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Little Umpqua Gentian and the Big Biscuit Fire

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Joint Fire Science Program

Fire Science Brief

RESEARCH SUPPORTING SOUND DECISIONS

Many plants have evolved with fire as a natural disturbance in their habitats. Problems arise for rare plants, like Umpqua gentian, when fires, such as the 2002 Biscuit Fire, burn hotter than the low-intensity burns with which they are accustomed. Credit: Photo compliments of www.wildlandfire.com.

Little Umpqua Gentian and the Big Biscuit Fire

Summary

Umpqua gentian is an imperiled plant of the gaps and forested places, growing from the central western Cascade Mountains of Oregon, south to the Klamath Mountains in northwestern California. Since 1993, the Bureau of Land Management (BLM) and the Forest Service have worked together on a conservation strategy for this rare species, with the goal of maintaining viable, stable populations of genetic diversity. On the Medford District of the BLM, three sites had been monitored each year since 1995. When the 2002 Biscuit Fire burned the area, scientists had no information on how burning would affect this species. The Biscuit Fire burned in a patchy mosaic—hotter, with more intensity in some places, and lighter, with less intensity in others. The amount of fuel—dead plants—was directly related to how hot an area burned. Factors such as microclimates, local topography and moisture also played a role. Umpqua gentian plants were burned with low intensity fire, high intensity, or remained unburned. One year after the fire, plants in burned areas were either killed, dormant, or smaller in size than those in undisturbed areas. Plants that suffered moderate to high intensity burns died in higher numbers, or were forced into dormancy. Plants that were lightly burned were damaged, had their size reduced, but survived. The number of plants declined, and population loss was related to amount of area burned. Two to three years after the fire, plants rebounded, and regrew to nearly the size of unburned plants. Populations in burned areas also recovered to pre-burn numbers. Flowering, a periodic, every-other-year occurrence, had not yet recovered, even three years after the fire. The negative effects of fire on flowering plants may have long lasting consequences.

Key Findings

- Where fire burned with moderate to high intensity, it killed Umpqua gentian plants in greater numbers, and those that survived were forced to enter a dormant phase because their rhizomes, sitting in the litter layer above the soil, had been damaged.
- Where fire burned lightly, it damaged Umpqua gentian; the plants were smaller, but survived.
- In general, the number of plants in each plot declined, and the proportion of population loss related to the amount of habitat burned.
- While the plants rebounded two-three years after the fire, both in individual size and in numbers, reproduction, indicated by flowering, did not recover to pre-burn levels.

Introduction

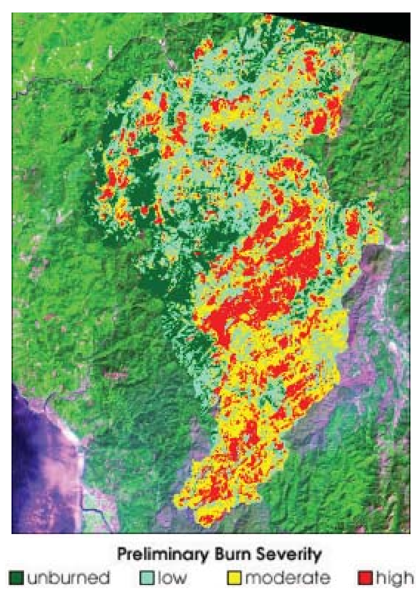
We would be nowhere without plants. Literally. In the deep history of our planet, plants helped create the oxygen environment that we can appreciate with every breath we take. We've respected plants and protected plants since our earliest known civilizations. People in Mesopotamia, the fertile lands watered by the Tigris and Euphrates rivers, cultivated crops and saved seed in seed banks thousands of years B.C. In older sites of the ancient world, archaeologists, digging in the dirt, have revealed granaries 10,000 years old—evidence of people preserving plant products long before they had a written language to describe and share their efforts. As a species, we recognize the welfare of certain plants is so inextricably linked with ours, that the heirs of the Mesopotamian people sent samples of their seed stores out of Iraq to safeguard them against destruction in the current war. It's easy to understand the importance of protecting plant species that offer us food, or medicines. Or maybe beauty. But what about the plants whose direct benefits to us aren't so obvious? Why have we listed species for protection, and spent vast amounts of time studying plants that seem inconsequential, unimportant, small?

The word "ecology" comes from the Greek oikos, meaning habitation. An ecosystem is the home of organisms living in it, and while most of us don't interact with the broad environment, but a very limited area that could be considered our habitat, the home condition of a single endangered species is our home, too. A single species interacts with others in its home in multiple, often still undiscovered, ways. Many populations of Umpqua gentian, a rare plant with habitat problems, burned in the 2002 Biscuit Fire. Thomas Kaye, Researcher with the Institute for Applied Ecology, studied the effects of this massive fire on Umpqua gentian, close to the plants, together in the dirt.

