Chapter 7: Establishing and adjusting appropriate management levels (AMLs)

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Objectives

- Evaluate BLM's approach to establishing or adjusting AMLs as described in handbook
- Determine, on the basis of scientific and technical considerations, whether there are other approaches to establishing or adjusting AMLs that BLM should consider.
- Suggest how BLM might improve its ability to validate AMLs.

Outline

- Legislative framework
- Review of handbook
- Developing science and validation
- Transparency and allocation

Legislative Framework

- BLM is required to manage public lands under the principles of multiple use and sustained yield (FLPMA 1976).
- “The principal goal…is to provide for the protection of the horses … and not the single use management of areas for the benefit of free-roaming horses and burros” (U.S. Congress 1971).
- Many other pieces of legislation are pertinent to BLM rangelands (Clean Water Act, Endangered Species Act, etc.)

Legislative Framework: AML

- Horses and burros should be managed "as an integral part of the natural system of the public lands", and "all management activities shall be at the minimal feasible level", while maintaining the "thriving natural ecological balance" and preventing "rangeland deterioration" (WHB 1971, 1978).

Challenging terminology

- What is a “thriving natural ecological balance”? (TNEB)
- What is “rangeland deterioration”?
- How to accomplish and assess “minimal feasible management?”
- How to allocate among “multiple uses”?

Appropriate Management Levels

- Set for each Herd Management Area (HMA)
- Lower and upper bound such that it should take 4-5 years to grow to upper bound from lower bound.
- The upper level should result in a thriving natural ecological balance and avoid range deterioration (BLM 2010).

Survey of districts about allocation of resources to horses in HMAs

- Half of the 40 responded to some extent to questions about AMLs, few about allocation
- Historic, numbers at HMA establishment
- Historical ratio between cattle and horses
- Subtracted amount used for livestock and divided the rest among horses and wildlife
- Consulted with wildlife agencies to assure forage for wildlife, used Standards and Guidelines for Rangeland Health
- Various forms of monitoring and assessment of vegetation, soils, watershed
- NEPA Process
- Natural Resource or Land Use Planning Process; Multiple Use Decision process

- One HMA adjusted AMLs 13 times from 1979-2007
- Habitat components of forage, water, space, cover
- Redefining herd areas
- Fire, lack of winter range, new data on horse distribution, weather, cultural resources protection, improve vegetation, protect riparian areas, change in available space due to boundary discrepancies, land use change, checkerboard ownership, etc.

Consistency and Standards

- GAO (2008): a lack of consistency in setting AMLS throughout the agency.
- In 2002, not formally set for most HMAs.
- Habitat assessment conducted by each district in its own way (BLM 2003, 2005) — details not provided to us.
- A goal of 2010 Handbook is to increase consistency.

Review of Handbook

Code of Federal Regulations Section 4180.1 - Fundamentals of rangeland health

- Standards and guidelines developed or revised by a Bureau of Land Management State Director under § 4180.2(b) must be consistent with the following fundamentals of rangeland health (abbreviated):
  - a) properly functioning watersheds
  - b) ecological processes are maintained
  - c) water quality is in compliance
  - d) habitats maintained for threatened and endangered species

H-4180-1 (BLM Rangeland Health Standards Handbook 2001)

- “Standards of land health are expressions of levels of physical and biological condition or degree of function required for healthy lands and sustainable uses, and define minimum resource conditions that must be achieved and maintained.”

The Handbook - Manage for a TNEB and Land Health

- “Vegetation should be managed within each HMA in a manner that achieves and maintains a TNEB and assures significant progress is made toward achieving the Standards for **Land Health** and other site-specific or landscape-level objectives.” (Handbook, p12)

- “When establishing AML, the analysis shall include an in-depth evaluation of intensive monitoring data or **land health** assessment. Intensive monitoring data shall include studies of grazing utilization, range ecological condition and trend, actual use, and climate (weather) data. Population inventory, use patterns and animal distribution should also be considered. A minimum of three to five years of data is preferred.” (Handbook, p18)

Land Health Assessments

- “Before issuing a decision to gather and remove animals, the authorized officer shall first determine whether excess WH&B are present and require immediate removal. In making this determination, the authorized officer shall analyze grazing utilization and distribution, trend in range ecological condition, actual use, climate (weather) data, current population inventory, wild horses and burros located outside the HMA in areas not designated for their long-term maintenance and other factors such as the results of **land health** assessments which demonstrate removal is needed to restore or maintain the range in a TNEB.” (Handbook, p19)

Establishing and adjusting AML – Multitiered Process

- Tier One - determine whether the four essential habitat components (forage, water, cover and space) are present in sufficient amounts to sustain healthy (WHB) populations and healthy rangelands over the long-term.
- Tier Two - considers forage availability and quantity in detail (relative to forage use, determines the appropriate stocking rate).
- Tier Two is the core of AML-setting, with respect to range carrying capacity. Yet, what is the linkage to land health?

Assessing Forage Availability

- Forage production is the basis of AML, yet methods recommended in the Handbook for measuring it could be strengthened.
  - based on back-calculation of what must have been produced given stocking rate and utilization estimates
  - total plant production = presumed offtake / percent utilization
  - presumed offtake = number of animal units x forage needed per animal unit

Assessing Forage Availability

- Estimates of horse numbers are not very accurate, and basis for conversion to AU's is questionable
- Utilization is most commonly visually estimated - problems, inaccurate, need direct measures such as biomass sampling in and out of grazing exclosures
- It is not clear how utilization is attributed to different consumers, accounting for differences in dietary compositions, spatial distributions.
- Unclear how constraints on availability are to be factored in, except for the allowable use factor (water, snow, topography, etc.).

Assessing Forage Availability

- Need to account for seasonal dynamics of plant biomass and quality due to senescence, transfer to litter.
- Allowable use factor - prescribes what fraction is available for use. This is where effects of herbivory on the vegetation component of land health are considered. Need a better, more scientific basis for setting it, involving hypotheses about herbivory impacts on land health.

