

PREScribed FIRE: THE FUNDAMENTAL SOLUTION

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ABSTRACT

The theory and practice that embodies "learning organizations" can be applied to developing and implementing effective natural resource policy and management. A learning organization is a group of people who are continually enhancing their capacity to create the results they want. At the heart of learning organizations is systems thinking. This paper applies the language of systems thinking to our contemporary fire story. The paradigm shift from fire suppression to prescription is a classic systems archetype known as "shifting the burden." The causal loop diagram that makes up this archetype has two balancing loops and one reinforcing loop. The problem/symptom is damage from wildfire; the symptomatic solution is fire suppression; the delayed side-effect is fuel build-up and loss of biological diversity; and the fundamental solution is the application of prescribed fire. The structure of this system, and the corresponding mental models are explored.

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INTRODUCTION

How does transformation and renewal happen in our natural environment? One process is fire. At the first Tall Timbers Fire Ecology Conference, Ed Komarek told us, "In nature, fire is a great regenerative force, one might even say rejuvenative force..." (Komarek 1962:105). How do people and their social organizations transform and renew themselves? One process is learning. "Through learning we re-create ourselves" (Senge 1990a:14). The purpose of this paper is to facilitate the shifting paradigm from suppression to prescription by providing a cross-fertilization of these two renewal processes: fire and learning. Averill et al. (1994) and Hurst (1995) further explore these renewal processes. My specific objectives are

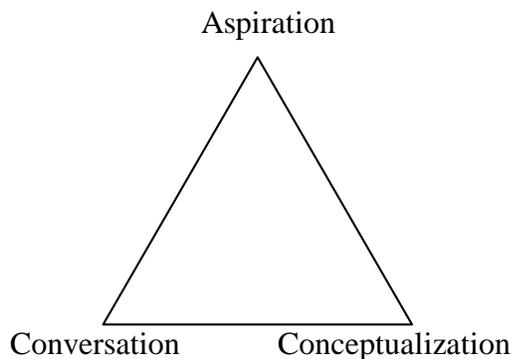
to 1) introduce the concepts of organizational learning to the fire management community, 2) tell our contemporary fire story in the language of systems thinking, 3) explore the classic systems archetype embedded in the story, and 4) suggest possible next steps.

During the last 25 years, the concept of organizational learning has become commonplace (Argyris and Schon 1996). Learning is not simply taking in information or passively acquiring knowledge. Think of something significant in your life that you learned, such as learning how to apply prescribed fire. You developed the ability to do something you had not done before by producing results. Without action or accomplishment, there is no learning. Argyris and Schon (1996) describe the difference between "organizational learning" and

"learning organizations." When there is a surprising mismatch between expected and actual results, organizational learning can take place if there is inquiry that leads to an improvement in how organizations produce results ("theory-in-use") (Argyris and Schon 1996). One definition of a learning organization is: a group of people who are continually enhancing their capacity to create the results they want (Senge 1990a, 1990b). This paper looks at the systems dynamics aspect of learning organizations.

For a fire to ignite and sustain itself as a chemical process, there are three requirements -- the familiar fire triangle of oxygen, fuel, and heat source. Similarly, there are three requirements for learning to ignite and sustain itself in an organization -- a learning triangle (Figure 1) made up of aspiration, conversation, and conceptualization (Senge et al. 1994). Remove any one element and the fire goes out (literally and figuratively).

Figure 1. The Learning Triangle.



The learning that leads to high performance organizations results from people's aspirations. The opposite of aspiration, desperation or apathy, leads to mediocrity. High performance can not be achieved through desperate measures.

