Communicating the Role of Science in Managing Giant Sequoia Groves[1]

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Abstract.—Management of giant sequoia groves has been and continues to be a hotly debated issue. The debate has reached Congress, with all parties seeking resolution as to what constitutes an ecologically and publicly acceptable management approach. Determining the correct management approach and communicating that approach to the general public is the crux of the problem. Emerging concepts and principles of forest ecosystem management may provide a mechanism to seek resolution of these management problems related to giant sequoia.

The Memorandum of Understanding between the members of the recently formed Giant Sequoia Ecology Cooperative provided the impetus for the development of this first working paper, which attempts to: 1) describe the historical events that led to much of the controversy surrounding management of giant sequoia groves; and 2) propose three management goals to guide development of best management practices for giant sequoia groves.

INTRODUCTION

The giant sequoia (*Sequoia gigantea* [Lindl.] Decne.) is botanically related to the coast redwood of California, baldcypress (*Taxodium distichum* [L.] Rich) of the southeastern United States, and dawn redwood (*Metasequoia glyptostroboides)* of China. Known as Sierra redwood or giant sequoia, it is noted worldwide for its great longevity, enormous size, awe inspiring beauty, ruggedness, and decay-resistant wood properties. Individual giant sequoia trees are among the largest and oldest living organisms in the world.

Giant sequoias are found in approximately 75 scattered grove locations, occupying 36,000 acres of forest within a narrow 260-mile long belt in the Sierra Nevada mountains of California. At present, more than 90 percent of all grove acreage is in public ownership. The National Forest system, primarily the Sequoia National Forest, manages all or part of 41 groves and about 50 percent of the total grove area. The National Park system (i.e., Sequoia, Kings Canyon, and Yosemite National Parks) include all or part of 29 groves and 30 percent of the total grove area. Other public ownerships, including Mountain Home State Forest, Calaveras Big Trees State Park, the University of California, Bureau of Land Management, and Tulare County manage 10 percent of the total grove area. The remaining area (i.e., approximately 10 percent) of giant sequoia is privately held.

The tree has been surrounded by controversy from its discovery. Dr. Albert Kellogg, the first to possess specimens of giant sequoia in 1852, hesitated to apply the new genus name *Washingtonia* sp. to giant sequoia. This delay to act by Kellogg enabled an English botanist, John Lindley, to be the first to formally propose a new name for giant sequoia, *Wellingtonia* after the Duke of Wellington. This naming of giant sequoia by the English after a noted Englishman led to a cross fire of American controversy that lasted for decades (Ornduff 1994).

The controversy over naming giant sequoia, although no small matter, pales in comparison to the firestorm of controversies that have since resulted from management activities in giant sequoia groves. Initial reservation of the majority of giant sequoia groves in the late part of the 19th century and early part of the 20th century resulted from numerous complaints over the "exploitive logging" that was taking place in such locations as Converse Basin.

People continue to be concerned about the short- and long-term effects of increased recreational use, reintroduction of fire (e.g., high-intensity prescribed burns) and silvicultural management (e.g., removing a few to many of the competing tree species to enable germination, survival, and growth of giant sequoia trees). Numerous schools of thought or philosophies have been presented as to the "best" approach for giant sequoia management.

Many pure preservationists would advocate just allowing natural processes to occur. Others would argue that people have been part of the problem and people should be part of the solution favoring reintroduction of fire and/or thinning to bring giant sequoia groves back to some "natural" condition. Others would argue that protection of the objects during management activities (i.e., the magnificent old-growth giant sequoia trees as individual trees) must be a major part of our thinking as we move to "restore" ecological processes (Piirto 1992a, b; Piirto 1994). The controversy has turned vitriolic. Many law suits have resulted. Who's right?

Well-meaning people cannot seem to come to terms on an appropriate short- and long-term management strategy for giant sequoia groves. The authors have held numerous discussions with people of many different viewpoints. No matter how hard we try, there is significant consternation over the use of management tools, particularly silvicultural manipulation such as logging. What is wrong with this picture? All parties have a deep and abiding love for giant sequoia, yet there is significant "mistrust" between them.

