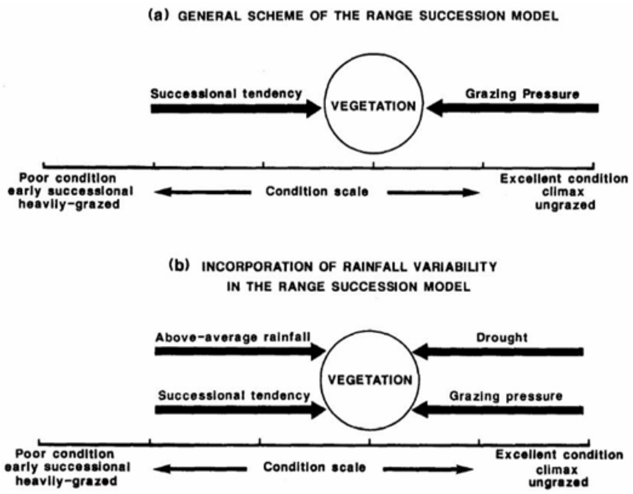


Fig. 2. (a) General scheme of the Range Succession Model. (b) Incorporation of rainfall variability in the Range Succession Model.

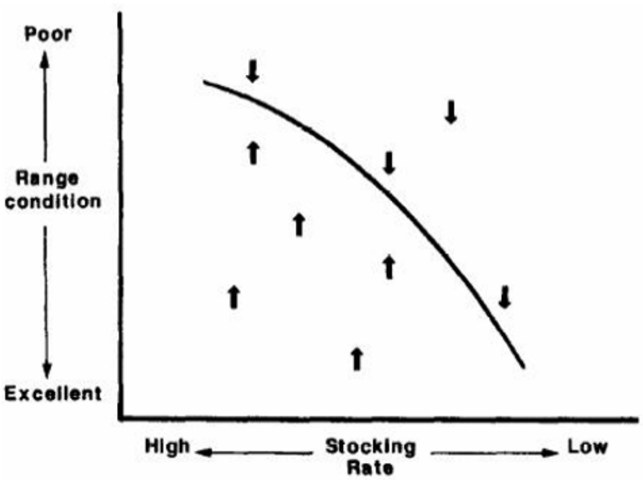


Fig. 3. Schematic relations between stocking rate and range condition under the Range Succession Model.

ability. Also, the climax, or PNC, is perceived to be in equilibrium with the climate and soils. It is also assumed that the trend to climax is steady, linear, directional, and predictable and follows the same path taken in retrogression. This process has been termed the "irresistible impulse to climax."

Another assumption is that retrogression caused by overgrazing is the opposite of succession (Figs. 2 and 3). The presumed unstable states can be reversed by changing, reducing, or eliminating grazing and then will result in succession to a higher condition class. Heady calls this the "grand illusion" and for many arid and semi-arid rangeland vegetation types these assumptions may be invalid.

Observations of the behavior of individual species led to categorizing them with respect to their response to grazing and their presence in the climax. If they were not present in the native vegetation they were called "invaders." Those present in the climax were classified

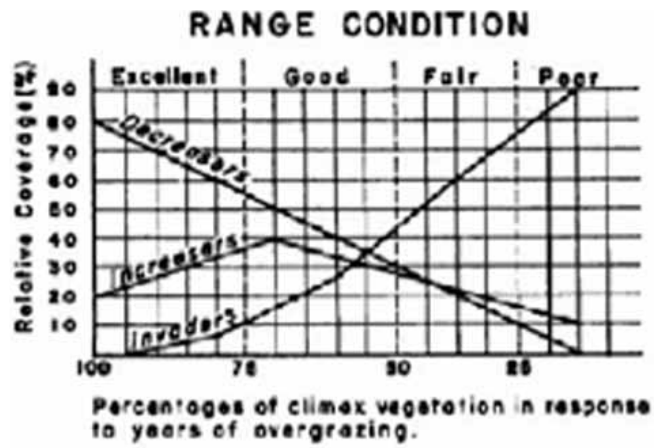


Fig. 4. Diagram illustrating a quantitative basis for determining range condition.

as: (1) increasers, those that increase under heavy use, and (2) decreasers, those that diminish under heavy use (Fig. 4). Generally, increasers were less palatable and decreasers the more palatable ones, although resistance to grazing is also a factor in the response of plants to use.

Even though the Climax Model was widely accepted and in use for decades, numerous researchers produced reports concerning rangelands, especially shrub-dominated areas where the model did not apply. However, for a long time, these findings did not change the perceptions of the federal land management and advisory agencies (USFS, BLM, NRCS) about how they managed and evaluated range condition.

An article by M. Westoby et al. (1989), however, caused at least the range science community to rethink the universal application of the Climax Model. Weaknesses of the Range Succession or Climax Model are most apparent in arid and semi-arid rangelands where episodic events are important.