Aspiration, the capacity of individuals and organizations to orient themselves toward what they value, results in commitment rather than compliance. What we aspire to achieve is often called a vision or a desired future condition. To accomplish extraordinary deeds, people work with the creative tension (Fritz 1984, 1991) that comes from simultaneously holding a clear vision of the desired future and an honest appraisal of current reality. Saveland (1995) provides more information on the application of this element of the learning triangle to fire. The next element of the learning triangle, conversation, concerns the theory and practice of "dialogue" (Isaacs 1993a, 1993b, Schein 1994, Brown and Isaacs 1997). Conversation is also proving to be important to high reliability organizations: "the point is an important one: evidence is growing that nonstop talk is a crucial source of coordination in complex systems that are susceptible to disasters" (Weick 1996:148). The last element, conceptualization or systems thinking, will be the focus of this paper.

SYSTEMS THINKING

Thinking about systems provides high leverage for problem solving and helps us communicate our mental models of how we see the world. We live in a world of events. When something happens, we react to it. With the passage of time, we may begin to see patterns emerge. At this level of understanding we can begin to anticipate problems and accommodate them. We are still responding to events, but in a more proactive manner. If we look deeper for the source of the patterns, we may begin to discern the systemic structure, a concept that is similar to what Argyris (1991) calls "double-loop" learning. Taking action to change the structure alters the source of a problem rather

than its symptoms. Changing the structure provides the greatest leverage for solving problems. While identifying and altering the underlying system affords greater leverage in problem solving, the real power of systems thinking comes from the ability to display and communicate our mental models of how we think the world operates. Thus, systems thinking can be thought of as a language for communicating about complexity and the myriad of interdependent relationships therein. The following steps can be used to think about the system: tell the story of events, draw graphs of trends and patterns, create a focusing question, diagram the structure, look deeper, and plan an intervention (Innovation Associates 1995).

STORIES

Our culture is a function of the language we use and the stories we tell. As Berry (1988:123) said, "It's all a question of story." In a novel that illuminates many of the facets of a learning culture, Quinn (1992) points out that the carrier of culture is the story we tell ourselves over and over again. Stories often contain a set of deep beliefs and assumptions that develop over time. The fire management community is beginning to tell an increasingly familiar story. The story is even being told in the popular press and in major policy documents:

"Human activities also influence ecosystem change. American Indian Tribes actively used fire in prehistoric and historic times to alter vegetation patterns. In short, people and ecosystems evolved with the presence of fire. This human influence shifted after European settlement in North America, when it was believed that fire, unlike other natural

disturbance phenomena, could and should be controlled. For many years fire was aggressively excluded to protect both public and private investments and to prevent what was considered the destruction of forests, savannahs, shrublands, and grasslands, While the destructive, potentially deadly side of fire was obvious and immediate, changes and risks resulting from these fire exclusion efforts were difficult to recognize and mounted slowly and inconspicuously over many decades.

There is growing recognition that past land-use practices, combined with the effects of fire exclusion, can result in heavy accumulations of dead vegetation, altered fuel arrangement, and changes in vegetative structure and composition. When dead fallen material (including tree boles, tree and shrub branches, leaves, and decaying organic matter) accumulates on the ground, it increases fuel quantity and creates a continuous arrangement of fuel. When this occurs, surface fires may ignite more quickly, burn with greater intensity, and spread more rapidly and extensively than in the past. On the other hand, uses such as grazing can sometimes reduce fine fuels, precluding periodic surface fires that would typically burn in these areas. Without fire, encroachment of woody species may occur in some savannah and grassland ecosystems...." (USDI & USDA 1995:7)

In short, the story tells us that when faced with the fact that fires cause damage, we have suppressed fire. Overtime, excluding fire from ecosystems built up fuel and diminished biological diversity. Yesterday's solution has become today's problem. Today, fire needs to be reintroduced into many ecosystems on a large scale.

After telling the story, the next steps include determining trends and patterns, creating a focusing question, and diagramming the structure. What are some of the trends? Since the early part of this century there has been a steadily increasing amount of effort put into fire suppression. Until recently, controlled burning has steadily decreased, especially when compared to when Native Americans widely applied fire across the landscape. With the advent of increasingly effective fire suppression and the lack of prescribed fire, the living and dead material that fuels fires is increasing and becoming more continuous. After a long trend of reducing damages, we have seen some recent increases. Focusing questions might be: why are we seeing increased damage, even though there has been increasing effort in suppression? why are we seeing crown fires in ecosystems that once had only surface fires? or why are we seeing reductions in biological diversity in many areas? The structure of the system can be identified by picking a system archetype that seems to fit or by tracing the chain of cause and effect. I will develop a causal-loop diagram and then relate it to a well-known system archetype.

