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FIREWISE Newsletter

MAKING SENSIBLE CHOICES IN THE INTERFACE

2009



FILLING A CRITICAL NEED THE NAPA COMMUNITIES FIREWISE FOUNDATION

By Stephen Gort

In 2008 alone 8,403 wildfires destroyed nearly 1.3 million acres in California. Napa County is the home of the premier wine producing region in the United States. Seventy five percent of the county's 500,000 acres is considered a high fire risk environment, and half of this acreage has burned in the past sixty years.

In response to the clear danger presented by the build-up of volatile fire fuels across Napa County, a group of senior fire professionals and concerned community leaders came together in 2004. They organized themselves into a cooperative, working unit, determined to protect property and save lives. They founded "Napa Firewise" a community-based fire awareness program designed to educate the public and encourage individuals to be proactive in preparing their property for greater fire protection.

Over time it became evident that there is a large gap between a community's desire to do something about fire safety, and its ability to put meaningful plans and projects into action, from a standing start. We have established and grown Napa Firewise to act as a "super agency" to help communities throughout their growth cycle.

In late 2007, we divided the County into 16 "communities", and set a goal to enable 4 communities per year, thereby covering the whole County in four years. We are filling the gap between communities and text books with hands-on, local expertise, and a broad range of real time support.

Free of charge, in support of a new startup community, the foundation:

- Provides necessary education and support for the local community "sparkplug"
- Conducts awareness meetings for the community to secure initial interest
- Provides the services of a defensible space consultant to establish basic community needs.
- Helps the community to empanel a fire safety committee.
- Conducts two or three CWPP planning meetings to formalize the community's plan and establish priorities for its projects.

See Napa Communities on Page 3



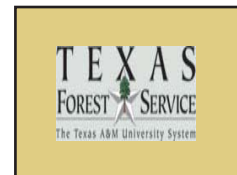
HIZ Workshop in Reno, Nevada at WUI Conference

PAGE TWO



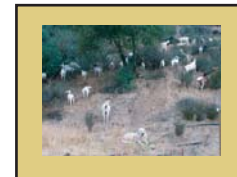
MyFirewise Virtually Connects Communities

PAGE TWO



Elementary School Students Help Community Achieve Recognition in Texas

PAGE FOUR



Grazing Most Efficient in Treating Small Live Fuels

PAGE FIVE

WELCOME TO THE FIREWISE GENERATION

A new feature to the Firewise website is designed to help young adults better understand wildfire. Teaching and helping them to put Firewise practices to work around home and in local communities is the focus of the program. Firewise Generation allows users to

See Generation Page 5



[We welcome your comments!](#)



ATTEND HIZ WORKSHOP AT WUI CONFERENCE IN RENO, NEVADA

The popular "Assessing Wildfire Hazards in the Home Ignition Zone" workshop will be offered March 22-23 at the Grand Sierra Resort & Casino in Reno, Nev. The International Association of Fire Chiefs (IAFC) and the national Firewise communities program are making the important training course available prior to the 2009 Wildland Urban Interface (WUI) Conference.

"The workshop series focuses on how to identify risks and help residents and communities reduce their wildfire vulnerability," said Jim Smalley, National Firewise Communities Program Manager. "The course continues to be a valuable tool for planners, landscapers, and fire and forestry professionals."

This two-day workshop covers the myths of wildland/urban interface fire, the history and context of WUI fire disasters, sequential elements of a WUI fire disaster, research and case studies, risk factors in the home ignition zone, information needed to conduct an assessment, the general health of the ecosystem, inspecting the home ignition zone, accessibility in case of a wildfire emergency, documenting an assessment, and much more.

The workshop includes question and answer, class discussion, and three classroom exercises where participants will perform home ignition zone evaluations. Participants will receive a student workbook, student handout with printed slide presentation, and a certificate of attendance with 1.6 continuing education unit's (CEUs).

"This course is designed to encourage participants to practice the information they learn immediately, so they can go home and train others," Smalley said.

This session is an opportunity for those who missed the workshops Firewise offered in 2008, to participate this year at the 2008 rates. To register or download the conference brochure, go to www.iafc.org/wui.



MYFIREWISE VIRTUALLY CONNECTS COMMUNITIES ON WILDFIRE ISSUES

A new Firewise Communities social network makes it easy for fire professionals, agencies, educators, and homeowners to connect on the issue of wildfire protection online.

MyFirewise launched as a test site in October and has already grown to more than 100 users. "It is really exciting," said Judith Leraas Cook, project manager for Firewise Communities/USA. "The site enables interested parties across the nation to discuss best practices in real time."

Each of the more than 450 recognized Firewise Communities/USA sites is represented through its own network on MyFirewise. Members can use the site to upload videos, pictures, and post discussion questions pertaining to wildfire mitigation. The Firewise Communities/USA recognition program (see www.firewise.org/usa) encourages voluntary action by residents to reduce their wildfire risks.

The MyFirewise site also features links to Firewise landscaping tips as well as instructional videos for community members to reference when working to modify wildfire hazards around their homes and within their neighborhoods.

Leraas Cook says an interactive educational tool is what the new network is designed to be. "Firewise was built around the idea that communities can work together to help prevent wildfire loss. MyFirewise takes this concept and applies it to the online space. People from all parts of the United States can now share stories of their wildfire mitigation challenges and successes with ease."

To join in, go to <http://network.firewise.org/>. Anyone interested in wildfire protection is welcome to participate.



FINDING A FIREWISE COMMUNITY JUST GOT EASIER

Since the 2002, the Firewise Communities/USA recognition program has had over 500 communities recognized. To date, 422 communities have current recognition in 38 states. A new feature to the Firewise website just made it easier to find any one of them. Simply go to the Firewise Communities/USA tab from the main page at www.firewise.org. Here you will see a map of the United States and the array of communities nationwide. Just below the map is the link "Download a current list of recognized communities" click on it and you'll get an up-to-date list of communities listed by state. Or try it now <http://www.firewise.org/usa/index.htm>.