M. H. Friedel (1989) used the concept of thresholds of environmental change to help describe and explain anomalies in condition assessments of central Australia's arid rangelands and stated that "the concept of thresholds offers a useful framework for identifying important environmental changes." She pointed out that once a threshold is crossed to a more degraded state, improvement cannot be attained on a practical time scale without a much greater intervention or management effort than simple grazing control.

Archer (1989) discussed mechanisms to explain how grazing and reduction of fire might cause a shift from a grassland or savanna domain across a threshold to a shrub land or woodland domain. This new domain cannot then be altered by reduction or removal of grazing (i.e., the threshold back to a grassland domain is difficult to cross). Other authors (Schlatterer 1989) suggested that succession may be halted indefinitely at some point on the successional scale.

This new conceptual framework for recognizing and describing changes in range condition has resulted, at least in part, from discontent with current concepts of range condition.

Westoby et al. (1989) proposed the dynamics observed on rangelands be described by a “state and transition” model. The “states” are recognizable and relatively stable assemblages of species occupying a site and the “transitions” between states are triggered either by natural events (e.g., weather or fire) or by management actions (e.g., grazing, destruction, or introduction of plants) or a combination of the two.

“Thresholds” are characterized as boundaries in time and space between two states and the initial shift across the boundary is not reversible on a practical time scale without substantial intervention through the use of fire, herbicides, or heavy machinery (Friedel 1989). Stocking-rate reductions are not enough to cause a reversion to the former state. Emphasizing the role of grazing and ignoring or downplaying the interaction of fire, drought, climate change, new plant introductions, altered wildlife populations, etc,. is not realistic.

The concept of thresholds of change that must be crossed for a system to move from one state to another offer promise for improved concepts, descriptors, and measurements of range condition.

Reasons suggested for suspended stages or different trajectories of succession may include: (1) dominance by a highly competitive species or life form, (2) long generation times of the dominant species, (3) lack of seed or seed source, (4) specific physiological requirements that limit seedling establishment except at infrequent intervals, (5) climatic changes, (6) restriction of natural fires, or others (Laycock 1991).

Many of the examples of the recognizable stable states of range condition on North American rangelands represent conditions from which substantial improvement is difficult (i.e., thresholds are present that are difficult to cross in order to obtain range improvement). Some of these states probably represent conditions that were reached as the rangeland areas were deteriorated by grazing, reduced fire frequency, alien species, or other factors. Others may represent stable states that were reached after some range improvement took place when grazing pressure was substantially reduced, but further change is difficult to obtain (Laycock 1991).

The ball and cup or trough analogy is another way to show multiple stable states (Fig. 5). A community is represented as a black ball on a topographic surface (cup or trough), which represents the range of environmental conditions under which the community is stable.

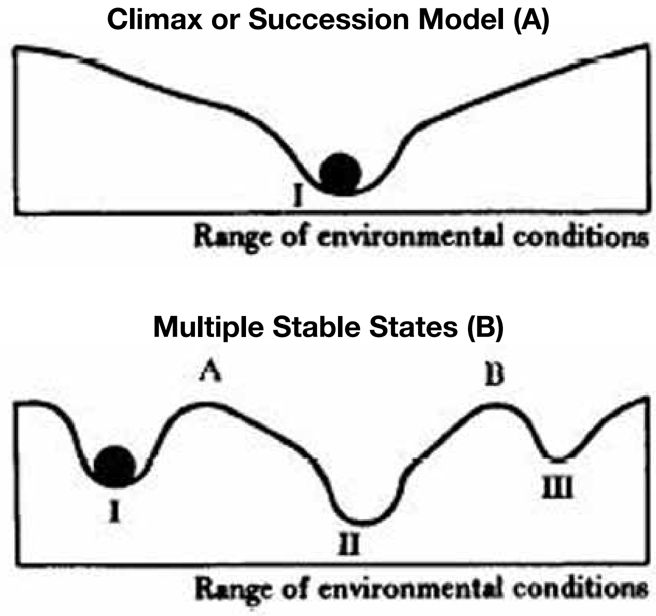


Fig. 5. The ball and cup or trough analogy. In (a) the community is stable because after all disturbances of perturbations it will return to configuration I. In (b) if the community is perturbed beyond a certain critical range, it will cross threshold A and move to a new stable configuration II.

