

# **Principles of Successful Livestock Grazing Management on Western Rangelands Colorado Guidebook**

**AgNext**

**COLORADO STATE UNIVERSITY**

**SUSTAINABLE SOLUTIONS  
FOR ANIMAL AGRICULTURE**

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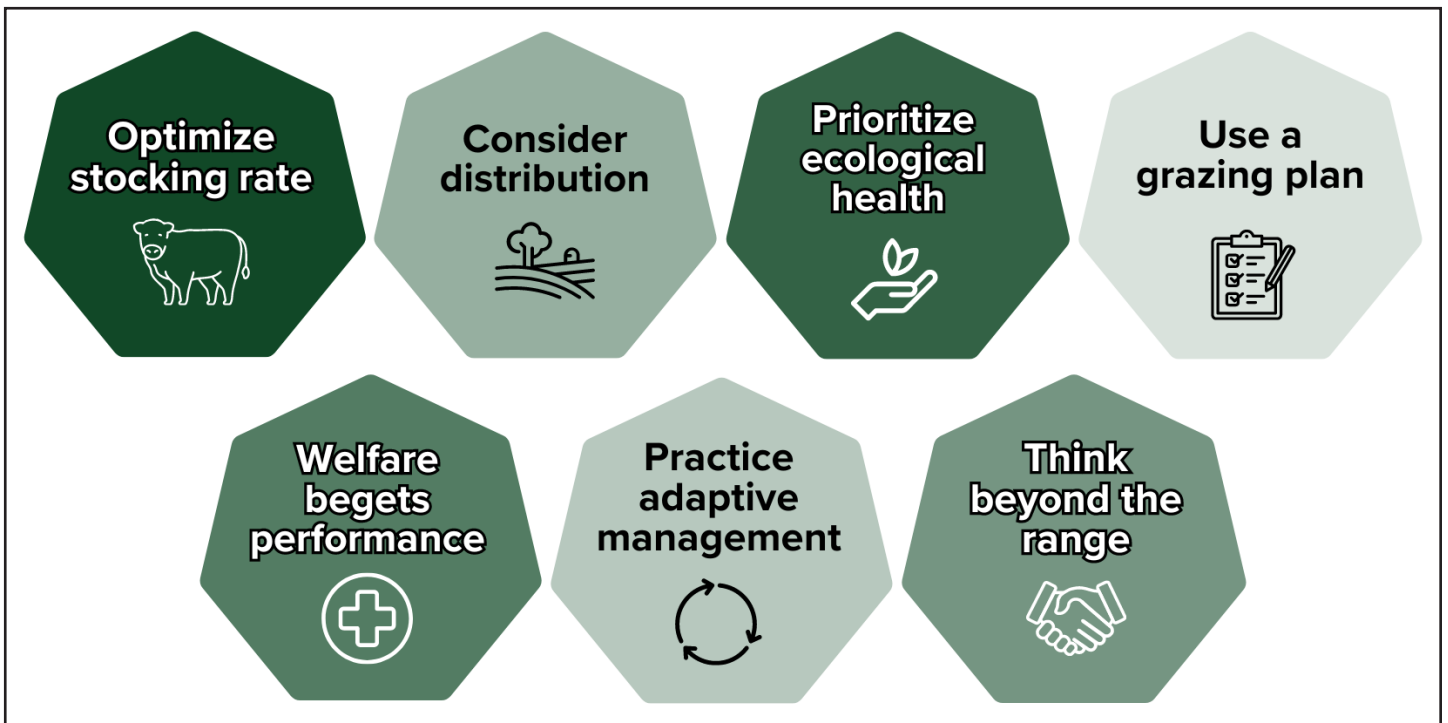
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# Introduction

*Livestock grazing management in the diverse rangelands of the Western United States is enormously complex. For more than a century range science has sought to provide actionable information to livestock producers across a dizzying range of contexts. The principles described here are the result of an effort to clearly and concisely state what we have learned. We have delineated seven statements that, when applied by managers, will maximize the likelihood of success of grazing management across the rangelands of the Western US.*

## Project Background

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Our research team created our principles using an iterative survey and feedback process between our advisory team and a group of >80 grazing management experts from across the region. After initial work by the advisory team, a widely distributed survey elicited lengthy responses totaling >25,000 words of wisdom about grazing management. We then distilled these into a set of draft principles, which were debated and revised among the advisory team. These draft principles were then returned to the initial survey respondents for further feedback. We also received feedback from >100 range professionals in a “campfire conversation” session at the 2023 Society for Range Management Annual Meeting. The advisory team then further debated and revised the principles to arrive at the statements presented here.