If currently are or would like to find out more information about the Firewise Communities recognition program, your Firewise State Liaison can be quite helpful. To help you find your state liaison we have created an updated nationwide list. From the www.firewise.org/usa Firewise Communities/USA web page go to the tab "Contact a Representative" and click on the contact list. Or you can try it now <http://www.firewise.org/usa/contact.htm>.





NAPA COMMUNITIES FIREWISE FOUNDATION

- Provides the funding and project management assistance for an early project such as preparing a community fire break – an early, visible success breeds further community interest and involvement.
 - Provides these start-ups with consulting help on grant writing and the Foundation acts as a fiscal sponsor for grants until these communities can stand alone. This includes accounting support and grant status reporting.
- All in all, our aim is to get communities “up-and-running”.



The Chipping Program

One of our earliest programs was to provide a free chipping service throughout the County. The local Bay Air Quality Board wanted to reduce or ban burning. Napa Firewise said: “If you don’t want us to burn, give us a chipper”.....and they did! The equipment was funded by both the air quality people and a grant from Fireman’s Fund Insurance Company. The local Cal Fire organization provides the supervision and equipment maintenance, and manpower is provided by the County Corrections Department - with low risk inmates.

- In 2005, chipping was provided for 40 days and processed 9,000 cubic yards.
- In 2006, 40 days and processed 11,000 cubic yards.
- In 2007, 120+ days and processed 26,000 cubic yards.
- In 2008, 240+ days and processed 140,000 cubic yards.

This service is free to County residents.

Using a website function, citizens describe the size and location of their curbside brush pile, and it is chipped, usually within 10 days.

Funding

The entire program is funded and managed by The Napa Communities Firewise Foundation. The Foundation itself has received grants from the U.S. Forest Service Federal Wildland Urban Interface (WUI) program, the Napa County Fire Department, CalFire, and private grants from Fireman’s Fund Insurance and the Bay Area Air Quality Management District.

In 2007, the organization was successful in obtaining non-profit status and incorporated under section 501(c) (3) as the “Napa Communities Firewise Foundation”. Among other benefits of restructuring, the Foundation is now able to offer tax incentives for donations.

This year marks the launch of the “**Fire Safe – Firewise Development Campaign**”, designed to ensure sufficient funding through private and commercial donations so that Napa Firewise can continue its crucial programs and fire protection practices well into the future.


Major Accomplishments

- The success of the Napa program is a direct result of providing the community with needed fire prevention information, funding for fire preparedness activities, free vegetation management services, and hands-on assistance in building community action plans.
- During the past four years the Foundation has:
- Hosted 30 community meetings to promote wildland fire awareness and explain state and local fire code regulations;
 - Cleared 200,000 cubic yards of flammable vegetation through our countywide free chipping program;
 - Cleared nearly 600 acres of dry wildland vegetation using goats and labor provided by county inmates;
 - Provided more than 150 hours of consulting for communities involved in developing wildland fire protection plans (CWPP);
 - Trained fire service personnel and private contractors in defensible space regulations and home inspection techniques;

- Conducted more than 250 free defensible space home inspections;
- Designed and executed a comprehensive communications plan, including:
 - Produced and distributed over 250,000 postcards, brochures and newsletters throughout Napa County on fire awareness and prevention;
 - Authored numerous articles on fire topics for the Napa Valley Register and other local publications;
 - Developed a series of highway signs, strategically placed throughout the county, promoting defensible space and wildland fire awareness;
 - Secured \$516,200 of grant funding to support ongoing programs and activities; more than \$95,000 of in-kind service from the Fire Services, and more than \$426,000 of in-kind services from Napa County residents.

The Future

In parts of California, more homes are being built in high fire-risk areas and record vegetation buildup has provided unprecedented amounts of fuel just waiting for ignition. It’s a recipe for disaster. Because of the magnitude of the problem, state and local fire agencies are limited in what they can provide. The notion of a fire engine and crew protecting every home is just not realistic. As residents realize the risk to themselves and their community, they too often lack the resources and the know-how to take the next steps, without help.

The answer lies in a comprehensive, systematic approach such as that developed by Napa Firewise. “We must be honest with ourselves. Wildland fires are part of our history and will certainly be part of our future. Being prepared is critical.” Says Ernie Loveless, Chief, CAL FIRE Napa-Lake-Sonoma Unit. “Our goal is to make every citizen aware of the significant risk of a major fire in this community and to empower them to take action to protect their homes and their families” says Darren Drake, City of Napa Fire Marshall. 

Stephen Gort is a Director and Treasurer of the Napa Communities Firewise Foundation and manages the Firewise program for the community of Circle Oaks in Napa County, a nationally recognized Firewise USA Community.



FIREWISE COMMUNITY FORMED IN ELEMENTARY SCHOOL RECOGNIZED



Left to right: Teacher/Advisor Ms. Alicia Eberlan, Committee members Mackenzie Corbett, chairperson Gabrielle Newman, Shelby Abel, Madeline Lowery, Teacher/Advisor Ms. Linda Tootle, TFS Representative Jan Amen. Committee member not shown: Chase Webb, Andy Trezell, School Superintendent and Etoile Fire Chief Andy Sanders.