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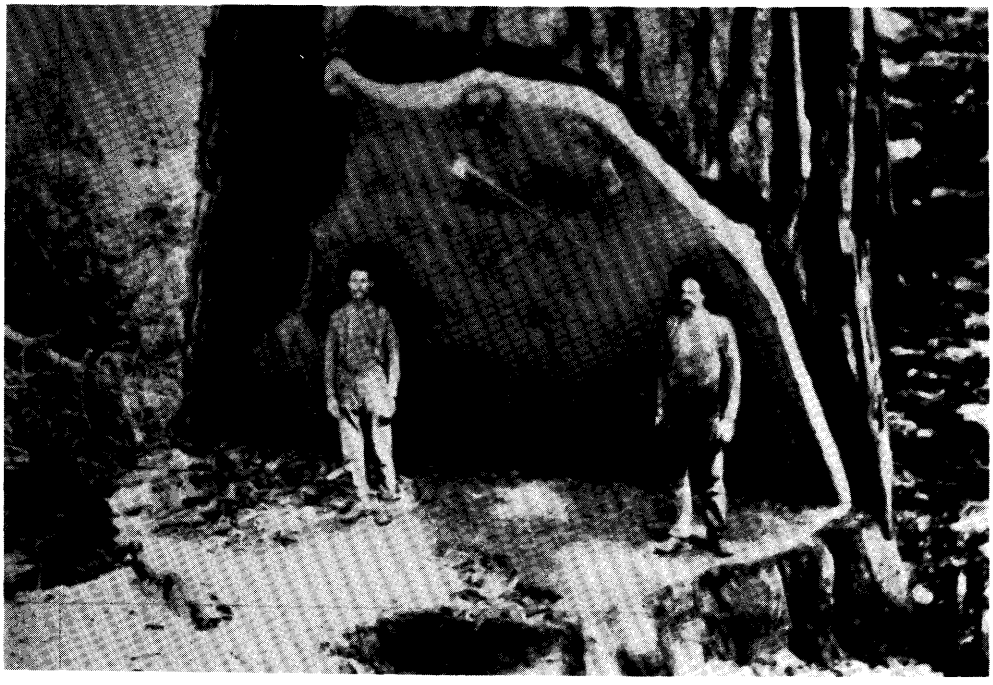

Figure 1.—This Mark Twain tree stood on privately owned land when it was cut in 1891 for museum exhibition purposes. The logged over area now known as the Big Stump grove is under the federal jurisdiction and protection of Sequoia National Forest. (Stauffer Publishing Co. photo).

The arguments surrounding giant sequoia management are a classic case of the failure to communicate. Terms, concepts, and principles have not been accurately defined, particularly with reference to silviculture and ecosystem management. Expected outcomes (i.e., desired condition) are often poorly described and difficult to visualize in relation to the natural range of conditions. A process for enabling communication, collaboration, and resolution of giant sequoia issues is sorely needed.

Finding the best way to manage a giant sequoia grove is a goal that all of us can agree to. The next step is to implement a process that will enable us to achieve this goal on a grove-by-grove basis. This paper attempts to discuss some of the important considerations to achieve "best management of giant sequoia groves." The objectives of this paper are to:

1. Describe the historical events that have led to much of the controversy surrounding management of Forest Service giant sequoia groves.
2. Propose three management goals for achieving best management of the giant sequoia groves.

HISTORICAL PERSPECTIVES

Giant sequoia trees have commanded a high level of respect and regard for a long time, as summarized by President George Bush in 1992: "For centuries, groves of giant sequoia have stimulated the interest and wonder of those who behold them. The giant sequoia inspires emotion like no other and has mystically entered the hearts of humanity everywhere." A complete understanding of the historical record is needed in make informed and correct decisions for the management of giant sequoia groves. A brief account of this human association with the giant sequoia/mixed conifer ecosystem is provided in the sections that follow.

Prehistory

About 20 million years ago, trees closely related to the giant sequoia grew in a large area of the western United States (Harvey 1985). Over geologic time, these ancestral trees disappeared. Their descendants, the modern giant sequoia, are found in about 75 scattered locations within a narrow 260-mile long belt at an elevation between 4,500 and 7,500 feet in the Sierra Nevada (Harvey 1985; Weatherspoon 1986).