CAUSAL-LOOP DIAGRAMS

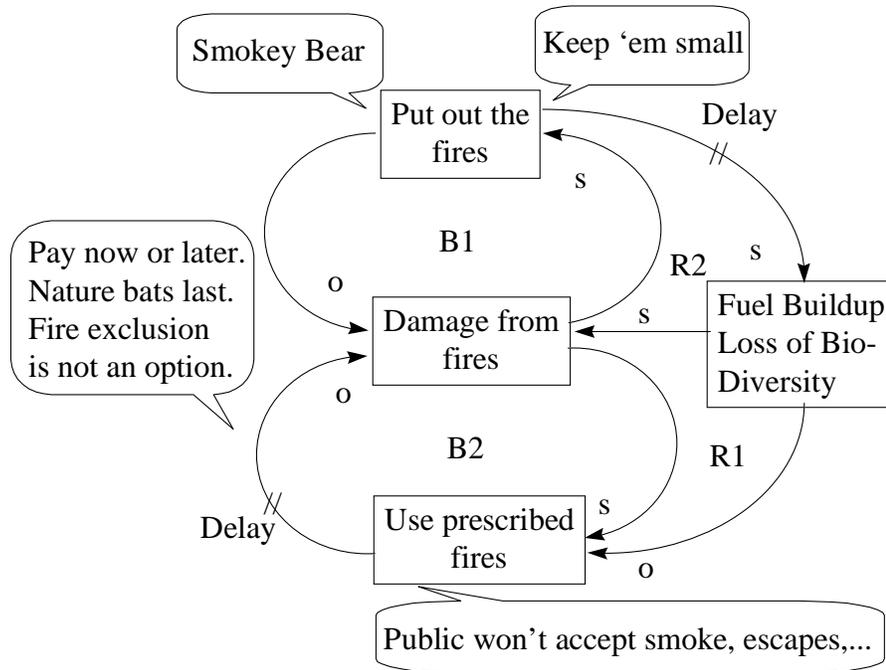
Causal-loop diagrams offer a method to diagram the story. Causal-loop diagrams consist of various combinations of balancing loops and reinforcing loops. A balancing

loop results when one part of the system counteracts another part, thus striking a balance. Reinforcing loops result when the various parts of the cycle feed on each other, either negatively (vicious cycle) or positively (virtuous cycle).

Figure 2 is a causal loop diagram of our contemporary fire story. It consists of two balancing loops and two reinforcing loops. The top balancing loop (B1), shows that the pressure to put out fires grows as the damage from fires increases. If damage from fires decreases, the pressure (or amount of effort) to put out fires decreases. Since this link moves in the same direction (decrease/decrease or increase/increase) an "s" (same) labels the link. As more efforts/resources go into extinguishing fires, damage from fires will decrease in the short-term. Since this link moves in the opposite direction (decrease/increase or increase/decrease), the link is labeled with an "o" for opposite. The odd number of "o's" indicates a balancing loop.

As damage from fires increase, the effort put into suppressing fires will increase (loop B1). Alternatively, more effort could be put into applying prescribed fire (loop B2). Over time, suppressing fires leads to a buildup of fuels and a loss of biological diversity. This can make it more difficult to use prescribed fire (loop R1) and can result in more damaging fires (loop R2). Delays often play a critical role in systems. Figure 2 shows two sources of delay: the time needed for fuel to build up and the time needed to implement a prescribed fire program over a large enough area to reduce the damage from wildfires. Innovation Associates' (1995) step of looking deeper means asking questions about purpose (what results do we really want?), personal responsibility (how am I responsible for this system functioning the way it is?), and mental

Figure 2. Causal-loop diagram of our contemporary wildland fire story.



