

-Discussion Paper-

Fire Science at Colorado State University

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July 26, 2000 (updated January 4, 2001)

Introduction

A free-burning wildland fire evokes a range of human emotions, stirring our souls as few other natural phenomena. Fires remind us of the awesome power of nature as well as the intricacy of life processes (e.g., birth, death, and adaptations to stress). At the same time, fire can be one of the more prominent tools for manipulating forests and landscapes to achieve land management objectives. The study of wildland fire thus provides multiple learning opportunities about natural resources and human interactions with the environment. As with other forestry and NR studies, these learning experiences occur in the classroom, laboratory, in the field environment, or over the internet.

This report summarizes the status of forest fire science in the Department of Forest Sciences, Colorado State University. Wildland fires have been studied throughout the 20th century in the US, but a formalized program at Colorado State University was not institutionalized until the mid-1970s, with the creation of the undergraduate concentration in forest fire science within the forest management (now forestry) major. Since then, the program has expanded in its tripartite mission (teaching, research, and service), often in lock step with local, regional, and national interest in wildland fires. This report is timely as the College of Natural Resources embarks upon an effort to reinvent itself within the context of a revised vision. Further, with pending changes in program and personnel within the Department of Forest Sciences, an introspective look at the current status of wildland fire science at Colorado State will allow assessment of internal/external environments and future outlooks.

Apparently a formal vision statement or long-term direction has never been adopted for the forest fire science concentration. A statement of aspirations for the program and students is:

Strive to be known as the pre-eminent program in the nation for the study of wildland fires. Students who complete the undergraduate concentration in forest fire science will receive a superior education and be competitive for entry-level and higher positions. Advanced degree study programs will be known for their scientific rigor with excellent placement opportunities.

Goals and objectives:

- Expand enrollments from current level (~ 40 undergraduates students, 10-15 graduates) pending staff availability
- Hire a fire ecologist to teach the graduate fire ecology course (F 624)
- Expand undergraduate offerings in response to student interests and needs
- Develop and strengthen WESTFIRE
- Continue to strengthen outreach and service programs

The existing vacancy in forest fire ecology provides an opportunity to devise strategies for improving the quality of the fire science program. These opportunities include (but are not restricted to): upgraded services to client groups (students, alumni, employers, and sponsors);

curricular updates; improvements in the environment for scholarship in fire science; and additions to research capabilities within and outside the CNR.

Current Situation

The forest fire science concentration at Colorado State University is unique among natural resource programs in North America. Typically, most SAF-accredited schools do not have well developed programs in fire science and may offer at most one course per year in fire management (or forest protection). By contrast, some SAF schools in the western US tend to focus greater attention on wildland fire in terms of instruction, research, and service programs. Table 1 summarizes the offerings at a sampling of these western schools. Some western SAF schools may not offer any fire courses per se, although fire issues may be covered in related courses (e.g., forest ecology, silviculture, ecological restoration).

Table 1 Comparison among a sample of SAF schools with active programs in wildland fire (source: respective university web-pages and personal communication).

INSTITUTION	PROGRAM	FULL-TIME FACULTY IN FIRE SCIENCE	COURSE TITLES AND LEVEL, I.E., UNDERGRADUATE (UG) OR GRADUATE (G)	REMARKS
University of Washington	Forest Management	1	Forest Protection (UG); Studies in Forest Fire Control (G)	Steady decline in fire emphasis since 1990
University of California, Berkeley	Forestry	1+	Seminar (UG); Fire/Insects/ Disease (UG); Fire Sci/Mgt in Urban Interface (UG)	Faculty new hire in 00 may add courses
University of Idaho	Forest Resources	1+	Fire Mgt (UG); Prescribed Fire Lab (UG); Fire Ecology (G)	Faculty on/off medical leave
University of Montana	Forestry	1+	Fire Mgt (UG); Fuel Mgt (UG); Adv. Fire Weather (UG); Fire Use (G)	Fire Lab provides unique resource
Northern Arizona University	Forestry	1	Ecological Restoration Applications (UG)?	No fire courses per se; active research program
Colorado State University	Forestry, Fire Science Concentration	1+	Fire Measurements (UG); Fire Mgt (UG); Fire Behavior (UG); Seminar (G); Fire Meteorology and Behavior (G); Fire Ecology (G); Technical Fire Mgt (6 courses thru DOE)	Active fire research program; Fire ecology course has not been offered for 2 years