Scientists currently conclude that human association with the giant sequoia ecosystems spans some 10,000 to 12,000 years. Archaeological evidence of human use and habitation of giant sequoia groves has been found (Hull 1989).

Uncontrolled Exploitation (1850-1890)

The giant sequoia of California were evidently observed by the Walker party in 1833, and probably before that by Spanish explorers. However, it wasn't until after the rediscovery by A.T. Dowd in 1852 that there was any public attention to the species.

The first phase of economic exploitation started almost immediately after Dowd's discovery. In 1853, a large giant sequoia in the Calaveras grove was felled for exhibition purposes. The Mark Twain tree was felled for exhibition purposes in 1890 (Figs. 1-2). The "big stump" that was left behind became the focal point for naming the area we currently know as the Big Stump grove. The last exhibition

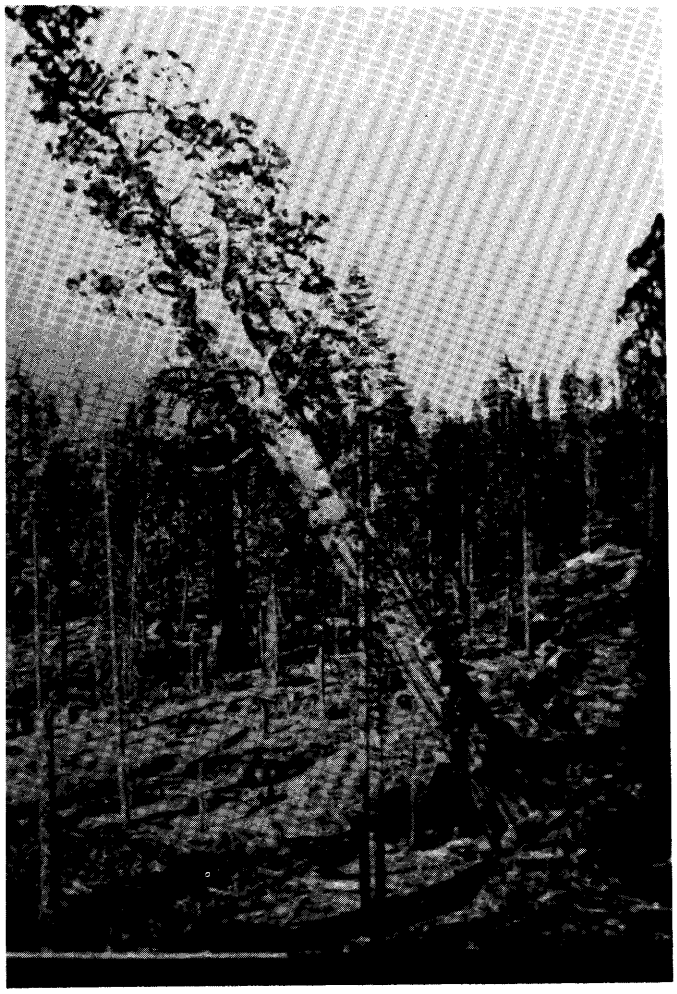

Figure 2.—The Mark Twain tree as it falls to the ground (Stauffer Publishing Co. photo).

tree probably was cut in 1893 for the Chicago World's Fair. Commercial logging of the species began to gain momentum in the 1860's (Johnston 1996).

Noncommodity values were recognized very early, probably as a direct result of commercial exploitation. Newspaper editorials as early as 1853 exposed the moral issue involved in cutting the big trees. In 1864, the federal government deeded Mariposa grove to the State of California "...for public use, resort, and recreation...." Elsewhere however, logging of the big trees for wood products had reached such a rate that in 1873, the California Legislature passed a law making it a misdemeanor to "...willfully cut down or strip of its bark any tree sixteen feet in diameter...."

State law was largely ignored; by the 1880's, much public land containing giant sequoia groves had been acquired by large lumber companies. Most of this land was south of the Kings River in Fresno County, now within the Sequoia National Forest. In 1890, a flume was completed that heralded a truly colossal event in the history of human relationships with the giant sequoias—the logging of the Converse Basin grove and its environs by the Kings River Lumber Company (Johnston 1996).