The botany of fire

Living in gaps and forested habitats, growing from Oregon's central western Cascade Mountains to northwestern California's Klamath Mountains, Umpqua gentian, known in Latin as *Frasera umpquaensis*, is a rare plant. Its scarcity has earned recognition by various agencies, and the Bureau of Land Management (BLM) and the Forest Service developed a conservation strategy to maintain viable populations of genetic diversity (necessary for any species—plant, animal, microbial—to be able to adapt to changing conditions). To that end, researchers have monitored three populations of Umpqua gentian on the Medford District of the BLM since 1995.

(Left) Photo of Umpqua gentian or *Frasera umpquaensis* inflorescence. Credit: Tom Kaye, Institute for Applied Ecology.



(Right) This image shows the preliminary burn severity classification of the roughly half-million-acres in southwest Oregon's Biscuit Fire that burned in July and August 2002. Credit: Image courtesy Keith Lannom, Remote Sensing Applications Center, USDA Forest Service.

From July 12 to 15, 2002, 12,000 known lightning strikes hit Oregon, flaring into 375 fires. Four fires—the Biscuit, Sour Biscuit, Florence, and West Florence fires merged into one—The Biscuit Fire. Fire personnel recognized the difficulties they were having in fighting the fire resulted from a number of factors, such as lands that varied abruptly from rainforest to savanna, from rugged terrain, to flats.

The Biscuit Fire, a convergence of multiple fires ignited by lightning, in a patchy mosaic of lightly burned to severely burned areas. Credit: Jacques Descloitres, MODIS Land Rapid Response Team, NASA Goddard Space Flight Center.

The Biscuit Fire burned in different areas in different ways, affected by local weather and topography. The fire team noted a clear relation between fire behavior, strong winds, and low humidity. When all was said and done, and researchers and managers tallied the effects of this massive fire, 499,965 acres had burned in southern Oregon and northern California, a boundary that stretched from 10 miles east of coastal Brookings, Oregon, south to the Klamath Mountains of northern California, east to the Illinois Valley, and north to nearly the Rogue River. A curious mosaic of burn patterns emerged—the fire burned 20 percent of the area lightly, killing less than 25 percent of all vegetation. The fire also burned very hot on 50 percent of the lands affected, killing more than 75 percent of the vegetation. How had Umpqua gentian fared? Prior to the Biscuit Fire, no information on the effects of burning on this plant existed, but Umpqua gentian lives in places where plant communities historically experienced frequent, low intensity fires—a botany that burns. Clearly, fire regimes have changed, with fewer fires often resulting in more intense fires where combustible leaves, twigs, branches, and wood have accumulated. Does controlling fire, allowing fire, or burning prescriptively help Umpqua gentian? How do managers develop fire plans for places where Umpqua gentian grows without the basic information they need? Kaye, along with his team, designed a study to open lines of understanding.

Contact

Several questions begged answers: what was the population trend of Umpqua gentian after the fire; how were this plant's population numbers affected by their burned habitat? Did plant sizes change after the fire? Were there differences in seedlings sprouting and surviving? Using three sites on the Medford District—Darlingtonia Bog, Trail 1166, and the Gravel Pit—Kaye and his team looked at these small plants growing close to the soil, counting them and noting the condition of the ground hugging rosettes of each plant. The rosette, an individual cluster of leaves that grows from a single rhizome, could be connected to other Umpqua gentian plants through a root system spreading through the soil. The researchers tallied the plants according to the stage of their growth: seedlings—small plants with up to four leaves; vegetative—no flowering stalk; reproductive—flowering stalk growing. The researchers considered plants (other than seedlings) as vegetative if the plant had no flowering stalk, and reproductive if the plant had at least one. Like mushrooms (the fruiting body of fungus) or aspen trees that happen to share a root system and thus make many seeming individuals one plant, distinguishing individual Umpqua gentian plants is tricky, especially when high numbers of plants are growing in the same area. The team considered rosettes as one plant if they joined one root system. With a light touch and limber fingers digging in the shallow dirt, the team also considered rosettes one plant if a rhizome connected them, or they were growing within 8 inches of each other.

Frasera umpquaensis populations in Oregon (black dots). Elk Meadows, Alpine trail/Elk Camp Shelter, Nevergo Creek, and Sourgrass Mountain are circled in red. Credit: Institute for Applied Ecology, 2008 Progress Report.

By noticing how many plants had burned, and the amount of charred duff, the researchers estimated the percentage of land that burned in each study plot. They compared plant survival and growth in burned areas with plants that were not damaged by fire. They also noted changes in forest canopy cover. With post-burn data collected, and with information about the plants' lives before the Biscuit Fire, Kaye and his team were ready to analyze how their plants fared.