## Goal

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Our research team aimed for principles that are evidence-based, adaptable, and outcome-oriented. These were the expectations given in our surveys and the guidelines for discussions among our advisory group. Ultimately, we recognize that there is not a scientific study to back up every statement made here, but none of the statements stray far beyond the literature. One use of these principles can be to spur future research.

Our assessment is that the principles described here have succeeded in being adaptable but mostly failed at being outcome oriented. The principles as written can be adapted to the wide range of contexts found in livestock grazing management in Western rangelands. However, there is a basic tension between practicality and orientation toward outcomes rather than prescriptions. Range science has always been an applied discipline, so it has focused on practices. We look forward to a more significant body of evidence connecting grazing management practices to outcomes.

## Key Points

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All the principles are interrelated such that they should not stand alone or be applied in isolation from the others. They also each connect back to the goals of the grazing operation. Indeed, in many ways they are intended to be value-neutral—their implementation depends on the operation's goals. They are thus not necessarily hierarchical and are presented in no particular order, but goal setting is fundamental to all of them. Most important, these principles are not intended to be definitive statements but rather a first attempt at a list that we hope will evolve with discussion, implementation, and research.

## Boundaries

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Any project such as this requires that we first decide on the boundaries of the project. Geographically, the boundaries for these principles are the arid and semi-arid rangelands of the 11 Western states of the US (Figure 1). Though necessary, this was also a somewhat arbitrary boundary so we expect that the principles will apply beyond that region.

For operational boundaries, we have limited the principles to those that apply to the interactions among managers, livestock, and the land. This means that issues such as finances and regulations are largely ignored. These are of course highly relevant, and these external factors permeate the principles, but once again drawing a line somewhere was necessary. Throughout we use the word “livestock” but, given their dominance, cattle were the focus of many of our discussions and most of our feedback.



# Practice Adaptive Management

*Successful grazing management relies on **adaptive management** and **flexibility**. This begins with **collaborative goal setting**, including identification of **challenges, opportunities, and tradeoffs** in advance. **Monitoring of outcomes** along with the use of **checkpoints** and **triggers** enable **timely adjustments** of plans and strategies. **Regular formal meetings** with **team members and stakeholders** to **share and integrate lessons learned** further enhance the likelihood of success.*

## Definitions

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**Adaptive management**: a formal process of planning, doing, monitoring, and learning that iteratively improves management.

**Checkpoint**: a set point-in-time (date, days after turnout, etc.) when a metric is measured and assessed to determine if an action or change is needed.

**Trigger**: a predetermined value of a metric whereby a management action or change will occur.

**Stakeholder**: a person or group with an interest in management actions or outcomes.

## Discussion

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Grazing management that formally integrates the adaptive management process is more likely to succeed in achieving its goals. Adaptive management is not a grazing management “system”, but rather a process that can be integrated into a variety of grazing management approaches. Indeed, scientific reviews have suggested that successes ascribed to well-known prescribed management practices may instead be due to the adoption of adaptive management.

Regularly scheduled team meetings to discuss goals and strategies, plan monitoring, and review monitoring data were viewed as helpful. Lastly, adaptive management should be recognized as an ongoing process that is part of the job rather than a one-time activity.

Flexibility is essential to successful adaptive management. Where regulations or cultural resistance limit flexibility, the success of the adaptive management process can also be hindered.

Goal setting is the foundation of adaptive management and of these grazing management principles. Regardless of location, climate, business structure, and other factors, all operations should have goals for a diverse set of management outcomes, including economic, ecological, and social.

## Checklist

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- Practices adaptive management, including:
    - Formal, collaborative setting of diverse goals
    - Monitoring of goal-relevant outcomes
    - In-season and year-to-year adaptation
    - Formal meetings to integrate lessons learned
  - Identifies and engages stakeholders relevant to goals
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## Resources

- This [Department of the Interior guide](#) is technical and lengthy but is the most useful guide we are aware of.
- The [Sustainable Ranch Management Assessment Guidebook](#) from the University of Wyoming Extension guides the reader through a self-assessment of ranch sustainability
- This [Rangeland Management Strategies](#) guide from the USDA Western SARE includes a useful general introduction to goal setting.
- The two volumes of the [Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems](#) are indispensable guides for setting monitoring goals and following through with effective data collection.
- The [Library at FarmAnswers.org](#) has extensive information about strategic planning and goal setting.