Pinchot and Muir Think Alike (1890-1930)

On the issue of giant sequoia logging John Muir (Fig. 3) and Gifford Pinchot (Fig. 4) were very much in agreement as is evidenced by the following statements:

"...timber was magnificent. But who shall describe the Sequoias? Their beauty is far more wonderful that their size." (Pinchot 1947).

"The Big Tree...is Nature's forest masterpiece, and, so far as I know, the greatest of all living things." (John Muir).

"So with John Muir and Hart Merriam, Head of the Biological Survey, I made a memorable trip to the Calaveras Grove...Never were two more delightful talkers that Muir and Merrian...I could have sat in the front seat of our wagon and listened to them for weeks..." (Pinchot 1947).

"...I ran into the gigantic and gigantically wasteful lumbering of the great Sequoias...I resented then, and I still resent, the practice of making vine stakes hardly bigger than walking sticks out of these greatest of living things." (Pinchot 1947).

"In this glorious forest the mill was busy, forming a sore, sad centre of destruction...And as the timber is very brash...half or even three fourths of the timber was wasted." (John Muir).

Adverse public reaction to the logging was picked up and amplified by George Stewart, editor of the Visalia Weekly Delta newspaper. His campaign led to the establishment of Sequoia and General Grant National Parks in 1890. Stewart was also instrumental in creating the concept of "forest reserves" which later provided the land from which many of our National Forests were created.

Grove Protection (1930-1960)

Logging and lumbering of giant sequoia groves like Converse Basin was largely completed because of economic conditions by 1930. Most privately held lands containing giant sequoias, including those that had been cutover, passed into either state or federal ownership between 1926 and 1960. This conversion of land ownership from the private sector to the government sector was thought to be a benevolent action leaving few threats to the giant sequoia groves.

Grove Protection Revisited (1960-1980)

By the 1960's, foresters and scientists in all the agencies responsible for giant sequoia management, began to realize that successful fire suppression during the past 50 years or so was allowing dangerous amounts of fuel to build up in the groves. Also, the lack of canopy openings and bare soil as

Figure 3.—John Muir, President Teddy Roosevelt, and a group of people at the base of a giant sequoia in Yosemite National Park in 1903 (Harcourt Brace Co. photo).

created under natural fire regimes was inhibiting reproduction of the species. Instead, white fir and incense-cedar were becoming established in great numbers (Fig. 5). We now understand that grove protection by aggressive fire suppression alone was insufficient. Fuel reduction and control of vegetation structure are also necessary for long-term well being of the giant sequoia groves. The National Park Service began some of the first major experiments with prescribed burning as a means to overcome the problems that followed fire suppression. Harold Biswell at the University of California at Berkeley was a pioneer of this early fire management research.

Forest Service Management Begins (1980-1990)

By 1980, fuel-reducing prescribed fires were being programmed routinely in the groves of Sequoia and Kings Canyon National Parks, and at a much smaller scale in Yosemite National Park. The National Park Service received much criticism for an early prescribed burn conducted in the Redwood Mountain grove (Fig. 6). In 1985, the program was suspended because of accumulating criticism of smoke in the air, occasional hot spots that singed crowns and even killed some larger fir and pine trees, and most of all, char on large giant sequoia trees. This controversy arose in part because many of the critics focused attention on individual specimen trees, whereas the National park Service focused more broadly on the ecosystem in which these trees lived...different perspectives within the same social environment led to

Figure 4.—Pinchot and Roosevelt conferring during an Inland Waterways Commission trip on the Mississippi River in October 1907 (Harcourt Brace Publishing Co. photo).

Figure 5.—High understory density of various tree species poses a significant fire hazard in giant sequoia groves. These high density levels have largely occurred because of fire suppression activities.

the conflict. A considerable amount of controversy still remains as to the "appropriate" way to reintroduce fire in giant sequoia groves and surrounding areas.