Ecological Site Descriptions (Handbook)

- "**Ecological site descriptions** can be used to evaluate current management and to identify the potential effects in range ecological conditions or trends that could be expected from proposed changes in WH&B management. Ecological site descriptions for each Major Land Resource Area (MLRA) are available from NRCS." (Handbook, p32)
- This is based on traditional concepts of range condition relative to a reference (equilibrial climax) plant community, which may be inappropriate.

Habitat Monitoring (Handbook)

- The primary purpose of habitat monitoring is to collect the resource data necessary to:
  - Make a determination of excess animals (i.e., support the need to gather and remove excess wild horses or burros).
  - Establish or adjust AML.
  - Develop or revise HMAPs.
  - Evaluate conformance with Land Health Standards, LUP goals and objectives, or other site-specific or landscape-level objectives.
- Collection of habitat monitoring data should be coordinated with other resource programs (e.g., range, watershed, wildlife) to maximize efficiency and minimize duplication.

  (Handbook. p30)

Habitat Monitoring (Handbook)

- To achieve these objectives, monitoring efforts should focus on the following:
  - Evaluate current year's forage production and water flows.
  - Evaluate/measure use, map patterns of use and monitor seasonal distribution/movement.
  - Evaluate WH&B body condition.

(Handbook, p31)

Habitat Monitoring

- Methods suggested in Handbook are very general, based on traditional range assessments, rangeland condition metrics, need more specificity.
- Integrate BLM's report on: Assessment, Inventory, and Monitoring Strategy (AIM) for Integrated Renewable Resources Management (BLM, 2011)
  - a laudable effort to standardize and improve monitoring and assessment agency-wide intended to reach across programs, jurisdictions, stakeholders, and agencies to provide data and information valuable to decision makers
- Integrate BLM's BLM Rangeland Health Standards Handbook (2001)
  - Presents many good recommendations for monitoring land health, but presently no linkage to what is in the Handbook

Developing Science

Remote Sensing

- A number of highly developed data sources exist that have been in use for many years.
- Has utility for landscape assessment ranging from site-specific habitat management to broad landscape-scale predictions.
- Can be used effectively to characterize heterogeneous landscapes on the basis of detection of abrupt changes or gradual trends and patterns.
- Can provide consistent and reliable information on ecological effects and can be used to monitor landscape change and to extract unique or important features from complex ecosystems.
- Is an excellent tool for landscape level applications, such as range assessment, ecological monitoring, weed-invasion detection, and woodland-encroachment assessment.

Alternate Stable States

- The theory of alternative stable states predicts that ecosystems can exist under multiple “states” (sets of unique biotic and abiotic conditions).
- Ecosystems may transition from one stable state to another, in what is known as a state shift (sometimes termed a phase shift or regime shift), when perturbed.
- Due to ecological feedbacks, ecosystems display resistance to state shifts and therefore tend to remain in one state unless perturbations are large enough.
- Multiple states may persist under equal environmental conditions, a phenomenon known as hysteresis.
- Alternative stable state theory suggests that discrete states are separated by ecological thresholds, in contrast to ecosystems which change smoothly and continuously along an environmental gradient.

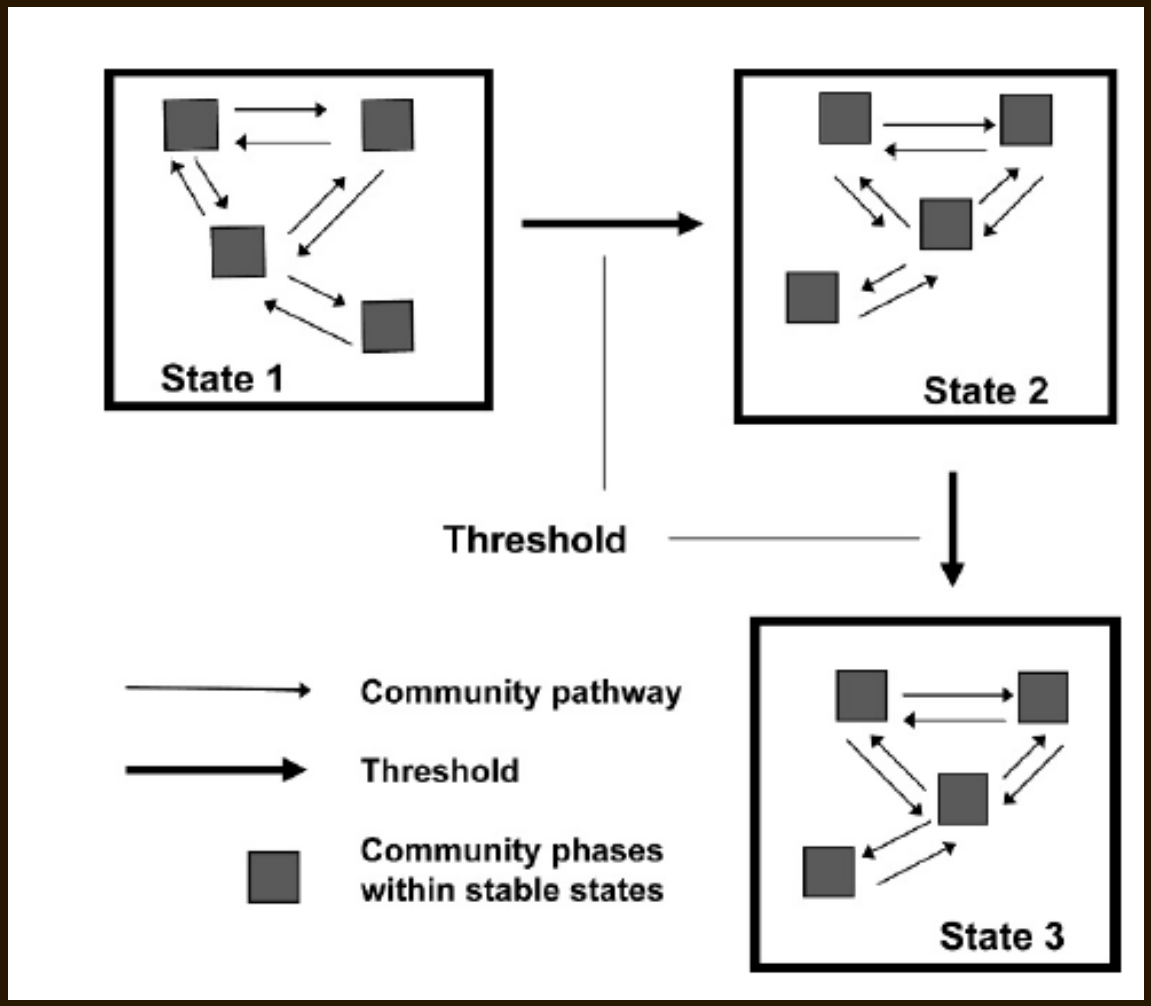
(Wikipedia)

State and Transition Ecology (Bestlemeyer et al. 2001)

- “The state-and-transition model formally acknowledged the multi-equilibrial nature of many rangeland ecosystems and the rapid and unanticipated shifts among these equilibria.”

