Expanding prescribed grazing for wildfire resilience in California: Opportunities and strategies for effective fuels management

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California's recent history of catastrophic wildfire underscores the urgent need to leverage every available tool to adapt to changing conditions and build wildfire resilience. Prescribed livestock grazing—the planned management of livestock to achieve resource goals [1–3]—offers a cost-effective, landscape-level tool for region-specific fuels management and post-fire recovery across the state[4]. This overview highlights **opportunities**, **considerations**, and **key actions** for integrating prescribed grazing into broader fuels management strategies.

Opportunities for leveraging prescribed grazing to build wildfire resilience

As state and federal agencies scale up efforts to treat a combined one million acres annually, prescribed livestock grazing offers significant potential to help enhance community protection of life and property, support ecological goals, create local economic opportunities, and advance the goals of California's Wildfire and Forest Resilience Action Plan. Livestock grazing is the most widespread land use activity in California, covering ~30 million acres[5,6], and is already frequently used to achieve multiple conservation goals on private, state, and federal lands[7–11]. This presents significant opportunities to integrate grazing into broader fuels management and restoration strategies to mitigate wildfire intensity and frequency and build post-fire resilience.

Livestock grazing (cattle, sheep, and goats) is increasingly recognized as a cost-effective tool for reducing wildfire risk, while also providing a range of other ecosystem benefits [12,13]. Planned grazing can support multiple ecosystem services—including food and fiber, biodiversity and habitat, carbon sequestration and security, and water flow and supply[14]. In terms of fuels management, grazing can reduce flammable shrubs—including those that ignite easily and contribute to ember cast—break up continuous fine fuels and decrease overall fuel biomass[12,13,15–19]. These changes to fuel profiles can alter fire behavior by slowing its spread and reducing intensity, which helps create defensible space. Additionally, grazing can play key roles in maintaining and restoring landscapes post-fire[20]. See **Box 1** for additional information on the spectrum of grazing management strategies.

Different vegetation treatments, such as prescribed burning, mechanical thinning, and grazing, provide distinct benefits that can complement each other in joint strategies for effective land management[21]. Integrating prescribed burning and grazing can enhance effectiveness of both treatments: prescribed grazing reduces flammable plant material that could otherwise intensify fire behavior, while prescribed burning improves forage for livestock and wildlife. For post-fire reforestation efforts, prescribed grazing can assist with site-preparation, helping to restrict shrub encroachment and other competitive vegetation[15,22]. Prescribed grazing can also be an effective tool in addressing fuel-loading near wildland-urban interfaces (WUI) and within urban and suburban communities, especially where other fuels management tools, such as herbicides or prescribed fire, may be restricted.

Livestock grazers have well-documented expertise in managing fuel loads and mitigating wildfire risks[23] and are uniquely positioned to contribute to coordinated regional strategies across land ownership boundaries. Establishing and maintaining regional partnerships to support joint strategies will require sustained funding, streamlined regulations, and access to technical support resources. Several federal and state agencies–including USDA-USFS, USDI-BLM, and CDFW– are actively collaborating with stakeholders on expedited procedures for implementing fuels reduction projects. These efforts represent significant opportunities for expanding the use of grazing across public and private lands.

Considerations and guidance for successful prescribed grazing

Effective prescribed grazing strategies for managing fuel loads in fire-threatened communities must integrate environmental, economic, and social considerations. While land management is inherently site-specific, evidence-based principles for successful grazing management[24] provide key guidelines, outlined below.

- **Ecological Health and Sustainability**
  Well-planned grazing can support biodiversity, soil health, and other critical ecosystem services while ensuring protection for sensitive species and habitats. Prescriptions must consider the needs of both target and non-target plants to perform critical functions (e.g., photosynthesis, reproduction), and should be timed accordingly to maximize effectiveness[1,2]. Both local knowledge and science-based technical information are essential for understanding a site's potential for reaching management objectives.
- **Livestock Management and Well-being**
  Ranch-level trade-offs between livestock production and fuels management goals are a critical consideration, especially with more intensive prescriptions (**Box. 1**). For example, the optimal timing for managing fuels may coincide with declines in forage palatability and nutrition, which can impact animal productivity[1,2]. Therefore, a comprehensive herd health program is essential for maintaining animal health, performance, and the long-term sustainability of livestock operations.
- **Adaptive Management and Planning**
  Successful grazing strategies depend on adaptive management and flexibility. Local managers need to proactively develop written plans[24,25] that address timing, intensity, duration, frequency, and distribution of grazing to achieve ecological health and livestock production goals. Grazing plans should also incorporate monitoring, checkpoints and strategic triggers, and protocols for making necessary adjustments.