Wary of the sensitive nature of giant sequoia groves, the Forest Service was much slower to begin active management. In 1975, the Sequoia National Forest made a modest attempt at prescribed burning in the Bearskin grove. Fuel loading was reduced and numerous giant sequoia seeds germinated in the burned area. However, most of these new seedlings died, presumably because of a lack of sufficient canopy opening and exposure to mineral soil. It was concluded that the fire wasn't "hot enough" to fully accomplish all of the fuel objectives; and if it had been, there would have been dead but unconsumed trees left on the site to produce more fuel in the future. This conclusion led Forest Service managers in 1983 to prescribe a "seedtree" regeneration harvest for approximately 15 acres of the Bearskin grove area (Fig. 7) to accomplish both fuel reduction and giant sequoia seedling establishment objectives (Fig. 8). The action in Bearskin grove set a precedent for other timber sales in other groves with objectives expanded to include timber production as well.

Even though the Forest Service complied with public involvement requirements of the National Environmental Policy Act (i.e., NEPA), it is evident that a consensus of public approval was lacking. When the logging was independently discovered by some who tended to be critical of Forest Service anyway, the sense of betrayal

Figure 6.—The results of a National Park Service prescribed burn in Redwood Mountain.

Figure 7.—Silvicultural treatments were completed on 15 acres of the Bearskin grove, Hume Lake Ranger District, Sequoia National Forest.

Figure 8.—Treating giant sequoia groves via selective cutting practices followed by prescribed burning or some sort of site preparation treatment is needed to create desired microsite conditions favorable for giant sequoia seedling/sapling survival and growth.

sent shock waves of dismay through the environmental community. Realizing the agency had gone too far too fast, The Sequoia National Forest ceased timber harvest within giant sequoia groves in 1986.

Since the late 1980's, and continuing to the present, articles about forest management featuring giant sequoias have appeared in newspapers, magazines, and on television. Articles like the Sacramento Bee's eight-part series titled "Sierras Under Siege" and other articles in Audubon, National Geographic, Sunset, Sports Illustrated and documentaries on CNN and the MacNeil-Lehrer program have caused increased visibility to what is occurring or not occurring in giant sequoia groves. Many letters have and continue to be received by various Forest Service offices from citizens concerned about the effective management of giant sequoia groves.

The 1988 Forest Plan for the Sequoia National Forest as mandated by the National Forest Management Act of 1976

and other laws did not satisfy the critics of Forest Service giant sequoia and resource management policies.

The Mediated Settlement (1990-2000)

In 1990, a Mediated Settlement Agreement (MSA) was reached on 25 forest planning issues for the Sequoia National Forest. More pages of this MSA document are devoted to giant sequoias that even timber sale quantity or watershed effects, both of which are consider "mega" issues. The basic agreement is to remove the groves from regulated timber harvest and "to protect, preserve, and restore the groves for the benefit and enjoyment of present and future generations."

But the public clamor about giant sequoia management on the Sequoia National Forest did not stop. In 1991, Congressmen Lehman and Dooley convened a hearing on that specific issue. Because of administrative agreements reached through mediation, unsettled issues focused mostly on questions about the state of ecological knowledge. It was at this hearing that the senior author of this paper presented a witness statement (Piirto 1991) outlining a number of lessons learned from past management practices and listing a number of recommendations. The lessons learned are as follows (Piirto 1991):

