



Fire Science RESEARCH SUPPORTING SOUND DECISIONS *Digest*

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Preparing Tomorrow's Fire Professionals: Integration of Education, Training, and Experience Through Science-Management Partnerships

In this issue of Fire Science Digest, we explore the career and preparation challenges faced by forest and rangeland fire professionals, both new and seasoned. As the job description grows more complex, a well-rounded background in current and emerging areas of fire science and fire management becomes critical. Today's top professionals are approaching retirement, and tomorrow's fire professionals need to be adequately prepared to succeed them.



Current students at the Northern Arizona School of Forestry and members of the Student Association for Fire Ecology (SAFE) dig a line on their first official fire at the Kaibab National Forest in Arizona. Left to right: Derek Yonker, Paul Daw, and Ray Perrault.

Introduction

Today's professional fire career involves far more than putting out fires. Managing fire within landscapes for ecological and social benefits is a complicated, data-intensive, and socially demanding profession. To be adequately prepared, a fire professional needs education, training, and experience in fire science, fire ecology, and fire management, as well as operational skills in wildfire and prescribed fire. Challenges to achieving well-rounded preparation include a legacy of separate preparation pathways, demographics of the current workforce, scheduling and credentialing issues, and recent changes to agency educational requirements. With help from the Joint Fire Science Program (JFSP), agencies and universities are working together to fill the gaps in education, training, and experience—the three sides of the professional development triangle—so that future fire professionals will be adequately prepared for the challenging tasks they will face.

Fire's essential role

Managing fire on the nation's forests and rangelands has never been easy, but it used to be relatively simple. For most of the 20th century, the main objective in dealing with fire was to put it out—period. Fire was viewed as a menace to the well-laid plans of human managers.

As scientists have come to recognize fire's essential role in ecosystem dynamics, managing fire for ecological and social benefits has become more complicated.

There's been a lot of change in how we work with fire in ecosystems, says Neil Sugihara, a U.S. Forest Service (USFS) fire ecologist

in California. We're still in a transitional phase, still growing our understanding of how fire fits into the land management process. We're not there yet.

What does it mean to "manage" fire today? Suppression is still an essential part of the job, but several important tasks have been added. Here is a succinct definition: "Fire management [is] a designated combination of fire suppression and fire utilization,

based on increased understanding of fire behavior and fire ecology." Fire managers must know how to suppress fire when appropriate, but also how to use it deliberately to create desired conditions on the land.

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The above definition comes from a 2009 Journal of Forestry article¹ that surveys the pathways by which fire managers become qualified to do their jobs. Sugihara is a coauthor of the article, along with several others involved in fire education and professional training. In its funding of research and extended education, the JFSP is contributing to improve these pathways and open new ones.

Sculpting the landscape

What does today's wildland fire professional look like? The job description, says Sugihara, blends the disciplines of fire science (the understanding of fire as



Heather Heward, a student in fire ecology and management at the University of Idaho.

Gabriel Cortez

¹ Kobziar, L.N., M.E. Rocca, C.A. Dicus, C. Hoffman, N. Sugihara, A.E. Thode, J.M. Varner, and P. Morgan. 2009. Challenges to educating the next generation of wildland fire professionals in the United States. Journal of Forestry 107 (7): 339-345.

a physical process) and fire ecology (the understanding of what fire does to an ecological community, both immediately and over the long term). “What we have historically called ‘fire suppression,’” he explains, “is the application of fire science, meaning the physical properties of fire—fire as itself. Today, the task is to apply those physical properties of fire to the management of ecosystems—fire ecology.”

The essence of fire management is to use wildfire, prescribed fire, and mechanical treatment of vegetation to sculpt the structure and composition of a plant community with the goal of influencing the spread and severity of a future wildfire, enhancing wildlife habitat, and setting the landscape on a course toward some desired condition. The well-prepared fire professional knows how fire will behave in different plant communities in different regions at different times of the year and how burning will change those communities. He or she knows how smoke behaves in different weather conditions and different topographies

and how to adjust the footprint or timing of prescribed burns to minimize impacts on nearby communities. He or she also has great people skills—able to converse with neighbors and explain management actions, motivate people to fire-safe their homes, and inform community campaigns about wildfire preparedness.

And, of course, he or she knows how to put out a fire when necessary. When you stack it all up, it’s a tall order—made even taller by three developments that past forest managers didn’t have to face: a buildup of forest fuels, an expanding wildland-urban interface, and a warming climate. We want to have all the ecological benefits from fire,” says one of article’s coauthors, Chad Hoffman, an instructor in forest resources at the University of Idaho. But to get there, the fire professional today has to balance many more emerging issues than he or she did 20 or 30 years ago.”