Table 1 shows that the fire science instructional program at Colorado State is unique in title, typical in terms of faculty resources, yet evidently broader than other sampled schools in terms of course offerings. Nationally, we are recognized as one of only a handful of universities where students can specialize in studies related to fire. Arguably, we have the largest fire program in the country, if not the world. We are the only institution formally participating in mid-career education of practicing fire specialists (i.e., through the Technical Fire Management program).

Students

During S 2000, approximately 40 undergraduate students were enrolled in the forestry major, fire science concentration at Colorado State University (or about 1/3 of forestry enrollment). Students who graduate with the fire concentration typically seek employment with government agencies (federal, state, local) with fire management responsibilities. Small proportions of graduates seek employment in the private sector (e.g., Nature Conservancy or small private firms). Undergraduate students usually work at least one summer in a fire-related position, although some students are drawn to academe after several years or seasons of fire experience. Employment prospects are generally enhanced by field experiences; extra years of fire-fighting and/or fire research experience seem to provide a competitive edge for students seeking fire-related employment.

During Spring 2001, 7 graduate students will be working toward advanced degrees on campus under the direction of Dr. Philip N. Omi. This does not include the students (~ 6) with graduate projects working on fire topics in other disciplines (e.g., forest ecology, CEMML), or other departments (e.g., Earth Resources). Additionally 5-8 students are completing theses off-campus.

Over the years, undergraduate and graduate students have added to the prominence of fire studies at CSU by attaining influential positions after leaving the university. Most of these “success stories” have resulted from graduate student alumni (see http://www.cnr.colostate.edu/FS/westfire/grad_sts.html), although undergraduates have also done well on the job.

Faculty and Staff

For the past few decades the department has benefited from the presence of multiple faculty and staff (Research Associates, GRAs) with interests in fire science, including subject experts in fire management, fire ecology, fire economics, silviculture, spatial analysis, soil chemistry, policy, and watershed impacts, among others. The pending vacancy in fire ecology creates a void in a subject area that is crucial to serving our student needs as well as assisting with public/private land stewardship efforts.

Future agency priorities and current workforce demographics suggest that fire ecology/fuels management will be growth areas for future employment for our students as well as providing funding for extramural research. Opportunities in both research and management should expand with the nation’s attention to fire management issues during 2000, along with regional interest in the Four Corners and Cheeseman Reservoir projects. In fact, recent episodes such as the Cerro Grande fire in NM, or the Bobcat, Hi Meadow, and Bircher fires in CO, point out the increased need for management expertise in the areas of fire ecology, fire effects, fuels treatment (including prescribed fire) in urban interface areas, and fire restoration. Thus filling the pending fire ecology faculty void is vital to the retention of a leadership position among the nation’s academic (teaching, research, and service) programs in fire science.

Facilities

Faculty and grad student offices are adequate. The Fire Science lab and WESTFIRE Management and Economics Lab need upgrading. The Fire Science lab could be refurbished if WESTFIRE is funded by Congress or as part of a start-up package for a new faculty hire in fire

ecology. Improvements to the WESTFIRE Management and Economics Lab will be forthcoming pending the outcome of the proposal before Congress and other extramural funding sources.

Instructional Offerings

According to the CSU General Catalog, graduates (of forest fire science concentration) perform fire management activities in the nation's public and private forests. The undergraduate degree also serves as a foundation for graduate studies. The current fire science concentration (Appendix) provides adequate preparation for our undergraduate students, but improvements are possible that could affect both majors and non-majors.

