

The Use of Fire as a Tool for Controlling Invasive Plants

JFSP Project Number 06-S-01

Final Report

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Introduction

Joint Fire Science Program (JFSP) Project 06-S-01 provided funding to professionally format and publish a report on the use of fire to manage invasive plants. This report was published by the California Invasive Plant Council (Cal-IPC), a non-profit organization focused on education and outreach related to the management of nonnative plants in wildland areas.

This Cal-IPC publication summarizes information generated by a previous workshop and a journal article. The workshop focused on a small circle of research scientists and land managers with current knowledge related to using fire to manage invasive plants, and the journal article was targeted for the broader weed science community. In contrast, the Cal-IPC publication is focused on the general land management community. We chose not to develop a separate product specifically targeting the fire management community, because we knew that such a product was in preparation as a chapter for a volume on fire and invasives being developed as a General Technical Report (RMRS-GTR-42), and funded by JFSP Project 04-4-1-08 (Kapler Smith et al., Publication of literature synthesis entitled “Effects of Fire on Nonnative Invasive Plants” as 6th volume in the General Technical Report “Wildland Fire in Ecosystems” “Rainbow” series). In this final report for JFSP Project 06-S-01 we provide details of the workshop, journal article, and Cal-IPC publication, and summarize their primary conclusions and recommendations regarding the use of fire to manage invasive plants.

Workshop Summary

The workshop was organized by the three PIs listed above, representing the California Invasive Plant Council, UC Davis, and the USGS. It was held at the United States Geological Survey, Western Ecological Research Center, Las Vegas Field Station, on 29-30 March, 2004. The purpose of this workshop was to bring together research scientists and land managers with experience using fire to manage invasive plants, so that knowledge and experiences could be shared and state-of-the-art information could be gathered for use in developing technology transfer products on this topic. The agenda (Table 1) and attendees (Table 2) for this workshop are included below. This workshop was primarily supported by a grant from the Center for Invasive Plant Management, but also benefited from resources associated with JFSP Project 00-1-2-04 (Brooks et al, Fire and Invasive Annual Grasses in Western Ecosystems) administered by the USGS.

Table 1. Workshop agenda

Workshop Introduction

The Goals of the Workshop

Joe DiTomaso (University of California, Davis)

Knowledge Synthesis of the Role of Fire as a Management Tool to Contain Invasive Plants

Peter Rice (University of Montana)

Database Summarizing the Benefits and Risks of Using Prescribed Burns to Contain Invasive Plant Species

Diana Kimberling (Oregon State University)

Fire and Invasive Plants, a General Overview

Matt Brooks (US Geological Survey)

Topical Sessions

(each session was comprised of an introduction followed by breakout groups, group reporting, and open discussion)

Risks and Challenges of Prescribed Burning

Ralph Minnich (California Dept. Forestry & Fire Protection)

Control of Invasive Plants Using Prescribed Burning

Joe DiTomaso (University of California, Davis)

Using Prescribed Burning in IPM Strategies

Dave Boyd (California State Parks)

Impact of Prescribed Burning on Plant Communities

Matt Brooks (US Geological Survey)

Impacts of Prescribed Burning on Soil Characteristics and Other Organisms

Edith Allen (University of California, Riverside)

Effects of Fire on Invasive Plant Potential

Lisa Rew (Montana State University)

Workshop Summary

Information Gaps—Where Do We Need to Go From Here?

Matt Brooks (US Geological Survey) and Joe DiTomaso (University of California, Davis)

Table 2. Workshop attendees

Mike Pellant	Bureau of Land Management	mike_pellant@blm.gov
Ralph Minnich	California Department of Forestry and Fire Protection	ralph.minnich@fire.ca.gov
David Boyd	California Department of Parks and Recreation	dboyd@parks.ca.gov
Marla Hastings	California Department of Parks and Recreation	mhast@parks.ca.gov
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Eric Lane	Colorado Department of Agriculture	eric.lane@ag.state.co.us
Lisa Rew	Montana State University	lrew@montana.edu
Kurt McDaniel	New Mexico State University	kmcdanie@nmsu.edu
Steve Radosevich	Oregon State University	Steve.radosevich@oregonstate.edu
Diane Kimberling	Oregon State University	dnkimber@wvi.com
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Dana Backer	The Nature Conservancy	dbacker@tnc.org
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Guy Kyser	UC Davis	ghkyser@ucdavis.edu
Joe DiTomaso	UC Davis	jmditomaso@ucdavis.edu
Edith Allen	UC Riverside	eallen@ucrac1.ucr.edu
Tim Prather	University of Idaho	tprather@uidaho.edu
Peter Rice	University of Montana	biopmr@selway.umt.edu
Steve Enloe	University of Wyoming	sfenloe@uwyo.edu
Matt Brooks	US Geological Survey	matt_brooks@usgs.gov
James Grace	US Geological Survey	jim_grace@usgs.gov
Jim Young	USFS, Rocky Mountain Research Station	jayoung@scs.unr.edu
Kris Zouhar	USFS, Rocky Mountain Research Station	kzouhar@fs.fed.us