1. There continues to be significant interest in the giant sequoia resource as there well should be. Yet this interest and concern is not supported by adequate funding to do research and carry out management in and orderly and planned manner.
2. Organizations and agencies involved with giant sequoia management have varied opinions as to what is the most appropriate course of action to follow.
3. Very little research has been done on giant sequoia particularly from the standpoint of comparing and evaluating management approaches.
4. Significant site disturbance is needed to obtain giant sequoia seedling establishment and survival. Mineral soil conditions favor seedling establishment and canopy openings facilitate growth and survival of established seedlings.
5. Thrifty young-growth stands of giant sequoia are not widespread within its native range.
6. Fire suppression over the past 90 years has resulted in significant stand density increases of associated tree species found in giant sequoia groves. It is possible that these changes in stand density are also influencing pathogen and insect relationships in the grove areas.
7. Both prescribed burning and silvicultural manipulation of giant sequoia groves have positive and negative effects which are not fully understood. For example, researchers have measured lethal temperatures at significant depths beneath the bark of old-growth giant sequoia trees during prescribed burning operations.
8. Custodial protection without some form of prescribed burning and/or silvicultural manipulation is probably not in the best interest for perpetuating the species.
9. Giant sequoia trees are subject to the same natural forces and man-caused influences as other tree species. Specimen giant sequoia trees have fallen within the boundaries of National Parks, State Parks, State Forests, National Forests and on private lands. Various factors are involved. And in some cases human activities have probably contributed to premature failure in all of these governmentally protected and managed areas. It is not known whether or not the present rate of old-growth giant sequoia tree failures is higher than historic patterns.
10. Both prescribed burning and silvicultural manipulation of giant sequoia groves have received adverse public criticism. It seems that no one agency is doing a perfect job of giant sequoia management. However, Mountain Home State Forest might come closest if we were to judge performance on the amount of public criticism expressed and publicity received. But the jury is still out as to what management approaches are most effective for perpetuation of the ecosystem and the giant sequoia species.

Based on these lessons learned, the following recommendations were made (Piirto 1991):

1. Management by necessity must involve more than custodial protection. And it can't simply focus on changing jurisdictional authorities. Management must be continuous as the ecosystems within which giant sequoia occurs are dynamic.
2. Do not alter present agency jurisdictions of giant sequoia groves. There is no evidence to suggest that one agency is doing a better job than another. The perpetuation of the species may be best served by a variety of management approaches.
3. Require that grove boundaries and permitted management activities be clearly identified for all giant sequoia groves following applicable NEPA procedures. This is largely what is stipulated in the 1990 Sequoia National Forest mediated settlement of the Land Management Plan. This requirement should be extended to all giant sequoia grove areas under federal management.
4. Provide funding and mechanisms to enable research symposiums and short courses on giant sequoia to occur on a timely and scheduled basis.
5. Establish a giant sequoia research center which would clearly identify research priorities. This research center would serve to insure that research is carried out in a timely manner. I would suggest that this center be housed within the USDA Forest Service's PSW Research Station or in a university where a spectrum of research can be accomplished irrespective of management direction.
6. Provide adequate federal funding to ensure appropriate and sustained management of the giant sequoia ecosystem. Identify giant sequoia management and research as specific line items in the federal budget.
7. Establish giant sequoia program managers in those federal agencies (e.g., National Park Service, Forest Service, Bureau of Land Management) which have a significant giant sequoia land base.

Regional Forester Ron Stewart accepted these recommendations and those made by other witnesses at the hearing. He directed other National Forests in California (primarily the Tahoe and Sierra National Forests) to adopt

the mediated settlement agreements on giant sequoia management and called for a symposium which would bring together scientists and others interested in giant sequoias.

Further federal action came in July 1992 in the form of a proclamation made by President Bush. The proclamation removed National Forest groves from the timber production land base, affirmed the terms of the Mediated Settlement, and directed that the groves "shall be managed, protected, and restored by the Secretary of Agriculture...to assure the perpetuation of the groves for the benefit and enjoyment of present and future generations." The Forest Service finally had coordinated management direction at the local, regional, and national levels.

Since 1992 there has been general agreement on how giant sequoia groves should be treated on National Forests; yet public apprehension remains. This is evidenced by the Sierra Nevada Ecosystem Project (SNEP) charge to examine the Mediated Settlement Agreement and make recommendation for scientifically based mapping and management of the groves (University of California 1996). New legislation is still being proposed such as the Sequoia Ecosystem and Recreation Act of 1996 (HR 3873) which proposed "...to protect and preserve remaining Giant Sequoia ecosystems." The fact that committees are being formed and legislation is being proposed demonstrates that issues still exist. Additional issues will likely develop as management actions are enacted in response to the following statement made in the SNEP report (University of California 1996): "There is evidence to suggest that inaction is currently the most significant threat to giant sequoias, the groves and their ecosystems."