Over the years, the study of fire has broadened so that no single curriculum can serve all needs for students in the major. At the same time, opportunities exist for serving needs and interests of students outside the major. This is because the interest in fire has expanded considerably over the years. What started primarily as a narrow focus on fire-suppression (by agencies and university curricula) has expanded to reach other natural resource disciplines in the CNR. Pedagogical opportunities in fire span a full spectrum of biological, ecological, social, political, and management issues.

The fire program at Colorado State comprises one of the most comprehensive instructional programs in the US (Table 1). Current courses include F 224 Wildland Fire Measurements (1 cr), F 424 Forest Fire Management (3 cr), F 425 Forest Fire Behavior (2 cr), F 593 Fire Seminar (1 cr), F 524 Fire Meteorology and Behavior (3 cr), and F 624 Fire Ecology (3 cr). In addition, Technical Fire Management courses offered in conjunction with Washington Institute, Inc. (through the Division of Educational Outreach) bring national recognition to the fire science program and university. These courses include: F 489A Numerical Analysis for Fire Managers (3 cr); F 489B Fuels and Fuel Management (3 cr); F 489C Economics and Management for Fire Specialists (3 cr); F 489D Fire Effects (3 cr); F 489E Fire and Land Management (3 cr); and F 489F Technical Fire Management Project (3 cr).

The F 624 Fire Ecology course is vital to the needs of fire science graduate students and other disciplines. This course (last offered in S 97) will be offered in 2001 with the assistance of guest instructors (Paul Gleason and Dr. Carol Martin).

Other improvements to the existing program include possible changes in course sequencing (to address concerns expressed in the SAF visit) and possible addition of several undergraduate courses. Possible additions that would better-prepare our students include an undergraduate survey course in fire ecology, an undergraduate fuels management course, an undergraduate fire economics/policy course, and possibly, a graduate course on human dimensions in fire management.

An undergraduate survey course in fire ecology would be a vital addition to our curriculum and likely attract substantial credit hour production. The fuels management and economics/policy courses would address issues of topical importance that cannot be treated adequately in the current F 424 Fire Management course. The graduate course on human dimensions could be offered in conjunction with NRRT and an adjunct faculty member who is relocating to Colorado from Cal State Chico. Additional staffing would be required to offer extra courses, with the possible exceptions of the fire economics/policy and fuels management courses.

Research

Colorado State University is a recognized leader in forest fire research, with high-profile research projects in a variety of topical areas, including fire/fuels management, and fire economics. Former recognition in the area of fire ecology/fire effects has fallen off in recent years but could be resurrected with a faculty hire in this subject area. The primary source for extramural funds is the federal government; primary competition for extramural funds usually comes USFS research stations.

The Western Forest Fire Research Center (WESTFIRE) provides an umbrella organization for fire research at the university. Currently at least \$1.5-2.0 million in fire research funds are generated annually from extramural sources. The interagency Joint Fire Sciences Program has provided a primary source of funding in recent years, i.e., since 1996. The university has identified WESTFIRE as a legislative priority for the year 2000-1, with a proposed funding request of \$4.5 million over three years. This request is separate from an EBC funding request to the state legislature for increased fire management funding in Colorado's urban interface areas.

WESTFIRE was spawned in the aftermath of the Yellowstone fires of 1988. Since that time, funding for research projects has grown each year along with working relationships with faculty in other departments (e.g., Earth Resources, NREL, Agriculture and Natural Resource Economics). Currently two full-time research associate positions (one vacant) and two part-time GRA positions are funded on WESTFIRE projects. Current areas of strength include fuels management, fuel treatment effects on wildfire severity, fire economics, and urban interface management. Possible areas of future strength include fire restoration in landscapes and fire effects on invasive plant species.