Just before Christmas 2008, the State of Texas and Firewise Communities/USA proudly welcomed a new Firewise Community into its membership. The community of Etoile, Texas is very special and unique as the project was organized by a Firewise Committee from the Etoile Elementary School. The committee made up of six students grade five through eight, completed fuel mitigation work around 37 homes and made their community more Firewise. There are two teachers who serve as advisors and the Etoile Fire Chief Andy Sanders is the community liaison. Students schedule project work days and create education themes for Firewise. This note is from the Firewise Committee Chair and 8th grader Gabrielle Newman and was provided from the Texas Forest Service.

Hi this is Gabrielle Newman from Etoile ISD and I am the chairperson of the Firewise Committee at my school. The committee consists of Shelby Abel, Chase Webb, Mackenzie Corbett, Madelyn Lowery, Alicia Eberlan, Linda Tootle, and Andy Trezell. We are all proud to be a part of the Firewise Committee and to participate in this

wonderful program. We hope to make a difference not only in our school, but in our whole community.

During our Christmas program we received national recognition from the Firewise Communities/USA program and presented by Jim Smalley, Project Manager for the national Firewise Communities program, P.J. Pearson, Texas Forest Service and Jan Amen, also from the Texas Forest Service. As part of the recognition we were presented with two Firewise Communities/USA signs, a framed print, and each member was given a lapel pin. The Firewise program was explained to the parents and their support was requested.

Some community members have cleaned their yards and property with the help of students keeping it safer from fire. When we are done we plan to make Etoile a safer community! As I graduate this year I hope to take this program with me to Woden High School!"

This spring our Firewise project work will include a mitigation day with the school and community doing work around the homes of elderly folks throughout the town. The Texas Forest Service will participate in the project by providing labor, chainsaws and tools. A Fuels/Mitigation crew will be the labor force along with Forest Service employees from neighboring districts. This will be a case of neighbors helping neighbors.



FIREWISE FEATURED AT WINTER MEETING OF N.E. FOREST FIRE PROTECTION COMPACT

Michele Steinberg, Firewise Communities Support Manager had the pleasure of attending the winter training meeting of the Northeastern Forest Fire Protection Commission (NFFPC) in Portland, Maine in January. The NFFPC is the governing body of a 'Compact' comprising of 7 New England states, 4 Canadian provinces and the New England National Forests.

In 1947, after the New England states were ravaged by a series of major forest fires, the U.S. Congress recognized the need

for closer cooperation among the states to fight forest fires. In 1949, Congress passed an Act establishing the first regional compact to prevent and control forest fires in the Northeast. Seven states -- Maine, New Hampshire, Vermont, Connecticut, Massachusetts, Rhode Island, and New York -- joined in 1949 and 1950; the Canadian provinces of Québec and New Brunswick later became members in 1969 and 1970, making this the first international compact. In 1996 Nova Scotia joined the Compact. The White Mountain, Green Mountain, and Finger Lakes National Forests joined in 1996 as ex-officio members under the name of the New England National Forests. The United States Department of Agriculture (USDA) Forest Service also provides assistance and coordination.

The annual training meeting was organized by the compact's Training Working Team and included presentations from members, Wildfire Lessons Learned Center, Nature Conservancy, and Firewise. A featured presentation was an after action summary of a large fire occurring at Lake Echo in Nova Scotia in June 2008. The significant fire consumed "blow-down" fuels from a hurricane the previous year. Steinberg noted, "Two homes were lost and firefighters made an extremely brave and luckily successful effort to save several other homes. Fuel loads were close enough to structures to cause ignitions. For the northeast, this fire of almost 5,000 acres in a suburban area was quite large (the largest since 1976). In addition, five thousand residents were evacuated and demonstrated that a wildland urban interface fire can occur in a non-western area."

Steinberg and Firewise state liaisons, David Russell from New York and Kent Nelson from Maine presented an overview of the Firewise Communities program and what it can do to help with the problems facing the Compact using shared experiences with the Firewise program.

Russell energetically spoke about what he learned from attending the "Backyards and Beyond" conference in Tampa in November 2008, and plans to start a New York Firewise Council to help bring more partners to support his efforts in reaching communities. His lessons summarized to

- 1) Educate the public and allow them to take responsibility over their own situation;
- 2) Don't reinvent the wheel – the Firewise

NFFPC from Page 4

participants and staff share excellent information and programs; 3) Firewise is a process and it's OK to proceed in small steps; and 4) Responsibility for protection is shared.

Kent Nelson explained how he and his staff worked with the Lake Arrowhead subdivision in Waterboro, Maine to become the first recognized Firewise Communities/USA community in Maine. He is working with another community and looks forward to recognition in 2009. Nelson has also worked with the Compact to secure a date and location for an Assessing Wildfire Hazards in the Home Ignition Zone workshop to be run by the national program instructors in the fall of 2009.

Additional Firewise state liaisons or staff were in attendance from all six New England states, Steinberg says "The Compact is a very effective organization for the northeast states and provinces in terms of providing education and training for members. The Prevention Working Team chair from Quebec expressed interest in taking the program to his province for use in its programming and outreach. The learn more about the NFFPC, they have an excellent website you're encouraged to visit at www.nffpc.org.



GENERATION from Page 1

FIREWISE
Generation

learn:

- Understand how wildfire works
- Enjoy increased physical strength and endurance
- Safely and effectively work with fire prevention tools
- Assess homes and other buildings for wildfire readiness
- Know what to do when a wildfire occurs
- Prepare your home for wildfire season
- Conduct Firewise maintenance work around homes
- Learn what it's like to be a wildland or structural firefighter

- Discover the relationship between fire and healthy forests
- Understand the physics of fire and vegetative fuels

Firewise Generation is broken into eight individual lessons with a targeted goal and broad use of new and existing resources to learn and master each topic. As an example, lesson one teaches you the basics of wildfire behavior once complete move to lesson two and understand how wildfire burns trees and other vegetation. Additional lessons help the user learn how to properly conduct an assessment and prepare a home from wildfire and what to do if wildfire strikes.