- “The state-and-transition concept provides a means for anticipating departures from the monoclimax model and incorporating this understanding into management plans. Consequently, this concept is being widely espoused within the range science community of the United States”

Conventional State and Transition Model (Briske et al. 2008)



Multiequilibrial and Disequilibrial Ecosystems

- Vegetation-climate equilibria, particularly ideas related to linear succession and climax plant communities, are too simplistic - important implications for assessing range condition.
- The concept of a static carrying capacity or AML - is questionable given intrinsic variability in climate, especially precipitation
- Plant-herbivore equilibria are often very loose, regulated by density-independent variation (climate). The result is that vegetation is more highly linked to climate than herbivory. Systems with highly variable annual precip (CV>33%) are more likely to exhibit non-equilibrial dynamics.

Resilience

- By their very nature, basins of attraction display resilience. Ecosystems are resistant to state shifts – they will only undergo shifts under substantial perturbations – but some states are more resilient than others. In the ball-and-cup model, a valley with steep sides has greater resilience than a shallow valley, since it would take more force to push the ball up the hill and out of the valley.

- Resilience can change in stable states when environmental parameters are shifted. Often, humans influence stable states by reducing the resilience of basins of attraction.

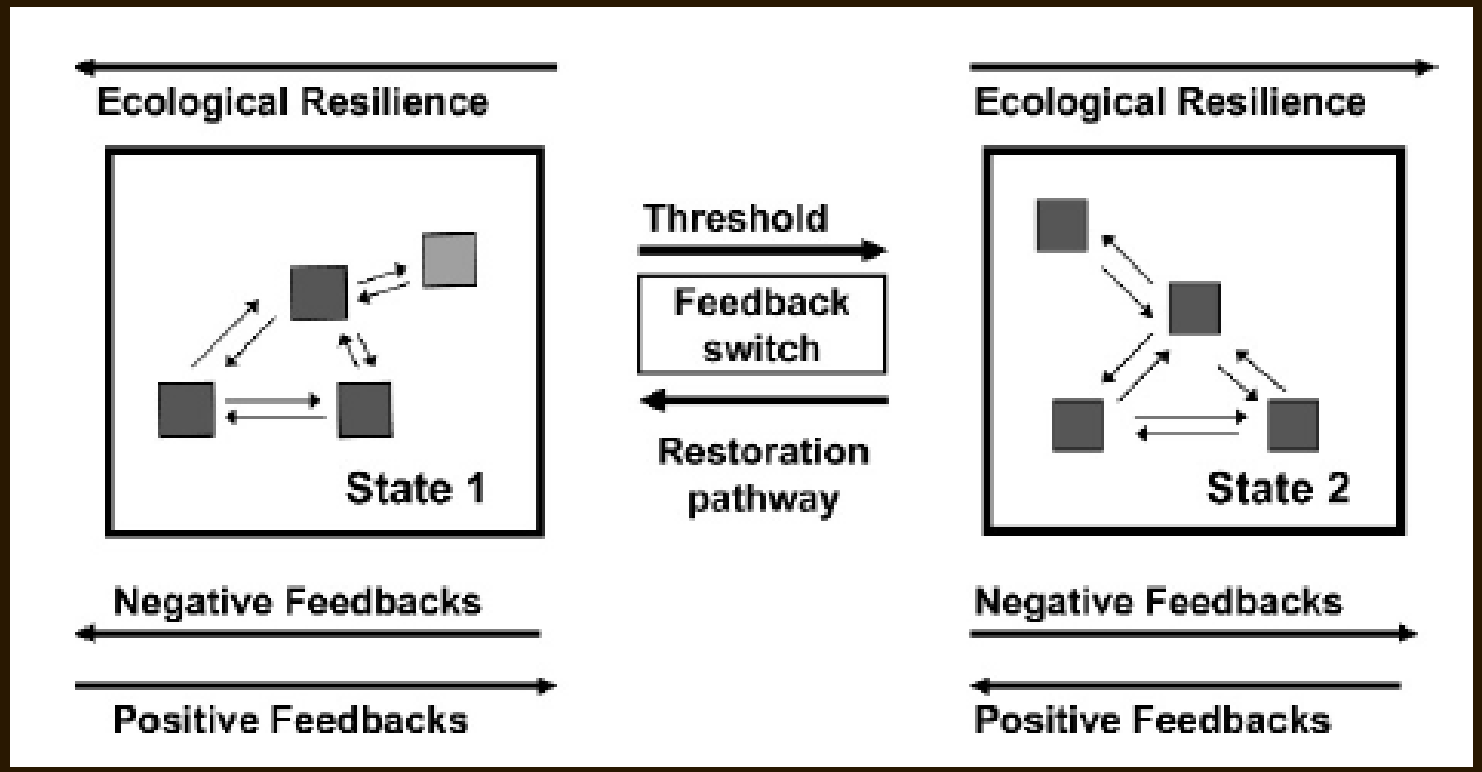
(Wikipedia)

Resilience-based State and Transition Models (Briske et al. 2008)

- Ecological resilience describes the amount of change or disruption that is required to transform a system from being maintained by one set of mutually reinforcing processes and structures to a different set of processes and structures (e.g., an alternative stable state).