Opportunities for WESTFIRE growth seem more promising with each passing year, especially with the heightened attention to fire issues in Colorado and throughout the western US. For the near future, Dr. Omi will continue to serve as Director for WESTFIRE as time allows. Continued WESTFIRE expansion will likely require release from his instructional responsibilities in the near-term. Over the longer-term (i.e., 3-5 years) a full-time director should be hired if WESTFIRE continues to grow.

Service

Aside from students, primary customers include government agencies, media, environmental interest groups, and private entities. Regular consultations and working relations are maintained with federal fire managers (USDI-NPS, BLM, FWS, and BIA; USDA Forest Service), state agencies (CSFS), and news media (local, state, and national outlets). Numerous requests for information have been fielded during SS 00 from media, environmental and private interest groups throughout the US.

In addition, the university is recognized nationwide for its efforts to improve fire management capabilities and workforce diversity in the federal fire management workforce. Involvement (as co-sponsor and crediting institution) for the Technical Fire Management program for the past 15 years has provided national recognition to the university as a leader in upgrading the skill levels of mid-career fire specialists. Participation (academic advisement) of students in the Student Career Enhancement Program (SCEP) in fire management has resulted in placement of minority and female specialists in influential positions across the country (see Appendix).

The university is also recognized for its sponsorship of fire-related workshops and conferences. In 1999, WESTFIRE co-sponsored the first symposium on Fire Economics, Policy, and Planning (San Diego) as well as a workshop on fire and resource management for two regions of the National Park Service (Albuquerque). In 2000, WESTFIRE co-sponsored the Fire 2000 First Congress on Wildland Fire (San Diego).

Additional scholarly contributions include service on editorial boards for leading journals (Forest Science and International Journal of Wildland Fire). Few, if any, comparable academic institutions have been as active in serving the wildland fire community.

Future Perspectives

Curriculum

In the short-term, a strategy is needed to assure that F 624 Fire Ecology is offered in S 01. The department should investigate the possibility of hiring an instructor from either inside (e.g., NREL or WESTFIRE) or outside the university to assume this responsibility. Over the longer-term, this course should become one of teaching responsibilities of a full-time faculty member in fire ecology.

Other changes suggested below would provide marginal improvements to the current fire science concentration. Other changes to the current curriculum may result from yet-to-be-implemented changes in the senior year of the forestry major, as well as suggestions from the SAF accreditation review. Also, changes should be consistent with pending college and department planning exercises and subject to standard curricular review processes.

The highest priority for new courses is an undergraduate survey course in fire ecology/fire effects (possibly at the 300-level) that could service all the departments in the CNR. In addition, an undergraduate course in fire economics/policy or fuels management would provide additional background required in integrated land management courses at the senior level. Either of these courses would permit the current F 424 Forest Fire Management course to go into greater depth about other subjects of relevance to fire professionals.

A survey course in fire ecology/fire effects (F 324?) could be taught in the sophomore or junior year and offered as a requirement for students in the fire science concentration and as a service course for all CNR departments. This course could be accommodated in the current curriculum by dropping F 331 (Wood Anatomy and Properties). The undergraduate course in either fire economics/policy or fuels management (F 3xx) could replace F 330 (Timber Harvesting and the Environment) in the junior year. Both F 330 and F 331 have been subject to waiver inquiries by fire science students in the past and may not serve the needs of future fire science students.

Another minor change to be considered is a switch in the way that F 425 is offered. Currently F 425 is alternated with F 524 (Fire Meteorology and Behavior) every other year (during Spring semester) during the junior or senior year. Switching F 425 to an annual offering and dropping it to the junior year could alleviate sequencing problems identified in the SAF visit.