The website is quite interactive and can be enjoyed by a single person or a group and encourages the user to "take it outdoors" to obtain tree samples for instance. Some of the lessons incorporate experiments that can be downloaded and completed outside or in your home. A toolbox checklist is provided and tells you what is needed. Most items can be found around the home.

Firewise Generations is ideal individuals, youth groups or application in schools. It combines existing resources from the Firewise Communities program with new material in one place. We invite you to try it today and remember lesson eight, "Share what you have learned."

Look for the link to Firewise Generation from the Firewise website www.firewise.org.



PLANNED HERBIVORY IN THE MANAGEMENT OF WILDFIRE FUELS

Grazing is most effective at treating smaller diameter live fuels that can greatly impact the rate of spread of a fire along with the flame height.

By Glenn Nader, Zalmen Henkin, Ed Smith, Roger Ingram, and Nelmy Narvaez

This article was previously published in the [Society of Range Management](#) newsletter, October 2007 and is reprinted with permission.

Wildfires are increasing in number, intensity, and size. Five of the most significant wildfire seasons in the United States since 1960, as measured by total acres burned, have occurred since 2000¹ The vegetation or fuel profile, a major factor determining fire behavior, is studied in two aspects: vertical and horizontal arrangement, and amount. The vertical arrangement of fuel determines the degree of its mixture with air and, thus, flame height and duration of elevated heat. The continuity of horizontal fuel arrangement determines potential for fire spread across the landscape. These attributes, along with topography and weather conditions (wind and fuel moisture), are what determine the kind of wildfire that is going to occur. Many management and ecological conditions have allowed for the increased fuels. The increasing number of residences being built in forest and rangeland ecosystems provides more ignition sources and restricts the ability to manage fire. Introduction of exotic plants such as cheatgrass also has changed the fire behavior in many sagebrush plant communities².

Fuel treatments are generally placed in two different categories. Fuel breaks are linear fuel modifications that are often situated along a road or ridge. They can range in width from 30 feet to 400 feet and

¹ National Interagency Fire Center. 2006. Wildland Fire Statistics. Available at: <http://www.nifc.gov/stats/index.html>. Accessed January 2006.

² Davidson, J. 1996. Livestock grazing in wildland fuel management programs. *Rangelands* 18:242-245.



Herbivory from Page 5

are designed as a tool for fire fighters to stop fires. Landscape area treatments are designed to reduce flame height and change fire behavior over a large area. Long-term landscape treatment efforts are focused on changing the plant community to decrease the flame height when fire occurs. Both approaches require maintenance in order to remain valuable fire management tools. The objective for fuel reduction is to change fire behavior by impacting the following: fuel bed depth, fuel loading, percent cover, and ladder fuels that result in a fire flame less than four feet high. At that level all fire fighting management tools can be used, while maintaining fire fighter safety.

Mechanized Treatments

Mechanized treatments are used by land managers to alter or remove vegetation, including mowing, mastication, and biomass harvesting. Mastication involves the use of a large mechanized device for chopping, and is used in brush and trees to break up the fuel pattern and decrease combustibility by placing fuels on the ground. It changes fire behavior by rearranging the fuel profile through distributing some of the fuel on the ground. This action also causes a reduction of ladder fuels, which decreases potential for vertical extension of fire into tree canopies; crown fires are very difficult for fire fighters to control. Mastication can be used as a pretreatment followed by prescribed fire or grazing treatments. Some of the disadvantages of mastication are the cost of \$350 to \$800 per acre, ground disturbance, short life of the treatment in some areas, terrain and surface roughness limitations, and soil compaction. Mastication can result in death in some brush species, but many species re-sprout from the roots and require retreatment. Mechanized treatments also include the thinning of over story vegetation through biomass harvesting. The harvested biomass is brought to a chipping unit and the resulting material is transported off the site for use in energy power plants. The sale of the biomass chips reduces the cost of this treatment. Thinning can provide desired conditions for both ladder fuels and crown spacing in one treatment. Soil moisture condition is the only limitation on the time of year that the treatment can be conducted. Disadvantages include transportation costs of hauling biomass and removal of nutrients from the ecosystem. In some cases, trees that are removed can

be sold as commercial saw logs to offset fuel treatment costs. Mowing is generally used in grass communities to drop the fuel on the ground, where it has less contact with air and thus has lower combustibility. Mowing needs to be done during the end of the green season or it can cause fires from the blades striking rocks when dry grass is present. The costs of mowing range from \$25 to \$40 per acre.

Herbicides

Herbicides can be sprayed to kill specific plants, but this does not alter the fuel pattern immediately. Herbicide treatment of targeted species has a cost of \$25 to \$250 per acre. The disadvantages include concerns about its impact on the environment and short-term increases in fuel flammability.

Prescribed Fire

Prescribed fire can be used to change the fuel load and pattern. Prescribed burning can generally be achieved for less than \$150 per acre. It is most effective for reducing surface fuels 0–3 inches in stem diameter. Because of air quality concerns and the need for the correct fire weather conditions (wind, air, and plant humidity), there is usually a narrow time period in the season during which burning can be done. A mechanical or hand removal treatment might also be required prior to the reintroduction of fire into the ecosystem to achieve desired fire behavior. The disadvantages of this treatment are reduced aesthetics, tree mortality, impaired air quality, liability concerns, pretreatment costs where applicable, the requirement of qualified people who understand prescribed fire, and treatment variation (it might burn hotter or cooler than planned). Also, it might not be appropriate for some plant communities, such as low-elevation sagebrush, which can be replaced post fire by cheatgrass.