- In light of this concept, effective ecosystem management must focus on the adoption of management practices and policies that maintain or enhance ecological resilience to prevent stable states from exceeding thresholds.

Considering resilience in the state and transition framework (Briske et al. 2008)



Invasive Species and Historic Grazing

- Ecosystems have been altered by introduced species, invasives, and historic heavy livestock grazing, so the ecological “balance” (state) isn’t what it used to be - ecosystems may be trapped in alternate stable states.
- Another implication – it may be wrong to consider such altered systems as having the potential to ever be “natural” in the sense of a pre-European reference state.

Adaptive Management

- Two meanings:
  1. managing adaptively, in response to changes in forage, etc. (not what we are referring to)
  2. adapting management to new information, and what we have learned through outcomes of previous management

Adaptive Management

- An iterative decision-making process that incorporates development of management objectives, actions to address the objectives, monitoring of results, and repeated adaptation of management until desired results are achieved (Herrick et al 2012).

- A key tenet of adaptive management that is relevant to managing free-ranging horses and burros is the treatment of management actions as testable hypotheses.

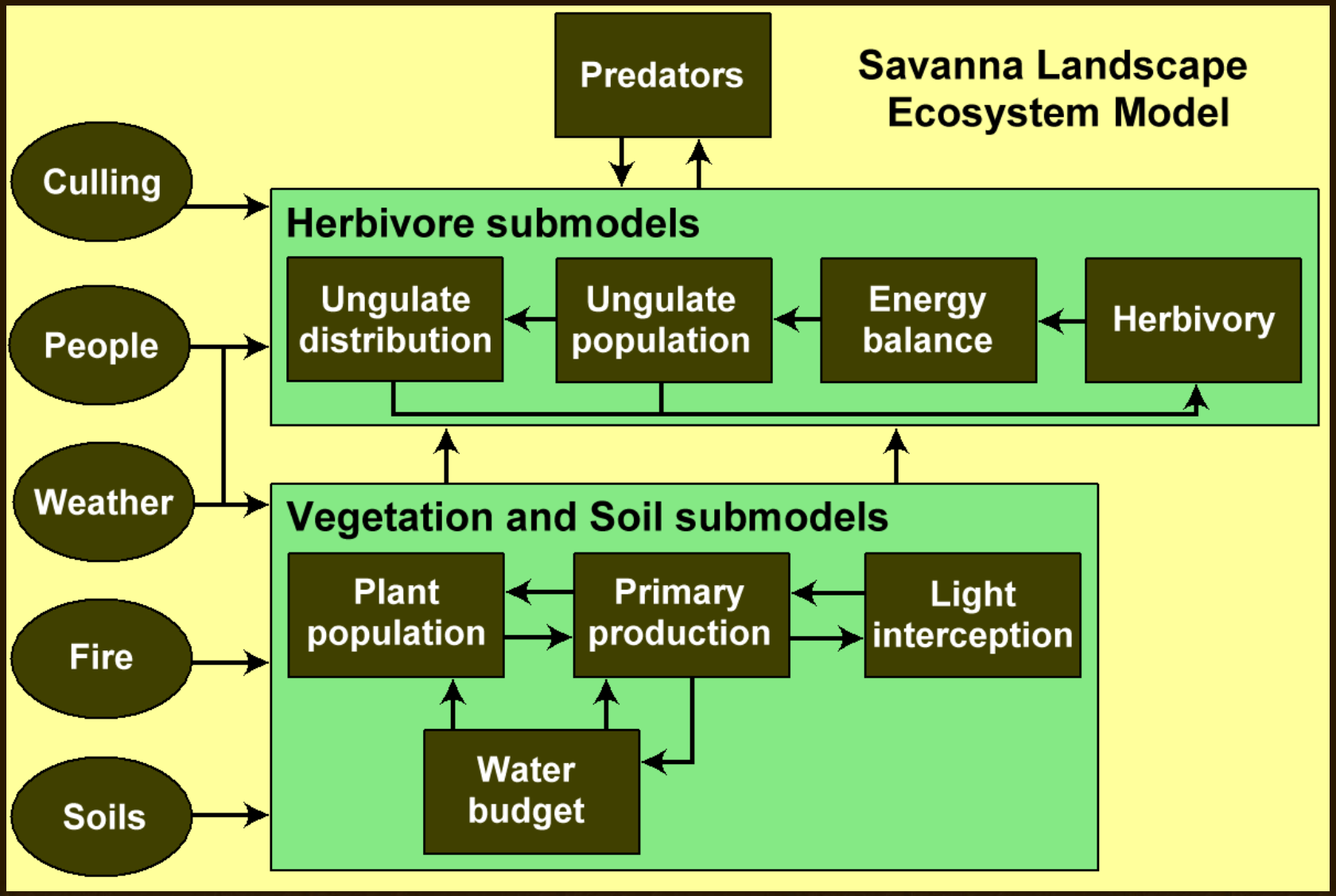
Adaptive Management

- Create a hypothesis of the expected outcomes of management, with respect to range and horse conditions, even if leaving the status quo. If AML is adjusted down (or up), what is to be expected and how is that going to be determined or verified?