Additional options for curricular change

The above curriculum changes could improve student preparation and satisfaction in the current forestry major, forest fire science concentration. However, additional alternatives for change

might also be considered at this time, pending thorough evaluation by department faculty and consistency with pending changes in CNR vision. Other alternatives include:

1. Develop a separate Wildland Fire Science major at the college-level in conformance with SAF accreditation standards.
2. Develop a separate Wildland Fire Science major at the college-level without SAF accreditation and without the Pingree Park requirement

Both of these alternatives would capitalize on interdisciplinarity of CNR and allow students to pursue a minor in fire science (a common request). The second alternative would provide maximum flexibility in curriculum design and, most importantly, leave summers free for students to pursue fire jobs. Potential down-sides include the decoupling from the forestry major (and SAF accreditation) and consequent reduction in the department commitment to the summer Pingree Park program (Alternative 2). Other alternatives may be desirable and could be pursued, depending on faculty input and outcome of CNR/department planning exercises.

Faculty and Staff

In the short-term, additional part-time instructional staff should be hired with department funds to assist in teaching F 624. Over the longer term, a permanent hire in fire ecology is needed. This person should have general expertise in fire ecology but more specifically in the following subject areas:

- Role of fire in regulating patterns and processes at stand, community, and landscape scales
- Abiotic and biotic fire effects (both short- and long-term)
- Linkages between fire intensity/severity and effects
- Ecological basis for fuel treatments

In addition, this person should have a strong commitment to the tripartite mission of the university, with special appreciation for the needs and opportunities for assisting public land management and stewardship efforts.

Over the longer-term, several options exist for filling the current void in fire ecology expertise.

1. Make interim hires to teach fire ecology course only
2. Hire landscape or disturbance ecologist with ancillary interests in fire ecology
3. Hire full-time fire ecologist

Interim hires (option 1) would be the least desirable option in terms of the vision stated earlier. A landscape or disturbance ecologist with part-time attention to fire (option 2) would be an improvement over temporary instructors, but would perhaps be less able to respond to future growth areas in the fire ecology and fuel treatment subject areas. Of these, the full-time fire ecologist (option 3) appears to make the most sense in terms of current and future opportunities and ability to serve the needs of forestry students.

The possible rank of the new-hire in fire ecology deserves careful consideration, including image, recruiting, retention, and cost tradeoffs between junior and senior faculty positions. Hiring a senior-level faculty member (i.e., at the full Professor rank) could pose several advantages including the ability to attract a well-known candidate capable of making immediate contributions to the overall vision for the fire science program. Further, a senior level faculty member would be in a better position to capitalize on funding opportunities such as the recently-enacted National Fire Plan and could improve Colorado State's competitive advantages relative to peer institutions.

By contrast, a junior faculty hire (i.e., at the Assistant Professor level) would require more time to develop as a teacher and researcher, yet conceivably could contribute to the vision by program-development over a longer time-frame. From a recruiting standpoint, advertisement for a senior level position would generate a smaller but conceivably more-talented pool; a junior position would likely encourage a broader pool but with less depth. Retention of a senior faculty member may actually prove easier given the pending boom in full-time research positions (primarily USDA Forest Service research stations); on the other hand, a senior faculty member will have fewer years available before the onset of retirement decisions. Salary and benefit costs will be higher for a proven candidate at the rank of full Professor.

If fire science courses are added as described above and/or WESTFIRE continues to expand, then additional instructors may be needed. In the near-term, additional instructors may be hired using funds released from WESTFIRE. Departmental funds will be required for longer-term commitments.

Research and Scholarly Environment

WESTFIRE has brought national recognition to the university and fostered interdisciplinary relations within and outside CNR. Additional opportunities include greater involvement by and with the Department of Atmospheric Sciences, CEMML, and the Graduate Degree Program in Ecology.

The wildfires of summer 2000 will rejuvenate lobbying efforts on behalf of WESTFIRE in Washington DC. Although the outcome of WESTFIRE's funding request depends on the vagaries of national political processes, the mere existence of the Center has provided a focal point for generating funds from extramural sources. These funds will continue to support staff and graduate students. If Congress funds WESTFIRE, a full-time director will be needed to oversee day-to-day operations. Also, a full time research associate would assist in coordinating faculty-student teams working on proposed deliverables. In addition, funding from Congress would be used to create a visiting scholars program in fire science.