# Optimize Stocking Rate

*Setting an optimal **stocking rate** is the key decision for successful grazing management. For most operations, working from a **well-considered base stocking rate** and making year-to-year adjustments to strategically match livestock to forage will support achievement of goals. **Enterprise flexibility** and attention to **climatic indicators** can enable **timely growth** or **reduction** in the livestock herd.*

## Definitions

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**Optimal:** most favorable when accounting for local context and a diverse set of goals.

**Base stocking rate:** the livestock that the rangeland to be grazed can support in an “average” grazing year; a rough long-term estimate of carrying capacity given local context and goals.

**Well-considered:** based on multiple types of information and revised as needed.

## Discussion

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For more than a century, range science has identified stocking rate as the key factor in grazing management outcomes. Amid numerous other complex factors, turning out the right number of livestock for the right amount of time to achieve management goals stands out. Indeed, a poor choice of stocking rate, especially over multiple years, can outweigh other positive management activities.

While overstocking has been, and remains, a problem across the world, it is important to note that understocking can also hinder the achievement of goals. Because of this, we liken the setting of stocking rate to driving a car. Sometimes it is optimal to drive faster, other times slower—the key is to have good reason for the choice of speed and to continually monitor to determine if a change is needed. At the same time, many of our survey respondents encouraged a conservative approach in notoriously variable semi-arid and arid Western rangelands.

A base stocking rate is typically used as a “rule of thumb” starting point for adjusting up or down to meet current conditions and management goals. Historically it was based on local knowledge, often handed down from previous generations. While this is still crucial, there are new tools that provide accurate long-term forage production data and other useful information.



Instead of simply turning out the same number of livestock year after year, managers should make year to year adjustments to stocking rate based on current conditions, climatic indicators, business needs, and other factors. Several survey respondents noted that enterprise flexibility, for example running stockers alongside a cow-calf operation, can assist with this.

## Checklist

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- Has a well-considered base stocking rate in mind, incorporating:
    - Local/historical knowledge
    - Forage production data from technical advisors and/or online tools
    - Operation-specific context
  - Makes year-to-year adjustments in actual stocking rate using:
    - Local/historical knowledge
    - Climatic forecasts and indicators
    - Operation-specific context
    - Enterprise flexibility
  - Connects stocking rate decisions to goals
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## Resources

- The best online source for understanding historical and current forage production on Western rangelands is the Rangelands Analysis Platform (<https://rangelands.app>).
- There are many good resources online for guidelines for setting stocking rate, with many local Extension and NRCS offices serving as resources. The University of Idaho has a concise general guide [here](#).
- The Western Water Assessment has a good [Climate Dashboard](#) that contains many climatic indicators and other data. Similar sites exist for other regions.
- An Extension info sheet about how climatic indicators can be used for stocking rate decisions in Eastern Colorado is [here](#). Those from other regions should seek local expertise for understanding how the status of these indicators influences weather.



# Use a Grazing Plan

*Grazing managers should have a **written grazing plan** that uses **strategic triggers** and aligns with management goals. Be sure to **address timing, intensity, duration, and frequency** of access to rangeland, ensuring **sufficient plant rest** while remaining **drought-ready** at all times. **Record keeping** is essential and **including ecological goals in planning**. Throughout, **integrate data, technical support, and experience into decision making**.*

## Definitions

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**Strategic trigger:** a goal-oriented metric for when livestock enter or leave a pasture; rather than simply a set amount of time, it can be based on vegetation condition, livestock behavior, or other factors.

**Sufficient plant rest:** timely relief from grazing pressure supports plant health; rest does not necessarily require livestock absence if distribution is managed but does usually require appropriate growing conditions.

**Drought-ready:** Western rangelands are subject to drought at any time; managers should have a plan for when growing conditions rapidly deteriorate and for when they remain poor over multiple years.

## Discussion

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Timing, intensity, duration, and frequency are the necessary elements to include in any grazing plan, accounting for the various ways livestock impact rangeland. There are many valid approaches to grazing planning but in all cases the plan must be written down, not just in a manager's head. "Written" of course includes on a computer or app and can integrate charts or pictures. Putting the information down formalizes and improves it, turning a grazing plan from an idea into an adaptable process. Any record keeping about grazing must also be written down so that it can be analyzed.