Region-specific grazing strategies must be collaborative, context-specific, and outcome-based. These efforts should focus on identifying local goals, challenges, and opportunities using multiple information sources—such as monitoring data, technical support, and local experiential knowledge— throughout the decision-making process. Proactive planning will help manage uncertainties and trade-offs, while also enabling partners to more effectively resolve potential conflicts.

Key Actions

Map and prioritize grazing projects for fuel reduction, post-fire resilience, and community protection

- Inventory current grazed acreage across the management spectrum (see **Box 1**), including:
  - Fuel reduction as an incidental benefit of grazing (e.g., permitted grazing on federal allotments)
  - Fuel reduction as a grazing co-benefit (e.g., grazing leases on recreational, municipal watersheds, or other public/quasi-public lands providing livestock forage while reducing fuel loads)
  - Fuel reduction as a primary focus of grazing (e.g., targeted grazing prescriptions to establish fuel breaks, address WUI fuel loads, or to protect strategic resources or infrastructure)
- Prioritize landscapes where grazing can strategically protect vulnerable communities, human health and safety, critical infrastructure, and high-risk ecosystems
  - Develop map-based analysis to identify high-risk fuel areas, integrating constraints and opportunities for prescribed grazing

Support long-term investments in grazing infrastructure, economic activity, and workforce development

- Provide technical training and support to help prescribed grazing operators meet regulatory requirements, including supporting training and development opportunities for California Certified Rangeland Managers
- Provide support for business training and workforce development to help new and existing livestock grazers shift from a production model to a service model
- Increase lease terms on agency-managed grazing lands (e.g., 5-year minimums) and expand cost-share opportunities for permanent infrastructure development to help grazers recover investments, ensure economic viability, and support sustainable grazing practices

Enhance policy and regulatory support for prescribed grazing projects
- Develop regional guidelines and grazing management plans (currently in development by the Board of Forestry and Fire Protection's Range Management Advisory Committee)
- Streamline CEQA permitting process for state-funded prescribed grazing projects, including updating CalVTP to encompass a broader range of qualifying project sites
- Facilitate streamlined NEPA analyses for prescribed grazing efforts on federal lands
- Reduce insurance rates for homeowners and communities using prescribed grazing for fuels reduction

Expand monitoring and applied research activities
- Support development of standardized contract performance metrics and vegetation removal criteria to quantify the amount of fuels removed or modified
- Incorporate total acres grazed and associated fuel reduction benefits (i.e., incidental, co-benefit, or primary; **Box 1**) into state and national target reporting, as permitted by agency guidelines
- Provide funding for applied research on scaling up prescribed grazing as part of regional, integrated strategies for fuels management, ecosystem resilience, and local economic opportunities
- Support applied research on how strategies across the grazing management spectrum (**Box 1**) can be used to build fire-smart landscapes

Accelerate community engagement and cross-boundary collaborations
- Integrate prescribed grazing across the California's Wildfire and Forest Resilience Action Plan goals
- Fund regional prescribed grazing coordinator positions to enhance capacity for collaboration across state, federal, and private land boundaries
- Provide funding to expand outreach and education for resource professionals, policy decision-makers, and other stakeholders on integrating prescribed grazing into joint strategies at regional scales

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BOX 1. Grazing can be adaptively managed by adjusting the number and type of animals (e.g., cattle, sheep, and goats), as well as the timing, intensity, duration, frequency, and spatial distribution of grazing. This results in a spectrum of management strategies, ranging from extensive to intensive, each of which offers opportunities to positively impact fuel loads and wildfire resiliency. At one end of the spectrum, traditional, production-based management focuses on optimizing grazing to support meat, fiber, and milk production, which can yield incidental benefits such as an annual reduction in fine fuels. With increasing management intensity and planning, livestock grazing can also be prescribed to deliver conservation co-benefits, such as reducing fuel loads, managing invasive plants, and promoting biodiversity and wildlife habitat. More intensive targeting prescriptions ("targeted grazing") focus on specific vegetation goals as the primary objectives. While all livestock grazing contributes to fuels reduction, this spectrum of strategies enables managers to address diverse regional needs for fuels management and post-fire resilience.

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