History Lessons

What lessons can we now say we have learned from this long human association with giant sequoia groves:

1. Native Americans, prominent American conservationists (e.g., John Muir, Gifford Pinchot) and people from all walks of life view giant sequoia groves as special places requiring careful management and stewardship.
2. A high degree of controversy has and continues to surround "exploitive logging" of giant sequoia groves for purely commercial reasons.
3. Governmental grove protection and aggressive fire suppression were not enough. Fuel reduction and control of vegetation structure are also necessary for long-term well being of the giant sequoia groves.
4. The results of management actions are time dependent. Judging the effectiveness of a management action shortly after it has occurred can lead to erroneous conclusions. A need exists for coordinated management and research activities to demonstrate both the short- and long-term effectiveness of management actions.
5. There has been significant public interest in giant sequoia for the last 147 years. Concerned publics and land managers in recent times have not effectively communicated with one another particularly with reference to identifying goals, establishing management plans, and visualizing the change in giant sequoia groves that can occur whether or not management plans are put into motion.
6. Most people agree that the reintroduction of fire and even thinning are necessary management actions in giant sequoia groves. The controversy seems to be focus on what constitutes an appropriate prescription for these management activities. How is success measured?
7. Concerned publics will enter the legislative arena to seek resolution of contentious controversies surrounding management of giant sequoia groves.
8. Federal officials (i.e., Lynn Sprague, current Regional Forester; Ron Stewart, prior Regional Forester; Phil Bayles, prior Forest Supervisor of the Sequoia National Forest; Sandra Key, prior Forest Supervisor of Sequoia National Forest; Art Gaffrey, current Forest Supervisor of Sequoia National Forest; and Jim Boynton, current Forest Supervisor of the Sierra National Forest) have been responsive and in many cases proactive to the recommendations made at the 1991 Congressional hearing in Visalia. The following management actions have occurred since the 1991 hearing:
    a. A symposium titled "Giant Sequoias: Their Place in the Ecosystem and Society" was held in 1992.
    b. Two positions dedicated to management and coordination of giant sequoia research have been created on the Sequoia National Forest. Robert Rogers holds the position of Giant Sequoia Specialist and Mary Chislocke Bethke holds the position of Giant Sequoia Program Manager. Similar positions exist in other federal and state agencies.
    c. A Giant Sequoia Ecology Cooperative has been formed.
    d. Grove boundaries have been clearly identified and mapped for most if not all National Forest giant sequoia groves.
    e. Federal funding is being provided.
    f. A Giant Sequoia Leadership Conference was held in Sacramento in January 1997.
    g. Many other significant actions and activities have occurred that are too numerous to list here.
9. A new vision has emerged as a result of the effective collaboration that was started with the mediated settlement, the 1991 congressional hearing, and the 1992 Giant Sequoia Symposium. However, issues and controversy over giant sequoia management still exist.
10. Management inaction was noted in the SNEP report as the most significant threat to giant sequoias.
11. Past public attitudes toward giant sequoia have not always been science based. Understanding what the public wants with reference to giant sequoia management will be important as future management plans for giant sequoia groves are developed. It will be important to properly frame the issues surrounding giant sequoia management.

One thing becomes impeccably clear after reviewing this historical record, the problems and issues that have surrounded giant sequoia will not be resolved with the same

level of consciousness that created them. Hopefully, the richness of the process to reach a higher level of consciousness to resolve these giant sequoia problems will be as rewarding as the end result.

MANAGEMENT GOALS FOR GIANT SEQUOIA GROVES

Determining the right goals for management of giant sequoia groves is the most difficult task managers face. The following goals based on the best available science and public collaboration (i.e., Mediated Settlement Agreement on the Sequoia National Forest) to date are listed to facilitate current and future discussion on the management tactics and strategies necessary to achieve "best management of giant sequoia groves":

1. Protect naturally occurring groves, and historical and biological artifacts within them, from events such as excessive logging activities, excessively hot fires, and inappropriate human uses that are contrary to, or disruptive of, natural ecological processes.
2. Preserve the groves in a natural state by allowing ecological processes, or equivalents thereof, to maintain the dynamics of forest structure and function.
3. Restore the groves to their natural state where contemporary human activities have interfered with the natural processes—especially fire and hydrology.