This ever-expanding portfolio requires adequate preparation in three dimensions: education, training, and experience. These are three sides of a triangle,



Northern Arizona University forestry student Raymond Perrault serves on a Student Association for Fire Ecology (SAFE) volunteer burn crew. Here he’s working the Scott Fire in Arizona’s Kaibab National Forest.

explains coauthor Penelope Morgan, a University of Idaho forest resources professor. “Fire managers need education, which the universities do best. They need training in on-the-job skills, which the employers, typically the land management agencies, do best. And they need experience, which comes from working and learning on the job. The only way we’ll prepare fire professionals for the future is to work together to give them all three sides of the triangle.



Hoffman has felt the lack of two of the triangle’s sides—training and experience—in his own professional preparation. He began his fire science career working on a USFS fuels crew. “I had an associate’s degree in nuclear engineering,” he says, “and I latched onto fire because it made a lot of sense to me as a physical process. I was doing fuels inventory and simulation modeling, but I got very little actual fire experience.”

Encouraged by his boss, fire ecologist Linda Wadleigh, Hoffman went back to school, earning bachelor’s and master’s degrees in forestry at Northern Arizona University. He’s now finishing a doctorate in fire behavior modeling at the University of Idaho, exploring the ecological links between bark beetles and wildfire.

So I’m still working on the experience and training sides of the fire professional triangle,” he says. That’s pretty common for those of us who continue with an academic career. Here at the U of I, we’re fortunate that we get to take part in prescribed burns and even wildfire. I fit as many of those into my schedule as I can.

A divided legacy

There are several paths to becoming a fire science professional. The most common approaches are from either the operations side or the academic side. The operations side provides the strongest training and experience components. Fire management training is overseen by the National Wildfire Coordinating Group (NWCG) and is offered primarily by public land management agencies, nongovernmental organizations like The Nature Conservancy, and 2-year technical and community colleges. The NWCG has developed detailed job descriptions and performance measures

for everyone on the fire line, from incident commander to logistics specialist to public information officer. Training takes place at fire academies nationwide, both agency sponsored and privately administered.

Universities have traditionally provided the strongest education component. A good fire science college education covers the growing body of ecological, physical, and social science about fire behavior, fire effects, and the role of fire in ecosystems and society. Those who pursue this pathway may become land managers for public or tribal agencies, private consultants, and university or agency scientists.

There are programs designed to help career fire people supplement their education or training. Most are designed for employees who are well into their careers—notably, agency fire and fuels technicians who want to meet the educational requirements of the GS-0401 Fire Management Specialist positions.

For example, Technical Fire Management® (TFM) is an 18-month, seven-module program that provides 18 of the 24 upper-division academic credits required



Heather Heward

Cody Fox and Gabriel Cortez, students in fire ecology and management at the University of Idaho, participate in prescribed-fire training in Van Buren, Missouri, with The Nature Conservancy.

for the technical-to-professional upgrade. Offered by a private company, Washington Institute, at its Duvall, Washington, headquarters, TFM consists of 1- and 2-week modules in math, statistics, financial administration, fuels and fire behavior, fire effects, and fire and land management. Students complete a final project, prepare a report, and defend their work before a panel of professionals. Humboldt State University provides the credits along with curriculum oversight.

TFM began in 1981, before the GS-0401 path was created, to educate technicians in what was becoming an increasingly knowledge-intensive enterprise. "Fire management in the 1960s and '70s got very scientifically based," says Gordon Schmidt, TFM's cofounder. "A lot of new scientific and technical tools became available, but technicians had no background for understanding the science behind them.

When GS-0401 made it possible for a technical employee to join the professional ranks without a

college degree, TFM stood ready to offer the appropriate academic credits.

It was never our intention to turn all technicians into professionals, Schmidt says.

"People come to TFM to learn the material, and now, as a bonus, they get the credits. To date, more than 600 fire professionals have received training through TFM.

A similar program in the public sector is the National Advanced Fire and Resource Institute (NAFRI), operated by the USFS. NAFRI offers



Northern Arizona University forestry student Wiley Volz.