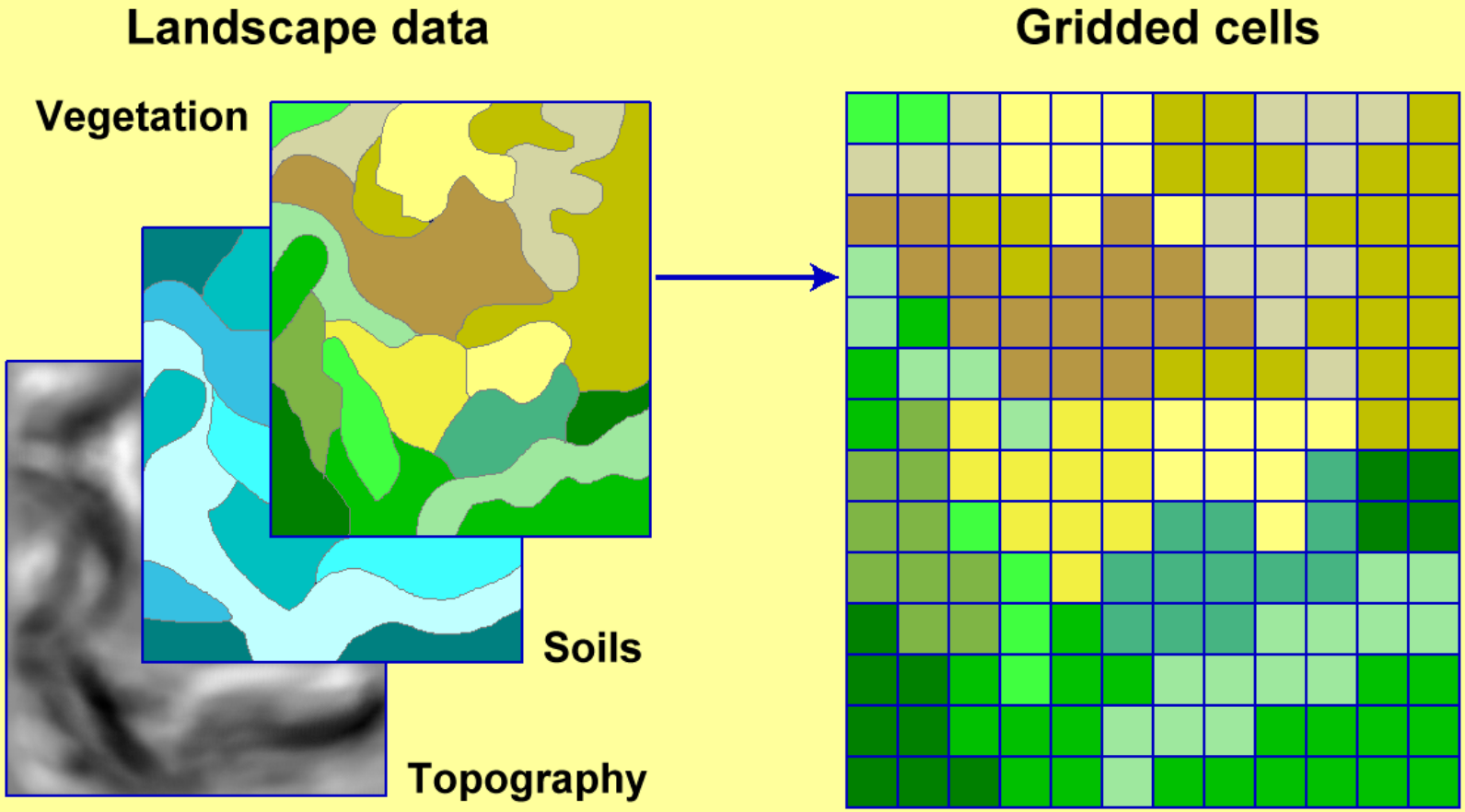
- Take a whole systems approach, considering ecological balance in terms of interactions between horses, the range, veg and soils, wildlife, and livestock. How do they interact? What are the forage requirements for all species combined? To what extent is there overlap or niche partitioning? What are the impacts of each herbivore species on the range? How much, and where?

Modeling Equids in Ecosystems

- Overlay spatial data on equid distributions, which are temporally variable, onto forage-production estimates to predict percentage utilization across the landscape.
- Use spatial modeling of equid habitat selection on a seasonal basis to provide estimates of equid distributions.
- Use remote-sensing data to cross-check and augment estimates of forage production.
- Use spatially explicit precipitation maps that account for patchy rainfall and topographic gradients to refine estimates of forage production.
- Estimate snowpack distributions by using remote-sensing products, SNOTEL data, snowpack modeling, and spatial interpolation. The snowpack in turn affects the forage supply for the horses in winter.

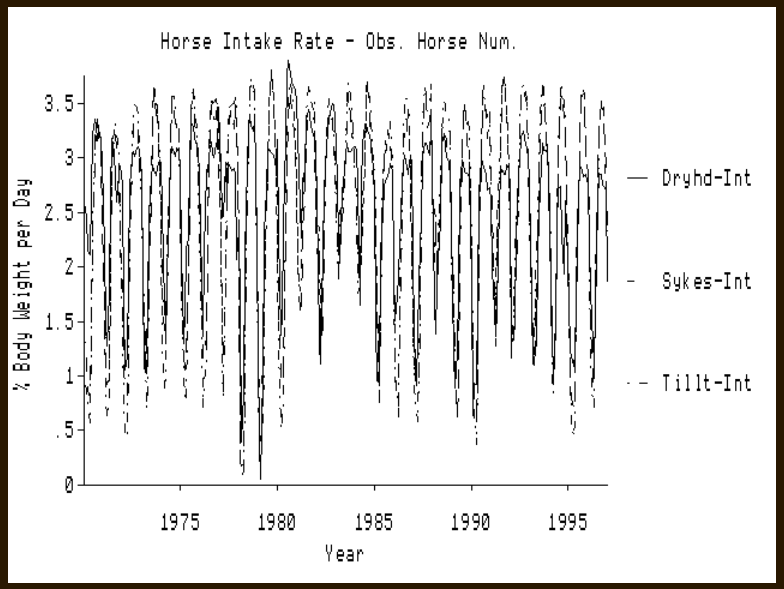

Savanna Landscape Ecosystem Model
Predators
Culling
People
Weather
Fire
Soils
Herbivore submodels
Ungulate distribution
Ungulate population
Energy balance
Herbivory
Vegetation and Soil submodels
Plant population
Primary production
Light interception
Water budget