Making connections

Before the Biscuit Fire ever introduced burning hazards to the Umpqua gentian's existence, populations of the monitored plants had experienced fluctuations, including a decline, but for the most part, the numbers of vegetative and reproductive plants grew from 1995 to 2002. Plants flowered on what appeared to be a periodic, 2-year cycle, and the number of seedlings, as would be expected, occurred in the year after the plants flowered. A puzzling aspect for researchers was the fact that they observed increases in seedling numbers after a low flowering year, and decreases in seedling numbers after a high flowering year. This, they feel, demonstrates that seedling numbers are not only determined by seed production. Umpqua gentian populations, they offer, appeared relatively stable before the Biscuit Fire.

After the Biscuit Fire burned Umpqua gentian habitat, populations at the three sites declined from 2002 to 2003. The decrease in non-seedling plants was directly related to the amount of area that burned in each plot. Umpqua gentian numbers then rebounded from 2003 to 2004 to levels similar to those seen before the Biscuit Fire. This, Kaye and the team feel, indicates a great recovery in the plant's numbers.

A plant in 2004, recovering from fire. Credit: Tom Kaye.

What isn't so obvious is recovery of the plant's seed-producing efforts. "The greatest and most persistent change in the populations at the three monitoring sites following the Biscuit Fire appeared to be in the number of reproductive plants," Kaye explains. The reproductive population, the team found, was much lower than in any flowering year before the fire. In 2005, a year which the team expected would be a good flowering year, based on the plant's periodic cycle, very few plants reproduced. This suggests, Kaye offers, "that the negative effects of fire on flowering may have long lasting effects in this species." The Biscuit Fire may have disrupted the every-other-year cycle of flowering that Umpqua gentian displayed. The change in the number of flowering plants showed a much weaker relationship to the area of the plot that burned, however.

Plants that did not burn were much larger than burned plants in the first or second year after the fire, but this difference later declined. "The mean number of rosettes per plant one year after the burn was 3.4 for burned plants and 7.1 for plants that were not touched by the fire. But three years after the fire, rosette number of burned plants caught up with unburned plants." It appeared that two or three years after the fire, burned plants could thrive as well as unburned ones, nearly recovering to the size of undamaged plants. The burned plants studied for comparison were growing in areas where fire had burned with light intensity, and thus effects of the fire were non-lethal, the team explains: "We believe that Frasera plants in areas of light burning recover to some extent after two to three years, but the recovery of plants in areas burned with moderate to high intensity was not determined. We believe, based on field observations, that individuals in moderate to high intensity burns had higher mortality due to damage or consumption of the rhizome in the litter layer above the mineral soil surface."

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While fire damaged plants that were burned, fire may have provided a slight boost to unburned plants. By releasing nutrients into the soil, fire may have contributed to the size increase in unburned plants in the two to three years after the Biscuit Fire.

Close-up view of the 2002 Biscuit Fire. Credit: Photo compliments of www.wildlandfire.com.

Banking on the future

The implicit meaning of the colloquialism "adding fuel to the fire" is that fire will burn hotter. And so it was—on plots with larger fuels loads, fire burned with higher intensity. The converse was also true—plots with less fuel burned with only low intensity. Keeping fuel loads low may help Umpqua gentian by shielding it from high intensity burning damage. By safeguarding the plants and preserving their lifecycles, we can hope they carry on their reproductive efforts—flowering, seeding, perpetuating their populations.

By safeguarding the plants and preserving their lifecycles, we can hope they carry on their reproductive efforts—flowering, seeding, perpetuating their populations.

Field sampling crew in 2003, the first year after fire, measuring plants in an unburned patch. Credit: Tom Kaye.

Management Implications

- Wildfire does not appear to threaten the plants, but the low flowering rate after the Biscuit Fire may mean the effects of burning on reproduction are long-lasting. Managers should consider maintaining lower fuel loads which may lessen burning harm on Umpqua gentian.

Further Information: Publications and Web Resources

Kaye, T.N., A. Brandt, and L. Mazzu. 2005. Effects of the Biscuit Fire on *Frasera umpquaensis* on the Medford District BLM. Institute for Applied Ecology, Corvallis, Oregon and USDI Bureau of Land Management, Medford District. Final report of Joint Fire Science Rapid Response Project JFSP-03-2-3-01.

Kaye, T.N. and L. Mazzu. 2006. Effects of the Biscuit Fire on *Frasera umpquaensis*, a rare plant of western forests. Abstract in Proceedings of the Third International Fire Ecology and Management Conference. Association for Fire Ecology, University of Washington Press, p. 190. Online at: http://emmps.wsu.edu/2006FirecongressProceedings/PDF/Program.pdf (30 January 2008).

Scientist Profile

Thomas N. Kaye is Executive Director of the Institute for Applied Ecology, a non-profit organization, and courtesy Assistant Professor at Oregon State University in the Department of Botany and Plant Pathology. His current area of research includes evaluation of habitat management practices (including burning), endangered species reintroduction, and exotic species invasion dynamics.

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