Survey respondents felt strongly about "high-intensity, short-duration" grazing, some in favor, some against. The scientific evidence on this approach is mixed, in part due to the diverse ways it can be applied. Our conclusion is that it can be successful but also that many other approaches can be successful across the great diversity of Western rangelands. From "high-intensity, short-duration" to "season-long, continuous" grazing,

the key practice is having a well-formed and adaptable grazing plan that connects to diverse management goals and ensures sufficient plant rest under changing conditions. The best plans will also integrate a wide range of data and local knowledge.

## Checklist

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- Uses a written grazing plan, integrating:
    - Triggers for movements and other actions
    - Drought contingencies
    - Connection to goals, including ecological goals
  - Keeps records of grazing movements and actions
  - Integrates multiple sources of data into planning and decisions
    - Monitoring data
    - Technical support and data
    - Experiential knowledge
- 

## Resources

- While many online resources exist for grazing management planning, few are comprehensive and few are specific to the Western US, and many contain a bias towards high intensity- short duration grazing management. [This guide](#) from ATTRA is relatively complete and contains good information for building a grazing plan.
- Many grazing managers find that a Grazing Chart is a useful tool for planning grazing in multiple paddocks. These can be difficult to find for free online, with some sources charging criminal amounts of money for a download but note that these are basically spreadsheets that can be easily created using Microsoft Excel or (free) Google Sheets. [An image search for “grazing chart”](#) brings up lots of images so you can see how these are constructed.



# Prioritize Ecological Health

*Successful grazing management prioritizes ecological health. Maintenance of heterogeneity in the plant community via planned grazing confers resilience while supporting biodiversity, soil health, and critical ecosystem services. Make use of both local knowledge and technical information and support to understand site potential and ecological processes. Identification and regular monitoring of goal-relevant metrics enables timely adjustments. Throughout, keep in mind a broad-scale view of the ecological effects of grazing management.*

## Definitions

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**Ecological health:** the integrity of the soil, vegetation, and water of the managed rangeland in the context of natural potential and historical trends.

**Heterogeneity:** variation across space and/or over time in properties such as vegetation type, cover, or height; a fundamental characteristic of rangelands.

**Resilience:** the ability of a rangeland to return to ecological health after significant disturbance

## Discussion

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An essential insight of range science is the fundamental importance of heterogeneity. Whereas historical management recommendations often emphasized minimizing variation in pursuit of predictability (known as “command and control”), it has become clear that such approaches instead lead to unstable systems prone to collapse. Instead, we now understand that heterogeneity supports both ecosystem stability and livestock productivity. A key point is that grazing as a management tool can be used to reduce, maintain, or increase heterogeneity.

Grazing managers should seek to understand the site potential (based on soils, climate, and other features) of managed rangeland to support ecological health. Numerous technical resources exist, and local knowledge can provide detail about the historical range of variability, especially under extreme conditions such as severe drought. Key concepts like states, transitions, and thresholds can provide insight into what managers see on the ground, how rangelands respond to grazing, and what metrics can be used for understanding grazing impact.

Management goals for ecological health are highly site-specific and managers should use the full range of resources at their disposal to identify appropriate metrics. Many survey respondents noted the importance of simplicity in creating metrics—ease of measurement is a priority given numerous other tasks. The use of key areas and key species, a longstanding practice in range management, can assist in simplification. Because ecological health issues do not stop at fence lines, managers should aim to collaborate with neighbors when considering ecological goals. Ultimately, rangelands are usually quite slow to change so grazing managers should look at the historical context of their management and use management practices with an eye to long-term ecological health.

## Checklist

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- Grazing management goals include measurable ecological health metrics
  - Management practices support heterogeneity, vis-à-vis:
    - Variable grazing impact within/among pastures and/or year-to-year
    - Management maintains diverse plant communities
    - Sensitive areas identified and managed appropriately
  - Is familiar with relevant ESDs and/or other technical ecosystem information
- 

## Resources

- The two volumes of the [Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems](#) contain discussion of rangeland ecological health and tools for monitoring it, including discussion of different sampling approaches such as key areas.
- The [technical guide Interpreting Indicators of Rangeland Health \(version 5\)](#), in its introductory sections, contains a concise and useful description of many key concepts in rangeland ecology, including ecological processes, states/transitions, and resistance/resilience.
- Though they are inconsistently developed across the Western US, Ecological Site Descriptions are indispensable resources for understanding rangeland ecology. The [EDIT website](#) is an accessible and well-maintained resource for finding ESDs relevant to your management.
- The [Rangelands Analysis Platform](#) maps different vegetative cover, which is useful for understanding existing heterogeneity on managed rangeland.