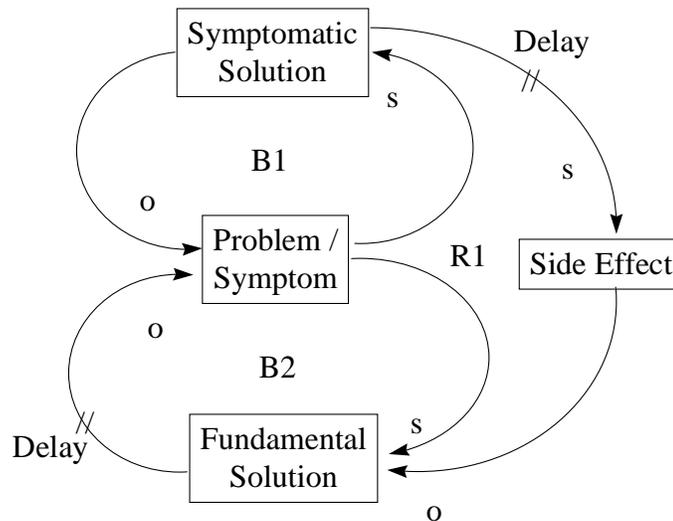
models (what are the beliefs, assumptions, and thinking that perpetuate the system?). Surrounding the loops in Figure 2 are common beliefs and assumptions about fire. Foremost among these is Smokey Bear, one of the most recognized cultural icons who has driven home the message “Only You Can Prevent Forest Fires” to several generations. Along with Smokey’s overt message is the implied message that all fires need to be put out because they are destructive. The watch word of fire suppression organizations has been “keep ‘em small.” Obstacles to increasing prescribed fire include the belief that “The public won’t accept the smoke, the escapes, and the costs.” Some of the common statements supporting prescribed fire include: “Pay me now or pay me later,” “Nature bats last,” and “Fire exclusion is not an option.”

SYSTEM ARCHETYPES

System archetypes are tools that capture the common stories in systems thinking (Kim 1992, 1994a, 1994b). They are powerful, both for diagnosing problems and for identifying high-leverage interventions that will create fundamental change. The tragedy of the commons (Hardin 1968) is one such archetype that may be familiar to many natural resource managers. Figure 2 is a variation of another common system archetype known as “shifting the burden” (Figure 3).

In “shifting the burden,” a problem is “solved” by applying a symptomatic solution (B1), or a “quick fix” that diverts attention away from a more fundamental solution (B2). This is the archetype of addiction. In an “addiction” structure, the system degrades

Figure 3. "Shifting the Burden" system archetype.



into an addictive pattern in which the side-effect (R1) gets so entrenched that it overwhelms the original problem symptom. In our fire story, the problem/symptom is damage from wildfire; the symptomatic solution is fire suppression; the delayed side-effect is fuel build-up and loss of biological diversity; and the fundamental solution is the application of prescribed fire.

Systems intervention includes adding or strengthening a link or loop, breaking or weakening a link or loop, or combining the two in some way. Interventions for the “shifting the burden” archetype include: investing more resources in the fundamental solution, giving the fundamental solution enough time to work, overlooking short-term solutions, dealing with symptoms only to gain time, paying attention to dependency on quick fixes, supplementing the fundamental solution but gradually withdrawing the supplement,

and recognizing that the only way “out” is sometimes “cold turkey.” Because it is neither likely nor desirable to eliminate fire suppression completely, an effective systems intervention would focus on strengthening the fundamental solution (loop B2), -- recognizing that it is an addictive structure -- and would make allowances for the delays that are inherent in the system. One final caution: in “shifting the burden” each fundamental solution may also be a symptomatic solution to a more fundamental solution in an endless series of alternating symptomatic and fundamental solutions. Each new “fundamental” solution brings deeper awareness of the underlying issues, and in turn leads to the discovery of more fundamental approaches to the problem (Kim 1996).