University of Idaho

Samantha Arneberg on the fire line. Arneberg graduated from the University of Idaho in 2009 with a double major in fire ecology and management and forest resources.

courses in area command, incident management, aerial firefighting, the National Fire Danger Rating System, fire effects, fire behavior modeling, fire in ecosystem management, and learning from unintended consequences.” NAFRI also operates the Wildland Fire Lessons Learned Center, which analyzes incidents of unintended consequences and near-misses, such as fatality fires and escaped prescribed fires. The center also keeps an extensive library of case studies, teaching videos, organizational learning materials, newsletters, and other resources accessible via the Web.

Reconnecting the triangle

More recently, colleges and universities have begun to offer undergraduate programs in wildland fire ecology and management. Aimed at students just starting out in a fire science or fire management career, these programs supplement classroom learning with varying degrees of training and experience.

The University of Idaho’s undergraduate degree in wildland fire ecology, begun in 2006, is so far the only academic major of its kind in the country. We have about 30 graduates, and they’re just getting into the workforce,” says Hoffman, who administers the program. We don’t know yet how they’re going to do, but we designed the program to provide strong education in ecology and management, and we’re working on providing more training and experience.

Six other universities offer degree-seeking options or concentrations in wildland fire: Cal Poly, Colorado State, Humboldt State, Northern Arizona University, Oklahoma State, and Oregon State. “We’re working on new certifications and focus areas,” says Andrea Thode, assistant professor of forestry at Northern Arizona University, “and we’re creating mentorships and internships, where people have opportunities to gain training and experience.

Like Hoffman, Thode came at her career through the education pathway and didn’t get as much training and experience as she would have liked. I grew up in Los Alamos, New Mexico,” she says, “and I watched fires take away pieces of the landscape year after year since I was 6.” She pursued a doctorate in fire ecology at the University of California at Davis, intending to go on to a fire management career. “I had a desire to



Nate Cordova graduated from Northern Arizona University in May 2010 and now works for the Lincoln National Forest.

be a manager who understood research,” she says, “but I kept hearing people say you can’t study fire if you haven’t fought fire.” So she took firefighter training at the National Interagency Prescribed Fire

Training Center in Florida, but her class schedule made it hard to participate in real fires.

This is a problem for most university students who want to gain experience and training while going to school. “For reasons that have nothing to do with our wildland fire system, many universities have gone to semesters,” says Gary Bishop,

fire management officer on the Kaibab National Forest in Arizona. “But Mother Nature is not on the semester system. So students have to make a decision: go back to school, or work on the fire crew till the end of the season. Crew bosses, he says, are reluctant to jeopardize crew cohesiveness and safety for the sake of one person who has to leave in August.

Thode chose an academic career, at least for the time being, when she took an opportunity to join the Northern Arizona University faculty. She teaches courses in wildland fire, prescribed fire, and fire suppression skills, seeking out her own training and

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experience opportunities to bring to the classroom. If I'm teaching these things to my students, it's important for me to get out there and hone the skills myself.

Online learning

Many of today's mid- and upper-level fire managers were hired at a time when most fire management jobs didn't require a college education. Many started on fire crews and rose through the agency's technical ranks. We don't bring many of our senior people in from outside, says Bishop. We tend to grow our own, because we're a unique niche market.

Now, most federal agencies require their fire professionals to have some college education to be eligible for advancement to senior positions.

That, says Bishop, has posed challenges to us as supervisors. How do we hire quality individuals and get them those degrees, and still maintain our required staffing?"

Getting more education in midcareer can be difficult for employees, their families, and their bosses. Many work units support employees who want to improve their professional credentials, but not all do—it's hard to adjust work schedules around the absence of a key person. Some professional development programs are expensive, and most require that the student come to where the classes are held.

In response to this challenge, several universities are offering fire science and fire management programs online. These include the University of Idaho, Virginia Tech, University of Montana, Penn State, University of Tennessee, Oregon State, North Carolina State, Mississippi State, Northern Arizona University, and Humboldt State.

The University of Idaho's eight Web-based, upper-division fire science and fire management courses were developed with major support from the JFSP. The project (JFSP 05-4-1-07) was initially conceived as an innovative way to disseminate JFSP-sponsored research. Principal investigator Penelope Morgan and her colleagues Alton Campbell and Alistair Smith from the University of Idaho, Leigh Lentile from the University of the South, and Andrew Hudak from the USFS created the courses by synthesizing findings of more than 17 JFSP-funded and other research projects. Through readings, discussions, and hands-on course work, participants learn to seek out appropriate

research and science-based tools and apply them to real-world fires.