Some notable examples where stable states and transitions have been recognized and documented are:

1. Mesquite savannas (Fig. 6)
2. Sagebrush-grass steppe (Fig. 7)
3. California annual grasslands (Fig. 8)

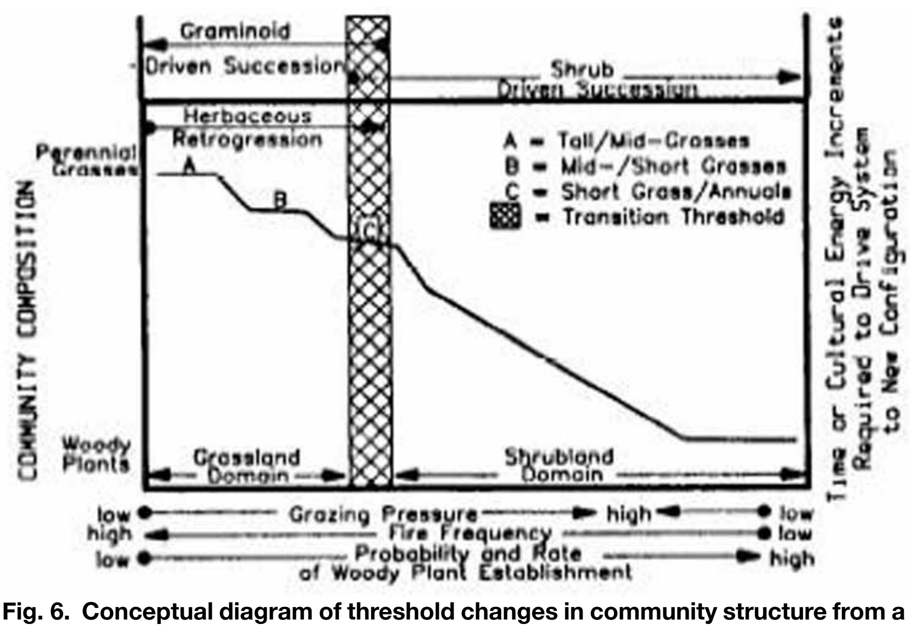
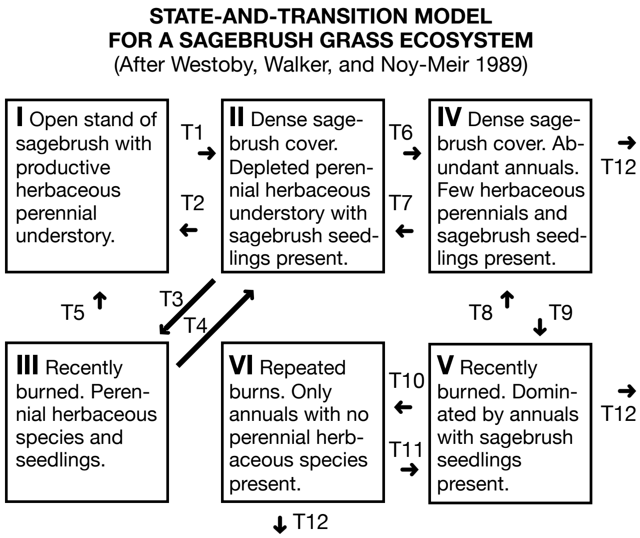


Fig. 6. Conceptual diagram of threshold changes in community structure from a grassland or savannah to a mesquite woodland as a function of grazing pressure. From Archer (1989).



Catalogue of Transitions

Transition 1: Heavy continued grazing. Rainfall conducive for sagebrush seedlings.
Transition 2: Difficult threshold to cross. Transitions usually will go through T3 and T5.
Transition 3: Fire kills sagebrush. Biological agents such as insects, disease, or continued heavy browsing of the sagebrush could have the same effect over a longer period of time. Perennial herbaceous species regain vigor.
Transition 4: Uncontrolled heavy grazing favors sagebrush and reduces perennial herbaceous vigor.
Transition 5: Light grazing allows herbaceous perennials to compete with sagebrush and to increase.

If climate is favorable for annuals such as cheatgrass, the following transitions may occur:

Transition 6: Continued heavy grazing favors annual grasses that replace perennials.
Transition 7: Difficult threshold to cross. Highly unlikely if annuals are adapted to area.
Transition 8: Burning removes adult sagebrush plants. Sagebrush in seed bank.
Transition 9: In absence of repeated fires, sagebrush seedlings mature and again dominate community.
Transition 10: Repeated burns kill sagebrush seedlings and remove seed source.
Transition 11: Difficult threshold to cross if large areas affected. Requires sagebrush seed source.
Transition 12: Intervention by man in form of seeding of adapted perennials.

Fig. 7. State and transition model for a Sagebrush Grass ecosystems.

Others:
Semi-desert shrub—Great Basin
Pinyon-Juniper

Summary

The Range Succession Model in use in the U.S. was developed primarily from the writing and concepts of Frederic Clements. Sampson, a supporter of Clements' ideas, proposed that, by measuring changes in plant species composition, the successional concept could be used to determine whether livestock grazing had had a deleterious effect on rangeland.