# Consider Distribution

The **distribution of livestock** can be as impactful to outcomes as the number of livestock. Examine **pasture-specific context** and manage livestock distribution via the **strategic location of attractants** alongside **well-planned, site-specific fencing**. Breeding of **locally-adapted livestock** and **herding** can further assist in achieving desired distribution. Pay attention to **herd dynamics** and **grouping tendencies**.

## Definitions

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**Livestock distribution**: the location of livestock, as individuals and as groups, across space and over time; grazing activity is key but consider distribution of other behaviors.

**Attractants (and repellants)**: landscape features and other factors that influence the location of livestock; includes forage, water, minerals, topography, shade, shelter, scratching posts, biting insects, and others.

**Site-specific fencing**: fencing and other livestock barriers that adhere to local context and management needs; straight lines that ignore the landscape can create problems.

## Discussion

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Within individual grazing units, livestock distribution is often variable due to the distribution of attractants and repellants. Recognizing that a windy hillside attracts livestock seeking relief from biting insects or that a patch of trees provides shade on a hot day might explain why some areas of a pasture are more heavily grazed than others. While some features are not movable, others can be manipulated to influence livestock distribution to achieve grazing management goals. For example, moving the location of minerals can assist in attracting livestock away from sensitive areas or towards high-quality forage areas distant from water. Additionally, changing the location of attractants over time can assist in maintaining or generating heterogeneity.

The location of fencing is often inherited or otherwise unconsidered, but it is likely that fence lines placed with consideration of attractants and repellants as well as ecological goals will lead to better outcomes. Because relocating fences is often costly or impractical, emerging virtual fencing technology presents a great opportunity for strategically re-locating boundaries. In combination with affordable electric fencing, virtual fencing can assist managers in more effectively achieving grazing management goals, including targeted grazing.

Livestock can be bred to be more likely to climb hills, handle hot weather away from shade, and graze farther from water, among others. Attention to these behaviors in making breeding choices, alongside active herding, can improve performance. Because livestock are inherently social animals that evolved to live in herds, attention to grouping tendencies and an increased emphasis on herd behavior can improve outcomes.

## Checklist

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- Goals and plans account for distribution within pastures via strategic:
    - Placement of attractants
    - Site-specific fencing
    - Low-stress herding
  - Livestock breeding accounts for local landscape and climate
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## Resources

- An excellent and concise introduction to different ways of influencing livestock distribution within pastures is [Factors and Practices that Influence Livestock Distribution](#).
- A good guide to low stress herding from Temple Grandin is [Low Stress Methods for Moving and Herding Cattle on Pastures, Paddocks, and Large Feedlot Pens](#).
- The [BEHAVE](#) program from Utah State University is an evidence-based approach to understanding livestock behavior.



# Welfare Begets Performance

*Optimize livestock welfare and performance by providing timely access to **nutritious forage, high-quality water, and appropriate minerals and supplements** while **minimizing environmental stressors**. Use a **written herd health plan** and **track quantitative performance data**, examining tradeoffs. **Regular monitoring** of livestock will ensure **timely medical treatment**. Breeding of **range- and climate-adapted livestock** will enhance the likelihood of success.*

## Definitions

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**Nutritious forage**: includes quantity, quality, and diversity of available vegetation, recognizing that plants often thought unsuitable or unpalatable can provide essential nutrients and help offset toxins.

**High-quality water**: highly site-dependent but water should not negatively affect performance and health; seek local technical support for testing and advice.

## Discussion

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As with most aspects of grazing management, the best way to achieve livestock performance on rangeland is through proactive planning, in this case to ensure access to nutritious forage and other essentials. Health and welfare on rangeland naturally follow from this, but regular monitoring can ensure that any health issues are identified in a timely manner. Though there is no substitute for directly observing livestock, new technologies that enable remote monitoring can increase the number of “contact points”.

As with other data, a written record of quantitative health and performance data is essential. New precision tools can assist with this. A written herd health plan will include many non-grazing elements but should not neglect key issues relevant to grazing, including identifying and mitigating environmental stressors. A good relationship with a veterinarian is important for ensuring timely medical treatment, health planning, and awareness of emerging livestock health challenges. Where predation is a threat, once again proactive planning to minimize risk is the most important strategy.