The University of Idaho's online program features an extensive Web resource, as well as an additional Web-based tool for finding online fire-related courses at other universities. Morgan and her colleagues also assembled the research on remote sensing of fire and postfire effects; this effort led to a workshop to assess users' needs for remote sensing technology and a user's guide to existing remote sensing tools, which can be found at http://www.cnr.uidaho.edu/fire_rs_synthesis/.

The courses developed for the University of Idaho's online program—fuels management and planning, assessing fire effects, fuels inventory and mapping, remote sensing of fire and postfire effects, wildland fire ecology and management, rangeland resources, and GIS applications—were also designed

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Francisco Castro Rego, a Portuguese fire researcher who developed and taught a fire behavior course, instructs students in the Geospatial Research and Teaching Lab at the University of Idaho.

University of Idaho

to meet the GS-0401 standards. In addition, these courses have been pulled into the University of Idaho's regular degree and certificate programs, including the new fire ecology and management bachelor's degree.

Agencies are also working from their end to fill educational and training gaps. Senior managers like Linda Wadleigh are always looking for opportunities to enhance training, professional development, and continuing education for employees and colleagues.

I'm fortunate that my job calls for me to do a lot of training," says Wadleigh, a USFS fire ecologist in Flagstaff, Arizona. "We present classes that were developed by NWCG, and we take the opportunity to stretch the curriculum and get people exposed to bigger ideas.

Wadleigh also administers a program called Continuing Education in Field Management. "We get fire people and fuels people together with vegetation people, and we have them do a project together. The program is guided by two university professors, James Long from Utah State and Frederick (Skip) Smith from Colorado State. They're silviculturists with a good understanding of resource management and fire and fuels applications," says Wadleigh. That's an example of getting people to work together.

Toward an integrated approach

Sugihara, Morgan, Hoffman, and Thode are all members of the Association for Fire Ecology education committee. The committee is leading a conversation among fire managers and academics on how to better combine the three sides of the triangle, both in early career preparation and throughout a professional career.

In their 2009 Journal of Forestry article, these researchers and their coauthors identify some of the shortcomings of the current system: school schedules that don't fit with field work, scarcity of advancement opportunities for people who lack college education, poor coordination between technical and academic schooling, and separate credentialing systems, to name a few. And when you look at the demographic," says Morgan, "it's really important that we deal with these issues right now, because many current professionals are nearing retirement age." Adequately preparing the rising generation, Morgan and her colleagues say, will require a more integrated system, similar to those used

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USFWS



USFWS

Members from the U.S. Fish and Wildlife Service conduct wildland fire management training and safety training. Today's fire professionals benefit from a mixture of education, training, and experience.

now to prepare other professionals, such as lawyers, doctors, and business managers, in which students combine college classes with summer job experiences, training courses, and internships.

Under this model, universities and agencies would continue to do what each does best—universities focusing on college-level coursework and agencies focusing on training and skill building—but in a more collaborative fashion. Degree programs would include more training and experience opportunities for students. Course content would be harmonized as much as possible with fire training courses. Better coordination of coursework would reduce redundancy and increase access to both education and training for those who need them. One strategy to improve coordination, say the authors, might be to invite NWCG-accredited trainers to coteach university courses in fire science and fire ecology.

Making the data accessible

A key requirement for ongoing professional development is access to current information and tools. Over the past decade, the World Wide Web has opened many opportunities to JFSP-funded researchers who are making fire-related resources widely available to both practitioners and students.

Starting in 2002, with multiple partners, the JFSP helped fund the initiation of an ambitious project called Fire Research and Management Exchange System (FRAMES). The goal was to develop both infrastructure and content for a comprehensive database of fire-related information and tools and make it available on the Web. The project (JFSP 03-4-1-02) was headed by Morgan and Greg Gollberg from the University of Idaho, Lloyd Queen from the University of Montana, and Robert Keane, Wayne Cook, and Mark Twery from the USFS.

The FRAMES researchers collaborated with those on two other JFSP-funded projects. The first project (JFSP 03-4-2-06) is known as the FIREHouse project, with principal investigator David Peterson. This collaboration led to the first of a series of “portals” facilitating access

to information and tools specific to a geographic region—in this case, the Pacific Northwest. The second project (JFSP 04-4-1-3), with principal investigator Morgan, was to develop equivalent content for the Southern portal.

FRAMES researchers continue to coordinate their efforts with other providers of fire-related information, including the Tall Timbers Research Station, the Wildland Fire Lessons Learned Center, and the NWCG. They also keep in touch with participants in JFSP’s regional Knowledge Exchange Consortia, helping those professionals access information tailored for their regions.