Hand Cutting

Hand cutting and stacking of fuels for burning is very labor-intensive and thus expensive. Costs range from \$800 to \$2,300 per acre, depending on amount of vegetation. It is the best alternative on steep slopes where mechanized equipment cannot operate.

Grazing

Grazing is best used when addressing the smaller diameter vegetation that makes up the 1- and 10-hour fuels. One hour fuels are those fuels whose moisture content reaches equilibrium with the surrounding

atmosphere within 1 hour and whose stems are less than one-fourth inch in stem diameter. Ten-hour fuels have stems that range from one fourth inch to 1 inch in stem diameter. Grazing can impact the amount and arrangement of these fuels by ingestion or trampling. It is a complex, dynamic tool with many plant and animal variables, and it requires sufficient knowledge of the critical control points to reach treatment objectives. Those control points involve the species of livestock grazed (cattle, sheep, goats, or a combination); the animals' previous grazing experience (which can affect their preferences for certain plants); time of year as it relates to plant physiology (animal consumption is directed by the seasonal nutrient content); animal concentration or stocking density during grazing; grazing duration; plant secondary compounds; and animal physiological state. Treatments either can be short-term to reduce flammable vegetation or long term to change vegetation composition by depleting root carbohydrates in perennials and reducing the soil seed bank for annual plants. The objectives are to change the fire behavior through modification of the fuel bed, fuel loading, percent cover, and ladder fuels.

Depending on the plant community, the vegetation of concern or fuel will differ. The grazing approach to fuel treatment differs with the plant life cycle (annual or perennial).

With annuals, the treatment is to remove plants while they are still green each year prior to fire season. Grazing before seed set can change seedbed dynamics, and with long-term implementation, grazing can change the species composition. For perennials, repeated grazing that depletes root carbohydrates and causes mortality of targeted species is required to change plant composition. Root carbohydrate reserves are at their lowest level just after the period when plants initiate active shoot elongation. If plants are severely grazed early in the growing season, carbohydrate reserves are depleted, and plant vigor is reduced³ Removal of bark or repeated defoliation are two other ways to destroy the plant. In brush species, the concept of changing the fuel profile the first year and

³ Doescher, P. S., S. D. Tesch, and M. Alejandro-Castro. 1987. Livestock grazing: a silvicultural tool for plantation establishment. *Journal of Forestry* 85(10):29–37.



managing it thereafter with grazing over large areas appears to be most sustainable.

Integration of different treatments could provide the best strategy. Livestock cannot effectively control mature brush plants that either grow higher than the animals can effectively graze or have large diameter limbs. Mastication, underburning, and hand-cutting can be used to manipulate the large-diameter, 100-hour brush fuels, and grazing can be used as a follow up treatment for controlling resprouting species or shifting the species composition to herbaceous plant fuel material. Tsiouvaras suggests that grazing followed by prescribed fire can be used safely to kill the aboveground parts of shrubs and further open the stand⁴. Magadlela reported that adding cutting and herbicide use increased sheep effectiveness by reducing the brush below 20% in one year, but increased the costs⁵.

Prescribed grazing has the potential to be an ecologically and economically sustainable management tool for reduction of fuel loads. However, much of the information on grazing for fuel reduction is anecdotal. Limited scientific research information is available. Existing data indicate there are two ways by which grazing impacts the fuel load: removal of vegetation, and hoof incorporation of fine fuels. Smith et al. found that 350 sheep (ewes) grazing intensely on sagebrush/cheatgrass in a 2.5-mile fuel break (divided into 20 pastures) in May in Nevada reduced fine fuels from 2,622 to 765 pounds per acre⁶. Vegetative ground cover decreased

4 Tsiouvaras, C. N., N. A. Havlik, and J. W. Bartolome. 1989. Effects of goats on understory vegetation and fire hazard reduction in a coastal forest in California. *Forest Science* 35:1125–1131.

5 Magadlela, A. M., M. E. Dabaan, W. B. Bryan, and E. C. Prigge. 1995. Brush clearing on hill land pasture with sheep and goats. *Journal of Agronomy and Crop Science* 174:1–8.

6 Smith, E., J. Davidson, H. Glimp. 2000. Controlled

28% to 30%, ground litter increased 20% to 23%, and bare ground increased 4%⁷. Tsiouvaras studied grazing on a fuel break in a California Monterey pine and eucalyptus forest in the fall at a stocking rate of 113 Spanish goats per acre for 3 days; brush understory was reduced by 46% and 82% at 20 inches and 59 inches in height, respectively. Forage biomass utilization in the brush understory was 84%. California blackberry showed the largest decrease in cover (73.5%) followed by toyon, coyote brush, honeysuckle, herbaceous plants, and madrone. Poison oak and eucalyptus exhibited very little change. Goat grazing not only broke up the sequence of live fuels (horizontally and vertically up to 59 inches), but also reduced the amount of 1-hour dead fuels by 58.3%, whereas the 100-hour fuels remained constant. The litter depth was also reduced as much as 27.4% (from 2.9 inches before to 2 inches after grazing). Animal trampling resulted in crushing of fine fuels and mixing them into the mineral soil, thus reducing the chance of ignition. Green et al. grazed 400 goats on chaparral in July⁸. The goats utilized 95% of the leaves and small twigs to 0.063 inches diameter from all the mountain mahogany plants⁹. Use of scrub oak was 80%, whereas use of chamise, eastwood manzanita, and California buckwheat was low, and *Ceanothus* was only taken under duress¹⁰. Under “holding pen” conditions, use of less palatable species approached the use of palatable plants¹¹. Lindler

Sheep grazing a fuel break in Nevada. sheep grazing to create fuelbreaks along the urban-wildland 24 R ng interface. Proceedings of the 53rd Annual Meeting of the Society of Range Management; Boise, ID. 6 p.