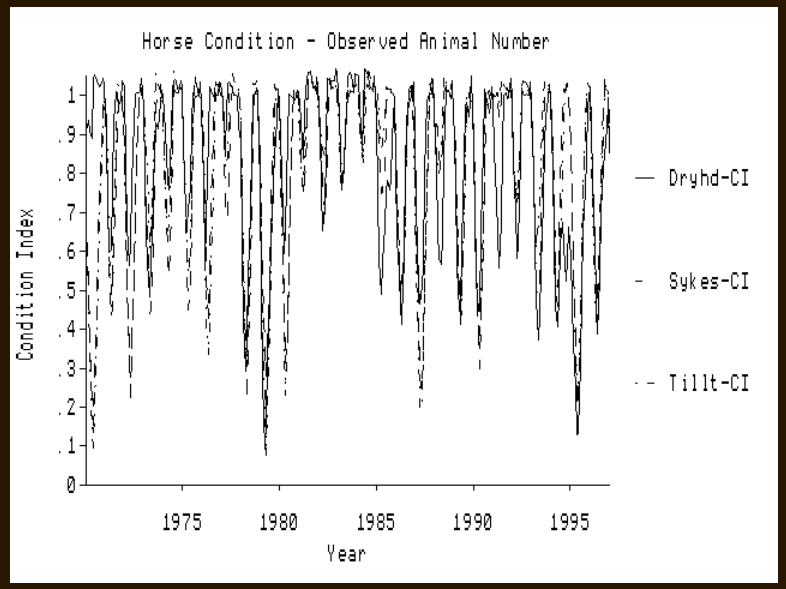
Savanna - A Spatial Ecosystem Model

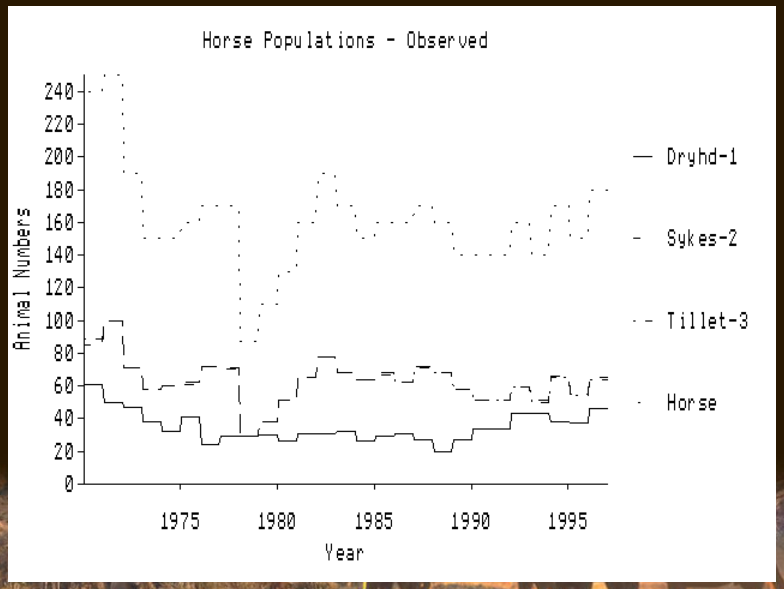


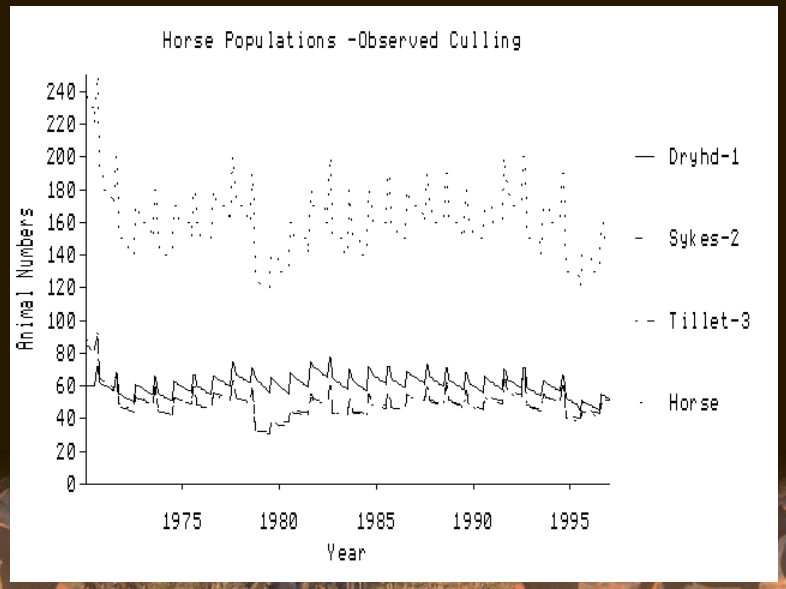
Example simulation output -

Modeled horse condition, population dynamics.