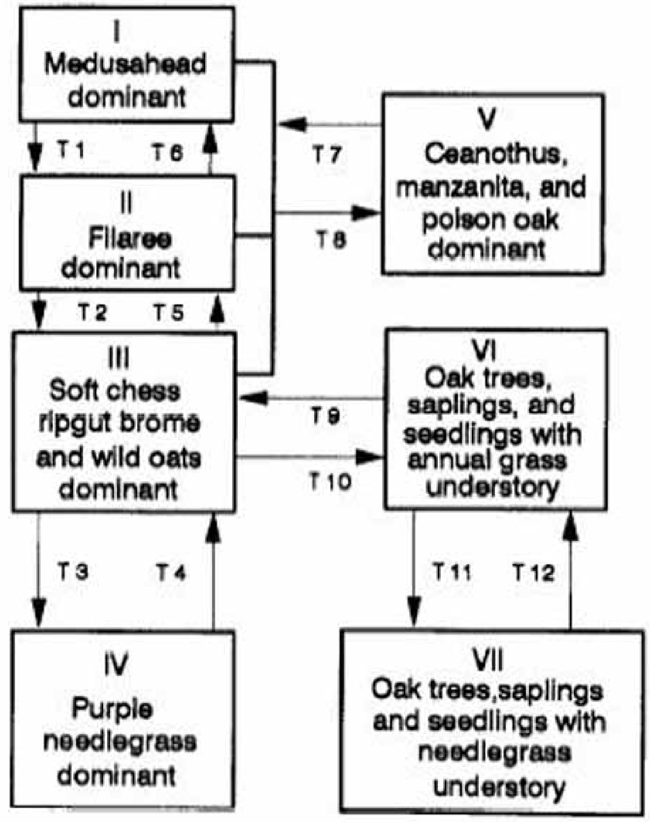


Fig. 8. State and transition model for annual grasslands.

Dyksterhuis proposed a formal procedure that he developed in the North American prairies that was quickly adopted by the SCS (NRCS), other land management agencies, and the range profession as a whole.

At that time the range condition methodology proposed by Dyksterhuis was innovative and definitely a progressive step based on Clements Climatic Climax. However, until recently, the range profession has never questioned the validity or application of this climax/succession model.

Even though the "climax" model was widely accepted for decades there were many rangelands, especially shrub dominated ranges, where the model did not apply. Weaknesses of the Range Succession or Climax Model are most apparent in arid and semi-arid rangeland, where episodic events are important.

An article by Westoby and others in 1989 caused the range science community to rethink the universal application of the climax model. They propose that the dynamics observed on rangelands be described by a "State and Transition" model. This new concept resulted, at least in part, from discontent with the current concepts of range condition.

Conclusion

Emphasizing the role of grazing and ignoring or downplaying the interaction of fire, drought, climatic

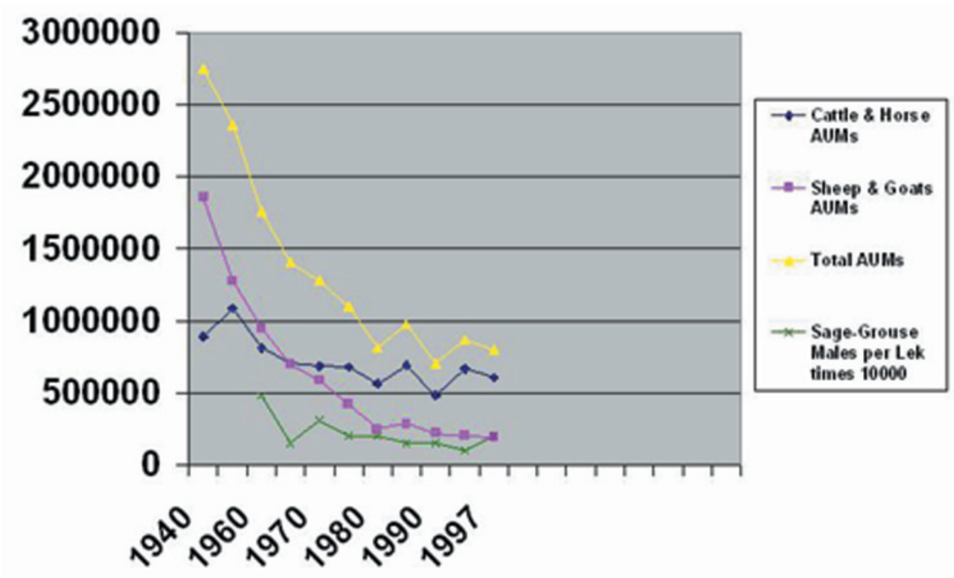


Fig. 9. Livestock AUM's on BLM land over time.

change, new plant introductions, altered wildlife populations, etc,. is not realistic (Fig. 9).

Suggested Reading

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