7 Smith, E., J. Davidson, H. Glimp. 2000. Controlled Sheep grazing a fuel break in Nevada. sheep grazing to create fuelbreaks along the urban-wildland 24 R ng interface. Proceedings of the 53rd Annual Meeting of the Society of Range Management; Boise, ID. 6 p.

8 Green, L. R., C. L. Hughes, and W. L. Graves. 1987. Goats control of brush regrowth on Southern California fuel-breaks. *In* First International Rangeland Congress; 14–18 August 1987; Denver, CO. p. 451–455.

9 Green, L. R., C. L. Hughes, and W. L. Graves. 1987. Goats control of brush regrowth on Southern California fuel-breaks. *In* First International Rangeland Congress; 14–18 August 1987; Denver, CO. p. 451–455.

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11 Green, L. R., C. L. Hughes, and W. L. Graves. 1987. Goats control of brush regrowth on Southern California fuel-breaks. *In* First International Rangeland Congress; 14–18 August 1987; Denver, CO. p. 451–455.

reported that goats stocked at 7 per acre for 3 weeks in the summer in a ponderosa pine forest were estimated to remove 15% to 25% of the vegetation, depending on the plant species present and the length of stay in the pasture¹². The cost of the grazing treatment was \$60 to \$70 per acre. In comparison, herbicide costs on adjacent sites were \$60 to \$125 per acre, and 75% to 90% of the vegetation understory in the pine forest was removed. Intensive grazing by cattle to control shrub growth has been demonstrated as being useful for maintenance of fuel breaks¹³. Perevolotsky et al. found that mechanical shrub removal and cattle grazing at the peak of green season in Israel 4 years in a row proved to be the most effective firebreak treatment¹⁴. Heavy grazing for a short duration removed more than 80% of the herbaceous biomass, but reduced regeneration rate of shrubs for only 2 years. They stated that using goats or other browsing animals can increase the amount of shrub material removed by direct grazing, but can decrease actual physical damage to shrubs (cattle will trample and break more brush and graze less due to their size, whereas the opposite is true for goats). Henkin et al. found that under heavy grazing (71–83 cow grazing days per acre), the basal regrowth of the oaks

12 Lindler, D., J. Warshawer, and D. Campos. 1999. Using goats to control understory vegetation. *Forest Vegetation Management Conference* 20:33–46.

13 Allen, B. H., and J. W. Bartolome. 1989. Cattle grazing effects on understory cover and tree growth in mixed conifer clearcuts. *Northwest Science* 63:214–220.

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**Herbivory from Page 7**

was closely cropped and the vegetation was maintained as predominantly open woodland. In the paddock that was grazed more moderately (49–60 cow grazing days per acre), the vegetation tended to return to dense thicket¹⁵.

Each species of animal has a unique grazing utilization pattern that is a function of mouth size and design, past grazing experience, and optimization of nutritional needs¹⁶. The mouth size controls how closely animals are able to select and then graze a given surface. Animals also differ in their forage preferences and diet composition, thus when developing a fuel reduction grazing program, it is important to select the kind of livestock that will consume the desired species to alter the fire behavior. Provenza and Malechek showed a 50% reduction of tannin in goat-masticated samples compared to unmasticated samples¹⁷. This illustrates that goats can affect one of the secondary compounds that are present in some brush species, and thus can eat more of that species. When preferred forage is absent or unpalatable, grazing animals are capable of changing their food habitat.

Magadlela et al. found that goats grazing in Appalachian brush defoliated brush early and then grazed herbaceous material later in the seasons¹⁸. Sheep preferred to graze herbaceous material first, but increased grazing pressure forced sheep to defoliate brush earlier in the season¹⁹. Goats reduced brush cover from 45% to 15% in one year. Sheep took 3 years to produce the same results. Brush clearing improved when goats followed sheep; total brush was reduced from 41% to 8% in one year. By the end

of 5 years of goat grazing, the brush was reduced to 2% cover. Luginbuhl et al. found that multiflora rose was nearly eliminated from the Appalachian Mountains after 4 years of grazing by goats alone (100%) or goats+cattle (92%)²⁰. Simultaneously, total vegetative cover increased with goats alone (65% to 86%) and with goats + cattle (65% to 80%), compared with the control plot where vegetation cover decreased from 70% to 22%. Lombardi et al. studied the use of horses, cattle, and sheep in Northwest Italy for 5 years and found that grazing reduced woody species cover and stopped the expansion of shrub population²¹. The impact varied with the type of animal. Cattle and horses had a higher impact on the plants through the damage caused by trampling. It was found that the effectiveness of control depended on palatability and tolerance of woody species to repeated disturbance. Juniper and rhododendron were reported not to have been grazed. Hadar et al. reported that the inconsistent response of some plants to grazing could be the interaction between grazing pressure and moisture conditions²². They found that heavy cattle grazing (340–394 cow grazing days per acre) during 7 to 14 days at the end of the growing season decreased species richness because of consumption of seeds from the annual plants.

The time of the year that grazing occurs can influence the types of plants consumed, because it impacts the plant physiological status, which controls the nutritional value to the animal. Additionally, the time of year affects the plant's postgrazing mortality. Taylor reported studies using heavy grazing by sheep in Idaho showed that season of use impacted the utilization²³. Late-

fall grazing reduced three-tip sagebrush, whereas grazing during spring increased sagebrush and decreased grasses.