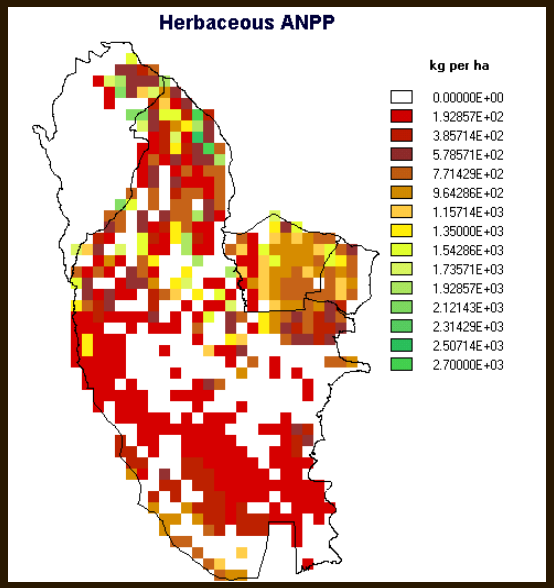


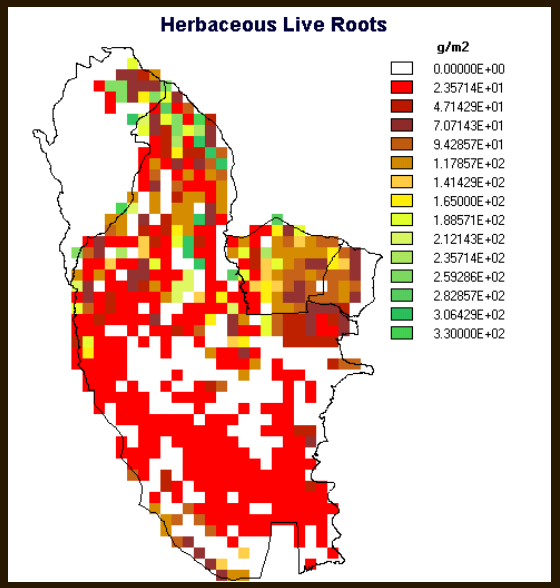


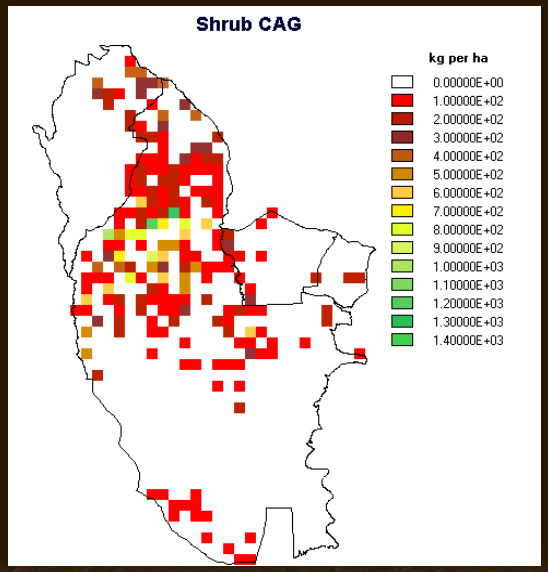


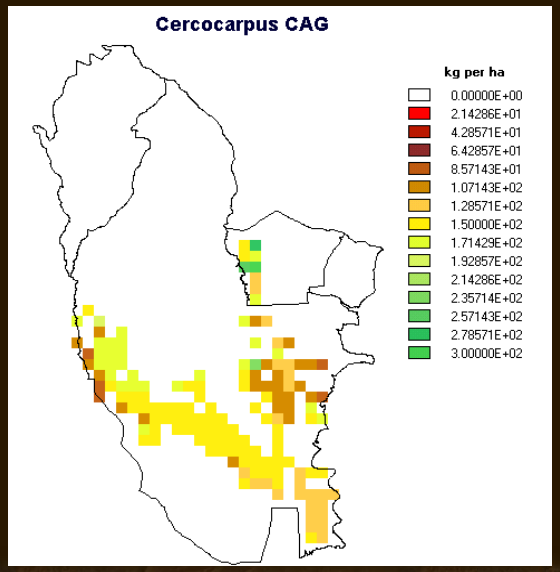


Modeled Distributions of plant production, and biomass.







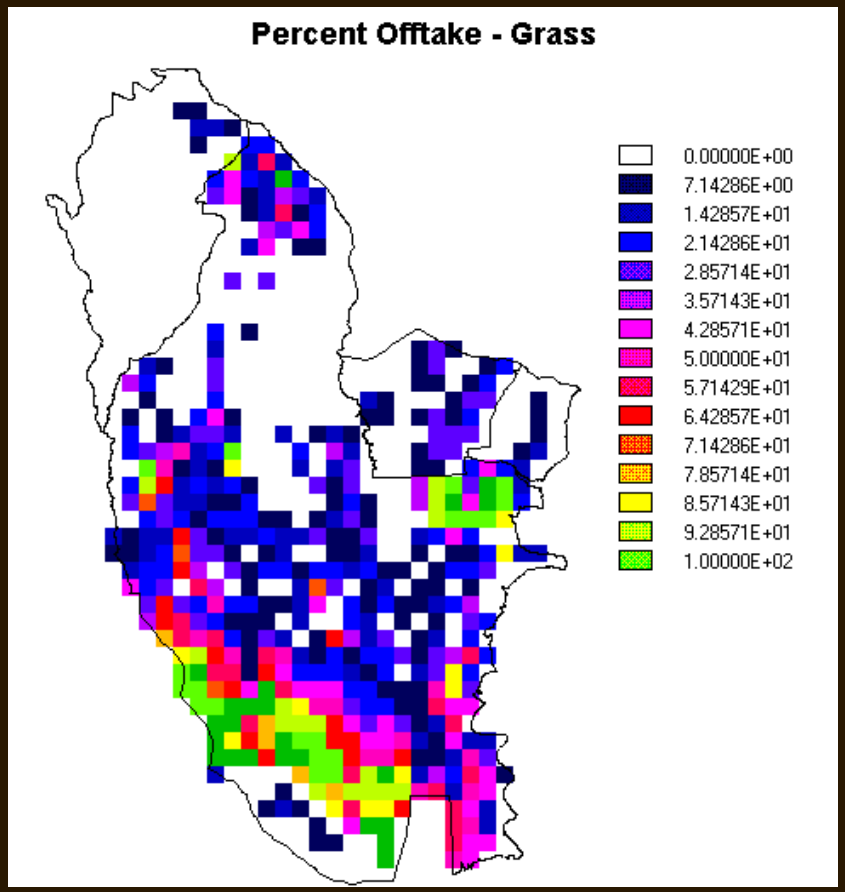


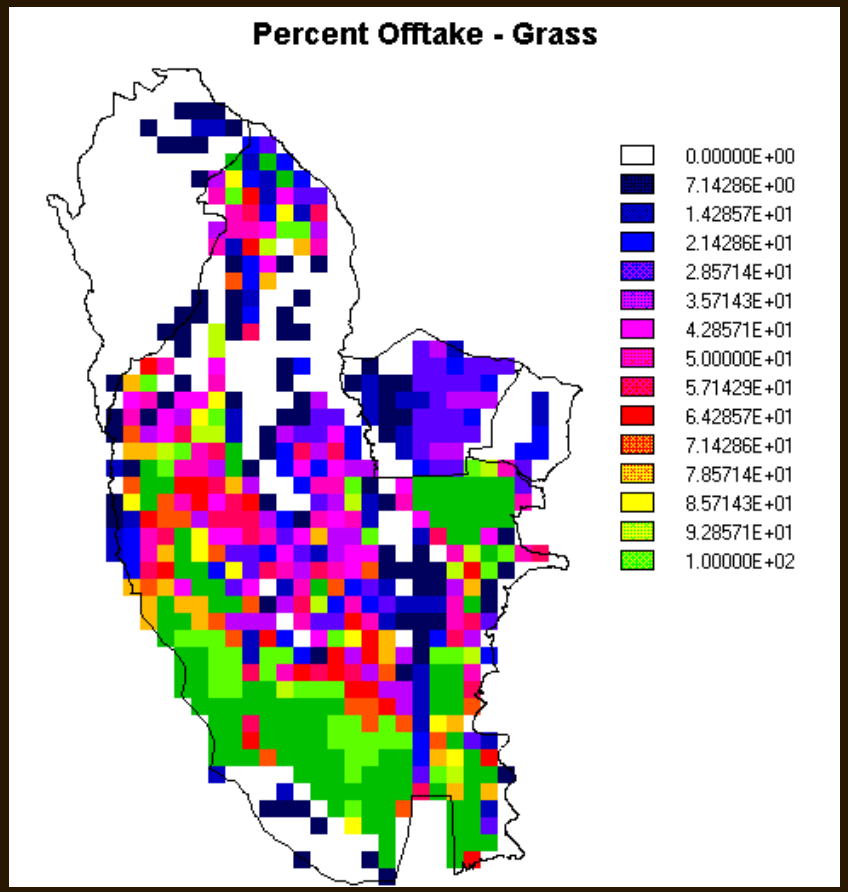
Modeled distributions of grazing impacts at moderate vs high horse densities.