Journal Article Summary

DiTomaso, J.M., ML Brooks, EB Allen, R Minnich, PM Rice, and GB. Kyser. In press. Control of invasive weeds with prescribed burning. *Weed Technology*.

The journal article was the initial product generated following the workshop. The purpose of this article was to provide a scientific summary with extensive literature citations as a comprehensive treatment on the use of fire to manage invasive plants. The primary audience for this article was the weed science community, which has relatively little exposure to the science associated with wildland fire. The abstract from this publication which is currently in press is as follows:

Abstract

Prescribed burning has primarily been used as a tool for the control of invasive late-season annual broadleaf and grass species, particularly yellow starthistle, medusahead, barb goatgrass, and several bromes. However, timely burning of a few invasive biennial broadleaves (e.g., sweetclover and garlic mustard), perennial grasses (e.g., bluegrasses and smooth brome), and woody species (e.g., brooms and Chinese tallow tree) also has been successful. In many cases, the effectiveness of prescribed burning can be enhanced when incorporated into an integrated vegetation management program. Although there are some excellent examples of successful use of prescribed burning for the control of invasive species, a limited number of species have been evaluated. In addition, few studies have measured the impact of prescribed burning on the long-

term changes in plant communities, impacts to endangered plant species, effects on wildlife and insect populations, and alterations in soil biology, including nutrition, mycorrhizae, and hydrology. In this review, we evaluate the current state of knowledge on prescribed burning as a tool for invasive weed management.

Cal-IPC Publication Summary

DiTomaso, J.M and D.W. Johnson. (eds.) 2006. The Use of Fire as a Tool for Controlling Invasive Plants. Cal-IPC Publication 2006-01. Berkeley, California: California Invasive Plant Council. 56 pp.

Introduction (by Matt Brooks)

Fire is one of the oldest tools used by humans to manage vegetation. Its use can be traced back to pre-historic times when it was used to manipulate vegetation to improve opportunities for hunting wildlife and to increase production of plant species that were used for food, textiles, shelter, and other practical applications.

Modern use of fire in wildland areas increased during the latter part of the 1900s. “Prescribed fire” has been used to reduce hazardous fuel loads, restore historical disturbance regimes, improve forage and habitat for game and livestock species, and promote biodiversity. In some cases, fire has also been used to manage invasive plant species.

Much of what we currently know about using fire to manage vegetation—and to control invasive plant species in particular—has been derived from studies of cropland systems. However, there are many fundamental differences between cropland and wildland settings, and our ability to use effects observed in croplands to predict effects that may occur in wildlands is limited. Some of these fundamental differences include the timing of fires, fuel types, fire types, other treatments that come before or after burning, and the types of invasive plants that are targeted (Table 1).

For example, fire is normally used in croplands as a technique to remove dead plant material left after harvesting. This can facilitate soil work (e.g., disking, plowing), suppress overwintering pathogenic fungal spores, or reduce the seed banks of crop competitors. Cropland fuels are typically dried crop stubble, often supplemented by fossil fuel accelerants. In wildlands, fires may occur anytime during the invasive plant’s life cycle, provided fuel moisture and weather are sufficient to carry a fire. Cropland systems are also inherently less complex than wildland systems. With fewer parts and interactions among parts, it is easier to reliably predict the outcome of fires in a cropland setting. There is a significant need for information specific to the effects of prescribed fire on invasive plants in wildland ecosystems.

The goal of this report is to capture the current state of knowledge on the use of fire as a tool to manage invasive plants in wildlands. It summarizes current literature and observations on: the risks and challenges of conducting prescribed burns; the types of systems where burning, used alone or as part of an integrated approach, can be effective for the management of invasive plants; the impacts of prescribed burning on the broader plant community and the soil. By providing a more thorough source of information on this topic, we hope this review facilitates

improved decision making when considering the use of prescribed burning for the management of invasive plants.