More recently, the JFSP is funding the creation of a new planning environment called Interagency Fuels Treatment Decision Support System (IFT-DSS).² When it’s fully functional, the framework promises to organize fuels planning data, software, and modeling tools into a seamless Web-based user environment, with the goal of making fuels treatment decisions more efficient and more scientifically rigorous. IFT-DSS will likely be a focus of future educational curricula opportunities within the agencies and universities.

² Fire Science Digest issue #7, “A Powerful New Planning Environment: The Interagency Fuels Treatment Decision Support System,” covers IFT-DSS in detail.

In addition, universities and agencies would collaborate on improving opportunities for students to gain experience. Some ideas: designate special student positions on seasonal crews, develop off-season trainee and intern positions, and invite students to take part in prescribed burns and other field operations. Students might also be given several months of leave in the midst of their studies to work in fire management for a season or longer.

Finally, agencies would improve incentives for midcareer professionals to continue education and training. They would offer competitive leave or grant programs and facilitate employees’ access to residence-based or distance learning programs and short courses. “We at the USFS have worked closely with the universities to develop their programs,” says Sugihara, “and I think they’re pretty good. And the students are very good coming out of these programs. Now we need to adjust our organizational structure so that there is a well-defined career path for fire management and land management people.” TFM’s

Schmidt agrees: “The problem is that all this has been left to chance. There has to be a coordinated effort by the agencies to make substantive change.

Lifelong learning

Two other essential elements to a well-rounded, well-grounded professional preparation, says Hoffman, are skilled mentoring and an ethic of lifelong learning (please see sidebar, “Making the data accessible”). Hoffman had a 2-year degree in nuclear engineering when he went to work on an Arizona fire crew and happened to draw Wadleigh as a boss. She gave me one of those ‘This is what you will be doing for 20 years unless you get a bachelor’s degree’ speeches, says Hoffman. I wouldn’t be here at the University of Idaho finishing my Ph.D. if she hadn’t convinced me that fire was a fun and interesting topic.

Wadleigh says she’s one of many who mentor their employees in this way. “There are definitely fire professionals and research professionals who have made it part

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of their job to develop their employees, she says. “I find that very encouraging. No one should expect that when you get your job, you’re done learning.

As the current cohort of fire professionals retires, it will—experts hope—be succeeded by a generation with better preparation in all three sides of the triangle. We will grow through all

“No one should expect that when you get your job, you’re done learning.”

this, says Sugihara. It’s one phase of development of what has become a totally different perspective on land management. Our workforce is much more aware of the ecological values of fire, and that will continue. The progress we’ve made has been monumental, but the work ahead is monumental, too.

How the JFSP is helping

The JFSP is doing its part in preparing the next generation of fire professionals:

- ▶ JFSP funding supported the development of eight upper-division online courses at the University of Idaho aimed at midcareer professionals in search of college-level learning (JFSP 05-4-1-07).
- ▶ The JFSP has sponsored conferences with organizations, such as the Association for Fire Ecology and the International Association of Wildland Fire, devoted to improving professional preparation.
- ▶ The JFSP has funded graduate assistantships to enable students to get field experience and has supported hundreds of students in master’s and doctoral programs by funding all kinds of fire-related research projects.
- ▶ JFSP-supported research findings have been incorporated into courses at colleges and universities throughout the United States.

Recently Morgan and Tim Swedberg, the JFSP’s communication director, conducted an email survey of scientists who were working on JFSP-funded projects.

The pair wanted to know how many students these scientists had engaged in their research and where those students’ subsequent professional pathways were leading. Morgan and Swedberg found that nearly 600 students had been supported by JFSP funding to do their research, and that 116 of them had received master’s or doctoral degrees after completing their work. “This was a survey that detected only a sample of these students,” says Swedberg. “The actual number is probably closer to 2,400 students supported by JFSP money.” Many of these students subsequently went to work for federal or state agencies after they earned their degrees. Many others continue in university programs, conducting research and helping to teach the next generation of professionals.

Finally, a recently created JFSP grant program sets aside \$25,000 in support of student travel and \$75,000 to encourage innovation in research by graduate students. This is a modest investment with a large payoff, says Christopher Dicus, natural resources professor at Cal Poly. “It doesn’t take much money to get a poor starving student excited, and the benefits will be immeasurable. Students will gain contacts, new information, the chance to network with professionals and peers—they’ll get a taste of a world they otherwise couldn’t afford to be part of. The JFSP will get a lot of bang for its buck.”





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