Even without funding from Congress, WESTFIRE projects will continue to grow on an opportunistic basis. In any event, a full-time director could devote more time to building the pre-eminence of the program. In the absence of such arrangements, faculty release time from instruction (funded from ongoing research projects) will be needed to manage WESTFIRE's continued growth and expansion.

Service

Although service efforts are often considered secondary in importance, the foundation for the fire science program is built on existing networks with fire practitioners in the field. Future efforts could include expansion in outreach efforts (additional major conferences/workshops on and off campus), web-based instruction (including off-campus degree programs), and improved relations with CSFS to improve fire management services to the people of Colorado. The extent to which these services are developed should be based on planning and workload principles.

Conclusions

The fires of 2000 will be remembered for many reasons, including their ecological and social significance. Nationally, nearly 7 million acres burned by late October, or twice the annual

average during the past decade. Ecologically, the fires demonstrated the futility of fire exclusionary policies of the 20th century, which unintentionally have contributed to unprecedented fuel loadings and wildfire severities. These impacts are particularly apparent in ecosystems characterized historically by short fire return intervals, i.e., ponderosa pine (*Pinus ponderosa* Laws.). Socially, the fires galvanized the publics who live and recreate in the forest, and the challenged the agencies to higher standards of initiative and accountability. The politically-charged aftermath of homes and resources destroyed spurred a Presidential initiative to expend \$1.8 billion toward mitigation and prevention for the future. This initiative has enormous potential impacts for academic programs in forest fire science.

The forest fire science program at Colorado State University has matured over the years and enjoys considerable prestige, yet faces critical changes and opportunities in the next several years. The department and college response to the upcoming changes will be pivotal in determining the future profile of fire science at the university.

The forest fire science program at Colorado State enjoys a high level of respect nationally and internationally in terms of our tripartite mission. In this document I have attempted to build a case for continuous improvement in fire science teaching, research, and service programs. A faculty replacement in the area of fire ecology and curricular enhancements are important parts to improving the fire science program, as well as continued development of the WESTFIRE center. Improvements in relations with Colorado State Forest Service, NREL, CEMML, and other external clients should also be fostered.

My hope is that additional ideas for future improvement will surface as this document is circulated internally and externally, including a list of action items and willing participants who can assist in these efforts. Although specific action items remain to be identified, a steering committee (faculty, students, and external clients) could prove helpful for facilitating future changes.

Attachment

Historical Perspective

Jack S. Barrows, former director of the US Forest Service's Fire and Atmospheric Science program, was instrumental in instituting the forest fire science concentration at Colorado State University. Jack retired to his alma mater (CSU class of 1937) in the early 1970s after completing his distinguished career, which included a stint with the National Academy of Sciences. Mr. Barrows recognized that a void existed in university fire science education across the US, and was instrumental in founding the fire science concentration within the Department of Forest and Wood Sciences at CSU. Mr. Barrows' specialty area was in fire management. In 1975, Dr. David Sandberg joined the faculty as a specialist in fire behavior, teaching F 425 and F 524. Dr. Sandberg left CSU in 1976 to become a project leader for the PNW Station in Corvallis. Dr. Philip Omi replaced Dr. Sandberg in 1977 and assumed responsibility for the fire management course and fire seminar after Mr. Barrows' retired from the university in 1978. Dr. Rick Laven was hired in 1978 and assumed responsibility for the graduate fire ecology course formerly taught by Dr. Ed Mogren.

The Colorado State Forest Service has been a partner with the Department of Forest Sciences in fire science instruction, including a 2 credit course in fire suppression during the 1970s and assistance with the F424 Fire Management course in 1999. The relationship with CSFS is an important link with the fire management community that should be strengthened in the future.

APPENDICES

- 1. Curriculum for Forestry Major, Fire Science Concentration**
- 2. History of Fire Science SCEP students (Student Career Enhancement Program)**