NEXT STEPS

While causal-loop diagrams and system archetypes give us a powerful language to explore our thinking about systems and to suggest possible interventions, they are not enough. Management “flight simulators” (Sterman 1992) can also be developed and should be the next step. The fact that all learning depends on feedback and that people cannot simulate mentally even the simplest possible feedback system, means that effective learning requires continuous experimentation with these virtual worlds (Sterman 1994). For more information on simulation models, see Morecraft and Sterman (1994). Simulation modeling, while necessary is still not sufficient. Moving learning organizations forward is an exercise in personal commitment and community building (Kofman and Senge 1993, Senge et al. 1994). Shifting the fire paradigm from suppression to prescription will require collaborative/participative community planning, leadership, and conversation.

Community planning based on the notion of aspiration and reflective conversation is at the heart of future search conferences (Weisbord 1992, Weisbord and Janoff 1995). Weisbord (1987) points out that our society is on a learning curve. We started the 20th century with having experts solve problems. This evolved to “everybody” solving problems, which in turn evolved into experts improving whole systems. Society is now moving into the era of “everybody” improving whole systems, a process that begins with collaborative/participative community planning.

Leadership is important to facilitating the shift from suppression to prescription – not the heros who put out the fires of impending crisis, but the designers, teachers, and stewards of learning organizations (Senge 1990b). The shift to prescription requires

leadership characterized by service (Greenleaf 1977, Kofman and Senge 1993), high principles (Covey 1990, Nair 1994), and the ability to engage people in adaptive problem solving (Wheatley 1992, Heifetz 1994, Hurst 1995, Senge 1996). While the paradigm shift to prescribed fire will require leadership, conversely leadership may have a lot to learn from prescribed fire. Prescribed fire operations can provide practice in the requisite skills of adaptive leadership (such as patience, timing, living with uncertainty, risk management, and building a safe container to hold the pressure (Heifetz 1994).

The root of the paradigm shift from suppression to prescription is a change in culture. Culture is a product of our language and our stories. To change the culture from suppression to prescription requires changing the conversation within our organizations and within our communities. Dialogue, the discipline of collective learning and inquiry, can transform the quality of conversation and the thinking that lies beneath it (Isaacs 1993, Brown and Isaacs 1997). Reflective conversation offers a mechanism to change ourselves and our culture and thereby facilitate the shifting paradigm from suppression to prescription. Systems thinking, with its causal-loop diagrams and simulation models, provides a language to facilitate this conversation.

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REFERENCES

- Argyris, C. 1991. Teaching smart people how to learn. *Harvard Business Review* 69:99-109.
- Argyris, C. and D.A. Schon. 1996. *Organizational Learning II: Theory, Method, and Practice*. Addison-Wesley Publ. Co., Reading, MA.
- Averill, R.D., L. Larson, J. Saveland, P. Wargo, J. Williams, and M. Bellinger. 1994. *Disturbance Processes and Ecosystem Management*. USDA Forest Service White Paper available on internet (<http://www.fs.fed.us/research/disturb.html>).
- Berry, T. 1988. *The Dream of the Earth*. Sierra Club Books, San Francisco, CA.
- Brown, J. and D. Isaacs. 1997. Conversation as a core business process. *The Systems Thinker* 7:1-6.
- Covey, S.R. 1990. *Principle-Centered Leadership*. Simon & Schuster, New York, NY.
- Fritz, R. 1984. *The Path of Least Resistance*. Ballantine Books, New York, NY.
- Fritz, R. 1991. *Creating*. Fawcett Columbine, New York, NY.
- Greenleaf, R.K. 1977. *Servant Leadership*. Paulist Press, New York, NY.
- Hardin, G. 1968. The tragedy of the commons. *Science* 162:1243-48.
- Heifetz, R.A. 1994. *Leadership Without Easy Answers*. Harvard University Press, Boston, MA.
- Hurst, D.K. 1995. *Crisis & Renewal: Meeting the Challenge of Organizational Change*. Harvard Business School Press, Boston, MA.
- Innovation Associates. 1995. *Systems Thinking: A Language for Learning & Action*. Participants Manual. Framingham, MA.
- Isaacs, W. 1993a. Taking flight: Dialogue, collective thinking and organizational learning. *Organizational Dynamics* 22:24-39.
- Isaacs, W. 1993b. Dialogue: The power of collective thinking. *The Systems Thinker* 4:1-4.
- Kim, D.H. 1992. *Systems Archetypes I: Diagnosing Systemic Issues and Designing High-Leverage Interventions*. Pegasus Communications Inc. Cambridge, MA.
- Kim, D.H. 1994a. *Systems Thinking Tools: A User's Reference Guide*. Pegasus Communications Inc. Cambridge, MA.
- Kim, D.H. 1994b. *Systems Archetypes II: Using Systems Archetypes to Take Effective Action*. Pegasus Communications Inc. Cambridge, MA.
- Kim, D.H. 1996. "Shifting the Burden" Revisited: Turtles All the Way Down. *The Systems Thinker* 7:7-9.