# Checklist

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- Grazing plan ensures access to nutritious forage and high-quality water
  - Written herd health plan includes grazing:
    - Availability of appropriate minerals and supplements
    - Mitigation of environmental stressors when possible
    - Plan for monitoring of livestock health
  - Quantitative performance data are tracked
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## Resources

- [Beef Quality Assurance](#) (BQA) is a great resource for information and templates related to herd health in beef cattle.
- The [Redbook](#) is a very useful tool, but strongly consider transferring the data gathered to a spreadsheet so that it can be organized and analyzed across years. There are numerous app-based and web-based tools that can take your record keeping a step further.



# Think Beyond the Range

*Successful grazing management must **recognize and integrate external factors**, including the interests of external stakeholders. In all cases **proactive planning** and **effective management** will increase the likelihood of success and minimize conflict. At the same time, it is important to **engage in honest dialogue with external stakeholders** and **participate in public education efforts**, using your experience and data to **demonstrate the benefits of successful grazing management** and **provide place-based context**. Throughout, recognize that **win-win solutions are possible** and **share lessons learned**.*

## Definitions

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**Stakeholders:** those with a stake in the outcomes of a grazing management decision vary based on the issue being considered—when it comes to thinking beyond the range, think broadly.

**Place-based context:** we know that grazing management is location-specific and blanket statements about the impact of grazing are unhelpful; sharing your story helps expand the conversation.

## Discussion

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This principle connects the other principles to all the things that occur outside the boundaries we have set. As many survey respondents noted, issues that seem external can very quickly become internal, so it was essential to include general best practices for working across boundaries.

The ever changing social, economic, and environmental conditions of Western rangelands and grazing management necessitate engagement, now more than ever. While some grazing managers may be in situations where isolation is still possible, increasingly even private-lands ranchers are subject to the demands of external stakeholders, if not through regulation then through requirements from industry. Many of the most enthusiastic statements in our survey emphasized the need for ranchers to communicate and build bridges with the public.

## Checklist

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- Engages with relevant external stakeholders
  - Participates in public education efforts
  - Shares lessons learned with other livestock producers
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## Resources

- The Center for Collaborative Conservation at Colorado State University has a [lengthy list](#) of resources for learning about collaboration and developing skills.
- There are numerous examples of ranchers engaging in win-win collaborations, both big and small. Some of the better known collaborations include: [Malpai Borderlands Group](#), [Blackfoot Challenge](#), [Altar Valley Conservation Alliance](#), [Collaborative Adaptive Rangeland Management Experiment](#), [Diablo Trust](#), and [Ranchers Stewardship Alliance](#).

# Grazing Principles Checklist

## Practice Adaptive Management

- Practices adaptive management, including:
  - Formal, collaborative setting of diverse goals
  - Monitoring of goal-relevant outcomes
  - In-season and year-to-year adaptation
  - Formal meetings to integrate lessons learned
- Identifies and engages stakeholders relevant to goals

## Optimize Stocking Rate

- Has a well-considered base stocking rate in mind, incorporating:
  - Local/historical knowledge
  - Forage production data from technical advisors and/or online tools
  - Operation-specific context
- Makes year-to-year adjustments in actual stocking rate using:
  - Local/historical knowledge
  - Climatic forecasts and indicators
  - Operation-specific context
  - Enterprise flexibility
- Connects stocking rate decisions to goals

## Use a Grazing Plan

- Uses a written grazing plan, integrating:
  - Triggers for movements and other actions
  - Drought contingencies
  - Connection to goals, including ecological goals
- Keeps records of grazing movements and actions
- Integrates multiple sources of data into planning and decisions
  - Monitoring data
  - Technical support and data
  - Experiential knowledge

## **Prioritize Ecological Health**

- Grazing management goals include measurable ecological health metrics
- Management practices support heterogeneity, vis-à-vis:
  - Variable grazing impact within/among pastures and/or year-to-year
  - Management maintains diverse plant communities
  - Sensitive areas identified and managed appropriately
- Is familiar with relevant ESDs and/or other technical ecosystem information

## **Consider Distribution**

- Goals and plans account for distribution within pastures via strategic:
  - Placement of attractants
  - Site-specific fencing
  - Low-stress herding
- Livestock breeding accounts for local landscape and climate

## **Welfare Begets Performance**

- Grazing plan ensures access to nutritious forage and high-quality water
- Written herd health plan includes grazing:
  - Availability of appropriate minerals and supplements
  - Mitigation of environmental stressors when possible
  - Plan for monitoring of livestock health
- Quantitative performance data are tracked

## **Think Beyond the Range**

- Engages with relevant external stakeholders
- Participates in public education efforts
- Shares lessons learned with other livestock producers