Grazing impact can change with the density of animals and duration of grazing. The shorter the duration, the more even the plain of nutrition is. Over longer periods in a pasture, animals select the most nutritious forage first and consume less nutritious forage later. Stocking density has a great impact on the grazing consumption and trampling of fuels. Fences, herding, topography, slope, aspect, distance from water, placement of salt, and forage density all impact the distribution of animals and their use of the forage. By concentrating the animals into a smaller area for short periods of time, the preference for plants decreases and animals compete for the available forage. Increasing stocking density also increases hoof action and incorporation of the fine fuels into the ground. Spurlock et al. stated that high stocking rates with little supplementation forces goats to graze even less palatable species and plant parts, and as a result, much brush can be eradicated in 2–3 years²⁴. Lindler et al. suggests that a stocking rate of 15 goats per acre in a California pine forest is required to effectively treat understory brush²⁵.

Hadar et al. reported that light grazing increased plant diversity on treated sites²⁶. Thus, when proposing a stocking rate for treatment consumption, the environmental impact needs to be considered.

Plants, over time, have developed mechanisms to limit or prohibit grazing. Launchbaugh et al. summarized this plant and animal interaction as follows: plants possess a wide variety of compounds and growth forms that are termed "anti-quality" factors because they reduce forage's digestible nutrients and energy or yield a toxic effect that deters grazing²⁷.

15Henkin, Z., M. Gutman, H. Aharon, A. Perevolotsky, E. D. Ungar, and N. G. Seligman. 2005. Suitability of Mediterranean oak woodland for beef herd husbandry. *Agriculture, Ecosystems and Environment* 109:255–261.

16Beasom, S. L. 1980. Dietary overlap between cattle, domestic sheep, and pronghorns. In R. E. Soesbee and F. S. Guthery [eds.]. *Noxious Brush and Weed Control Research highlights*. Volume 11. Lubbock, TX: Texas Tech University. p. 40–41.

17Provenza, F. D., and J. C. Malechek. 1984. Diet selection by domestic goats in relation to blackbush twig chemistry. *Journal of Applied Ecology* 21:831–841.

18Magadlela, A. M., M. E. Dabaan, W. B. Bryan, and E. C. Prigge. 1995. Brush clearing on hill land pasture with sheep and goats. *Journal of Agronomy and Crop Science* 174:1–8.

19Magadlela, A. M., M. E. Dabaan, W. B. Bryan, and E. C. Prigge. 1995. Brush clearing on hill land pasture with sheep and goats. *Journal of Agronomy and Crop Science* 174:1–8.

20Lombardi, G., A. Reyneri, and A. Cavallero. 1999. Grazing animals controlling woody species encroachment in subalpine grasslands. In *Proceedings of the International Occasional Symposium of the European Grassland Federation*; 27–29 May 1999; Thessaloniki, Greece. p. 85–90.

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22Hadar, L., I. Noy-Meir, and A. Perevolotsky. 1999. The effect of shrub clearing and intensive grazing on the composition of a Mediterranean plant community at the functional group and species level. *Journal of Vegetation Science* 10:673–682.

23Taylor, C. A. 1994. Sheep grazing as a brush and fine fuel management tool. *Sheep Research Journal* 10:92–96.

24Spurlock, G. M., R. Plaister, W. L. Graves, T. E. Adams, and R. Bushnell. 1980. Goats for California brushland. Oakland, CA: Cooperative Agriculture Extension, University of California, Leaflet 21044. 30 p.

25Lindler, D., J. Warshawer, and D. Campos. 1999. Using goats to control understory vegetation. *Forest Vegetation Management Conference* 20:33–46.

26Hadar, L., I. Noy-Meir, and A. Perevolotsky. 1999. The effect of shrub clearing and intensive grazing on the composition of a Mediterranean plant community at the functional group and species level. *Journal of Vegetation Science* 10:673–682.

27Launchbaugh, K. L., F. D. Provenza, and J. A. Pfister. 2001. Herbivore response to anti quality factors in forages. *Journal of Range Management* 54:431–440.

Herbivory from Page 8

Secondary compounds (eg, tannins, alkaloids, oxalates, terpenes) can control the plant–animal interactions that drive intake and selection. Animals might expel toxic plant material quickly after ingestion, secrete substances in the mouth or gut to render the compounds inert, or rely on the rumen microbes or the body to detoxify them. The species of livestock selected is important because some species can detoxify compounds or have a smaller mouth that allows them to eat around thorns; this allows them to still obtain nutritional or pharmaceutical products that aid in digestion and detoxification. Breeders can select for animal genetic lines that can adapt to these compounds. Tannins are the most important plant defensive compounds present in browse, shrubs, and legume forages. Concentrations in woody species vary with environment, season, plant developmental phase, plant physiological age, and plant part. Levels in excess of 50 g · kg⁻¹ DM can lead to low palatability, reduced digestibility, depressed voluntary feed intake, inhibition of digestive enzymes, and increased toxicity to rumen micro-organisms²⁸. In some cases, when the plant compound is known, it is possible to intercede. For example, polyethylene glycol (PEG), a polymer that binds tannins irreversibly, can be used to reduce the negative effects of tannins on food intake, digestibility, and preferences²⁹. For oxalates, calcium supplementation has shown to ameliorate the diet suppression. Launchbaugh et al.

28 Robbins, H., A. E. Hagerman, O. Hajeljord, D. L. Baker, C. C. Schwartz, and W. W. Moutz. 1987. Role of tannins in defending plants against ruminants: reduction in protein availability. *Ecology* 68:98–107.

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29 Villalba, J. J., F. D. Provenza, and R. E. Banner. 2002. Influence of macronutrients and polyethylene glycol on intake of a quebracho tannin diet by sheep and goats. *Journal of Animal Science* 80:3154–3164.

suggests that supplementation of protein, phosphorous, sulfur, and energy can also make a difference in intake of plant material containing secondary compounds³⁰. They even postulate that clay can be used to detoxify compounds³¹.