- Kofman, F. and P.M. Senge. 1993. Communities of Commitment: The Heart of Learning Organizations. *Organizational Dynamics* 22:5-23.
- Komarek, E.V. 1962. Fire Ecology. Tall Timbers Fire Ecology Conference Proceedings 1:95-107.
- Morecroft, J.D.W. and J.D. Sterman. (eds.). 1994. *Modeling for Learning Organizations*. Productivity Press, Portland, OR.
- Nair, K. 1994. *A Higher Standard of Leadership: Lessons from the Life of Gandhi*. Berrett-Koehler Publ., San Francisco, CA.
- Quinn, D. 1992. *Ishmael*. Bantam/Turner Books, New York, NY.
- Saveland, J.M. 1995. Fire in the forest. Pages 14-19 *in*: L. Eskew (ed.) *Forest Health Through Silviculture*, Proceedings of the 1995 National Silviculture Workshop. General Technical Report RM-267, U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Schein, E.H. 1994. The process of dialogue: creating effective communication. *The Systems Thinker* 5:1-4.
- Senge, P.M. 1990a. *The Fifth Discipline: The Art and Practice of the Learning Organization*. Currency Doubleday, New York, NY.
- Senge, P.M. 1990b. The leader's new work: building learning organizations. *Sloan Management Review* 32:7-23.
- Senge, P.M., C. Roberts, R.B. Ross, B.J. Smith, and A. Kleiner. 1994. *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization*. Currency Doubleday, New York, NY.
- Senge, P.M. 1996. Leading Learning Organizations. Pages 41-57 *in*: *The Leader of the Future*. Jossey-Bass, San Francisco, CA.
- Sterman, J.D. 1992. Teaching takes off - flight simulators for management education. *OR/MS Today* 19:40-44.
- Sterman, J.D. 1994. Learning in and about complex systems. *System Dynamics Review* 10:291-330.
- U.S. Department of Interior and U.S. Department of Agriculture. 1995. *Federal Wildland Fire Management: Policy & Program Review - Final Report*. National Interagency Fire Center, Boise, ID.
- Weick, K. 1996. Prepare your organization to fight fires. *Harvard Business Review* 74:143-148.
- Weisbord, M.R. 1987. *Productive Workplaces: Organizing and Managing for Dignity, Meaning, and Community*. Jossey-Bass Publ., San Francisco, CA.
- Weisbord, M.R. 1992. *Discovering Common Ground*. Berrett-Koehler Publ., San Francisco, CA.
- Weisbord, M.R. and S. Janoff. 1995. *Future Search: An Action Guide to Finding Common Ground in Organizations and Communities*. Berrett-Koehler Publ., San Francisco, CA.
- Wheatley, M.J. 1992. *Leadership and the New Science: Learning about Organization from an Orderly Universe*. Berrett-Koehler Publ., San Francisco, CA.