Table 1. Comparison of variables related to the use of fire to control invasive plants in croplands and wildlands.

	Croplands	Wildlands
Timing of Fires	Pre- or post-harvest	Varies with target species and ecosystem
Fuel Types	Crop residual, with a simple fuel structure	Fine and coarse debris, with a complex fuel structure
Fire Types	Surface fire	Surface or crown fire
Other Integrated Treatments	Fire preceded by chemical or mechanical treatments, followed by a cover crop	Followed by chemical or mechanical treatments, or revegetation with competitive species
Type of Invasives Targeted	Typically herbaceous	Varies widely—grasses, herbs, shrubs and trees
Ecological Complexity	Low	High

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Introduction

Matthew L. Brooks (US Geological Survey)

Chapter 1. Risks and Challenges

Ralph Minnich (California Department of Forestry and Fire Protection)

- Motivation and Limitations
- Responsibility and Liability
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- Training and Qualifications
- Safety Equipment
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- Project Review Process
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- Data on Species Response to Fire
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Chapter 2. Risks and Challenges of Prescribed Burning

Joseph M. DiTomaso (UC Davis)

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Joseph M. DiTomaso (UC Davis)

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Be Used
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Matthew L. Brooks (US Geological Survey)

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Use of Fire to Manage Invasive Plants
Research Needs

Chapter 5. Effects of Fire on Chemical, Physical, and Biotic Properties of Soil

Edith B. Allen (UC Riverside)

Effects of Fire on Soil Chemical and Physical Properties

Fire temperature

Nitrogen and organic matter

Other nutrients

pH

Physical properties

Long term resilience and recovery of chemical and physical properties

Effects of Fire on Soil Microbiological Properties

Impacts of Exotic Species on Soils

Conclusions

Literature Cited

Results and Recommendations

This review provides a general overview of how fire can be used to manage invasive plant species. In general, annual species that produce seeds well after the fire season begins, that have flowering structures embedded within the fuelbed, and that have short-lived seedbanks are most amenable to control using fire. In this example, the current cohort can be killed by fire before their seeds have matured and/or dispersed to the ground, and follow-up treatments are only necessary for a few years until the seedbank is depleted. In contrast, perennial species with perennating tissue that is either below-ground or well above the fuelbed (and thus protected from heating), and that resprouts readily because they are adapted to fire or some other form of recurrent disturbance, are not generally amenable to control by fire. Invasive plants that alter the fuelbed structure making it less flammable may also be difficult to control with fire because they produce fuelbeds that are relatively inflammable.

In all cases, follow-up monitoring and plans for re-treatment are required. For maximum effectiveness, in most cases, fire should be integrated with other control methods. The ultimate net effects of any treatment plan on the entire plant community, higher trophic levels, and ecosystem properties, need to be considered before a treatment plan is implemented. Fuel loads created by invasive weeds will rarely be sufficient to affect soil chemical and physical properties adversely, insofar as fire-induced erosion can be avoided. It is always possible that the results of intensive land management may be worse than the effects of inaction. For this reason, it is important to understand the range of effects fire and other management treatments can have on ecosystems.

Technology Transfer Plan

A mailing of 15 bound copies of the Cal-IPC publication and the Weed Technology journal article will be delivered to the JFSP. Additional copies will be available to the JFSP upon request to Cal-IPC. For the general public, additional hard copies of the Cal-IPC publication will be available from Cal-IPC (www.cal-ipc.org) for \$5 to cover shipping and handling until the initial printing of 1,000 copies runs out. Electronic PDF files containing the Cal-IPC report will be

available indefinitely at no charge on websites maintained by Cal-IPC (www.cal-ipc.org). The JFSP may also choose to post PDFs of both the Cal-IPC publication and the Weed Technology journal article on their own website as well.

Funding Summary

JFSP Project 06-S-01: \$5,000

Other support

Center for Invasive Plant Management CIPM grant (Montana State University Grant No. GC304-03-Z1138)

JFSP Project 00-1-2-04 (biological tech support for workshop)

USGS, Cal-IPC, and UC Davis (contributed time of PIs)

Deliverables

- 15 bound copies, one PDF file, and information on how to obtain additional copies of the Cal-IPC document, were sent to the JFSP office on 8 May, 2006.
- 15 bound copies and one PDF file of the weed technology journal article will be sent to the JFSP office when the final published paper is available (during calendar 2006).