Distribution of horse grazing pressure - non-uniform

Observed horse number

No culling





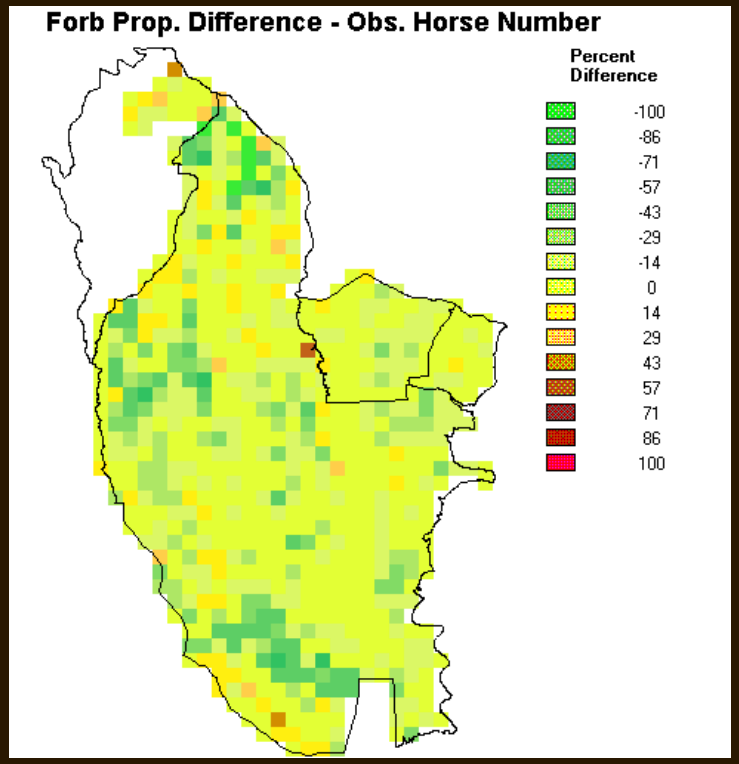
Impacts on plants are spatially heterogeneous.

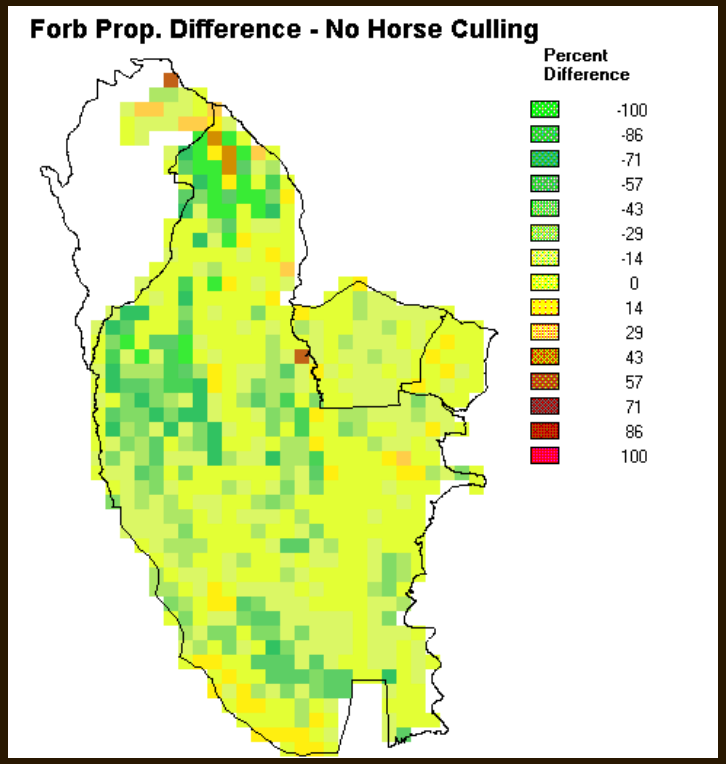
These are changes compared to no horses

Modeled changes in plant species composition at moderate versus high horse densities.

Observed horse number

No culling





Summary

1. Increase specificity on what land health is and the methods that can be used to assess it.
2. Specify how to determine the effects of management decisions and actions on land health
3. Integrate approaches in the Rangeland Health Standards Handbook and the AIM strategy.
4. Move beyond strict equilibrial ecology, adopt the widely accepted state and transition approach.
5. Use a scientific approach to attribute causality, model, and predict outcomes of management alternatives.
6. Take an adaptive management approach.
7. Think in terms of resilience and sustainability, with a systems perspective.

Provide transparent data and decisionmaking

- Allocation is a focus of attention, yet handbook does not address.
- Has both scientific and social components. Need more research.
- Allocation is a policy decision and should involve the public.
- Participatory adaptive management & data transparency (Chapter 8)

Science cannot transform how BLM is perceived by all members of the public, or set allocation by itself, but a scientific underpinning for its decisions would help BLM to explain and defend its management actions.