Grazing animals can effectively distinguish between plants that differ in digestible energy or nutrients. The animal's consumption is driven by its physiological state. Nonlactating animals have much lower nutrient requirements than lactating females or growing weaned animals and can consume a wider array of plants to meet nutritional needs. Animals can be forced to eat below their nutritional needs and they will balance their needs by using existing body fat and protein. The animal can tolerate short-term energy or protein deficits, but sustained periods at this status can be reason for concern. For this reason, lactating and young growing animals are not generally recommended for fire fuel control. In a system that is focused on maintaining the fuel profile, one can use growing animals in an annual brush grazing system that focuses on the annual new growth.

Because of the complexity of plant and animal interactions, a project evaluation should be developed that considers measurable and attainable objectives before grazing is used. It should include a review of treatment objectives, outcomes, and environmental impacts. This will dictate the kind of animal needed, grazing intensity, timing of the grazing event, and duration of the grazing period. Variation in animal–plant interaction is driven by forage type, grazing season, yearly season variation, animal interaction with the grazing system (animal density and competition), previous grazing experience, mixture of grazing animals, and pregrazing treatment (integrated approach). The treatment and resulting outcomes cannot conveniently be predicted and might require adaptive onsite management. Treatment standards include stubble height for grass, percent vegetation cover by brush, plant mortality, removal of 1- and 10-hour fuel, and fuel bed depth.

Any grazing plan designed for fuel reduction needs to consider the grazing
30 Launchbaugh, K. L., F. D. Provenza, and J. A. Pfister. 2001. Herbivore response to anti quality factors in forages. *Journal of Range Management* 54:431–440.
31 Launchbaugh, K. L., F. D. Provenza, and J. A. Pfister. 2001. Herbivore response to anti quality factors in forages. *Journal of Range Management* 54:431–440.

impacts on parameters other than just simply reduction. The effects of the grazing management should be studied for their impact on water quality, compaction, riparian vegetation, disease interaction with wild life (bluetongue, pasturella), and weed transmission. The positive aspects of grazing over other treatments also should be weighed, including recycling of nutrients into the products of food and fiber.

Grazing is best used when addressing vegetation with stems of smaller diameters that make up the 1- and 10-hour fuels. These two fuel classes are important because they can greatly impact the rate of spread of a fire, as well as flame height. Many fire managers have viewed grazing in the same context as other single-event mechanical fuel treatments. These grazing treatments have been expensive to implement because they have a physiological cost to the animal, and require higher costs (such as portable fencing) to reach fuel objectives in one year. Perhaps a sustainable use of grazing would be annual grazing of large areas following mechanical treatment. This provides improved nutrition by presenting smaller regrowth that is higher in nutrition; this allows animal performance to improve while maintaining a specific fuel profile in the grazing area.

There are many issues that need to be considered when examining grazing for fuel reduction. Grazing has a more varied outcome than the mechanical fuel reduction treatments. Until the grazing treatment is perfected into a fully understood tool, the dominant management strategy will be to force utilization by limiting nutrition and/or preference. There is a lack of scientific data available to help managers understand and control the many variables that influence the outcome of fuel removal, and thus reaching defined objectives will be more difficult. The objectives of the treatment must be well-defined and well-described. It is important to understand animal preference as well as proper timing in order to meet the objectives. Some have considered fuel reduction by grazing simply as a method to increase animals on public lands; thus a well-thought-out plan is important. Many do not trust agencies to administer a private sector contractor to conduct the treatment correctly; thus a contract needs to be well-defined within the parameters of the operator's control. In the past, fire managers

Herbivory from Page 9

were willing only to look at the short-term impacts and not the long-term health and fire safety of the site or the effects of a long-term grazing program. Consumptive use, such as grazing, might not be compatible with recreation land use in some areas. A survey by Smith et al. indicated that 90% of residents near a fuel break stated use of sheep was an acceptable method for fuel reduction³². Only 10% felt that they were inconvenienced by the treatment. Some responses indicated misconceptions held by residents regarding grazing and grazing management methods; one such example was fear of possible electrocution of animals and humans by electric fences. These misconceptions by the public must be addressed when land managers make proposals for grazing.



Conclusions

Modification of wildfire fuels is an important issue in many regions of the world. At present, limited research knowledge exists to help guide managers in using grazing animals for fuel management. That knowledge is necessary to direct the timing and intensity of grazing to reach fuel management objectives similar to other methods. Also seasonal variation of nutrition content and secondary compounds of shrubs need to be further defined. Most of the grazing fuel modification study work has been conducted with goats, primarily because of their preference for targeted plant species. Grazing animals can modify wildfire fuels through consumption and trampling. Animals are most effective at treating smaller-sized live fuels and 1- and 10-hour fuels. These fuels influence an important part of fire behavior by providing the flammable material that creates a

³² Smith, E., J. Davidson, H. Glimp. 2000. Controlled Sheep grazing a fuel break in Nevada. sheep grazing to create fuelbreaks along the urban-wildland 24 R ng interface. Proceedings of the 53rd Annual Meeting of the Society of Range Management; Boise, ID. 6 p.

ladder of fuel in order for a fire to extend up from the ground into the brush and tree canopy. There is a lack of research knowledge upon which to draw in order to refine the grazing treatment to meet fuel management objectives. Many treatments in the past had only a single grazing year focus. This strategy can be effective in a grass ecosystem if timed right, but systems with abundant shrubs often require multiple years to create and maintain a fuel profile that is more desirable.

More research needs to be done to allow effective use of grazing as a fuel reduction tool. Further research also needs to be done on secondary compounds in brush plants, their seasonal variation, and methods to overcome them to achieve target utilization levels. Knowledge of the nutrient status of the plants throughout the year also will assist in indicating the time of optimum utilization of grazing in fire fuel reduction.

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