It is critical for the Forest Service and the public at large seek agreement to these goals to protect, preserve, and restore giant sequoia groves. Successful completion of the collaborative demonstration projects beginning on the Sequoia and Sierra National Forests depend on it. The next step is to put the accumulated knowledge of science and management experience to work in such a way that satisfies the public demand to protect, preserve, and restore the giant sequoia groves under federal jurisdiction.

CONCLUSION

Attempting to resolve the vitriolic conflict over giant sequoia management will not be an easy task. It can be interpreted from the history lessons of our prior association with giant sequoia that a new process for arriving at best management decisions is needed. Perhaps ecosystem management will be that process to achieve a higher level of consciousness. Information and clear communication, however, will be needed in order to effectively implement ecosystem management.

A large amount of "quality" research work has occurred since the 1992 Giant Sequoia Symposium as an information base for the ecosystem management process (Aune 1994). The 1992 Symposium has led to many positive outcomes particularly in the scientific arena (i.e., numerous studies have been completed since then). The findings of these studies will be useful to analyses involving giant sequoia groves. A review of some of this current research is presented in Piirto (1996).

Expanding populations, increased and often conflicting demands for public lands, the expanding urban interface, increasing recreational use and associated impacts, increasing risk of damaging fires, reduced availability of federal funds, inefficient technology transfer, and failure to resolve conflicts are just a few of the many reasons why a new forest ecosystem management decision process is needed. It will be essential as this process is implemented that close and structured cooperation with agency personnel (e.g., National Park Service, California Department of Forestry, Bureau of Land Management, Forest Service, California State Parks), environmental organizations (e.g., Sierra Club, Save-the-Redwoods League), the forest products industry, and concerned citizens continue to develop. An improved cooperative spirit seems to be emerging as evidenced by the positive outcome of the 1992 Symposium and the recent formation of the Giant Sequoia Ecology Cooperative.

Working together, we can make a difference in finding the "right ecosystem management solutions" for giant sequoia groves. But we should also remember what Ticknor (1993) stated:

> "Sooner or later, our management decision process will be informed by reliable answers to these questions, but the answers, contrary to our wishes, will seldom be couched in terms of right or wrong, yes or no. They require the election of alternatives, the exercise of judgment, and the action of choosing."

And we should all understand what Theodore Roosevelt was trying to tell us in his address titled "Citizenship in the Republic" at the Sorbonne in Paris on April 23, 1910:

> "It is not the critic who counts; not the man [human] who points out how the strong man [human] stumbles, or where the doer of deeds could have done better. The credit belongs to the man [human] who is actually in the arena, whose face is marred by dust and sweat and blood; who strives valiantly; who errs, and comes short again and again, because there is no effort without error and shortcomings."

The practice of silviculture is at a crossroads today. Will Silviculturists embrace the emerging principles and concepts of ecosystem management and put them into practice? Ecosystem management is about breaking down barriers. It could become the process via which we rise to a new level of awareness in managing giant sequoia groves. It seems that silviculturists and giant sequoia may have something in common: a relic of the past or an icon to the future (Fig. 9). The choice is ours to make.

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Figure 9.—The General Grant Tree in Sequoia-Kings Canyon National Park. A relic of the past or an icon to the future, the choice is ours to make.

forests. The impetus to develop this first "working paper" came from direction provided in the Memorandum of Understanding which formed the cooperative. This paper is dedicated to Rueben and Martha Piirto.

LITERATURE CITED

Aune, P. S., ed. 1994. **Proceedings of the symposium on giant sequoias: their place in the ecosystem and society**; 1992 June 23-25; Visalia, CA. Gen. Tech. Rep. PSW-151. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 170 p.

Harvey, T. H. 1985. **Evolution and history of giant sequoia.** In: Weatherspoon, P. C.; Iwamoto, Y.; Piirto, D. D., tech. coords. Proceedings of the workshop on management of giant sequoia; 1985 May 24-25, Reedley, CA. Gen. Tech. Rep. PSW-95. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station.

Hull, K. L. 1989. **The 1985 south entrance and Mariposa grove archaeological excavations.** Final report.

Johnston, H. 1996. **They felled the redwoods.** Stauffer Publishing Co.

Ornduff, R. 1994. **A botanist's view of the Big Tree.** In: Aune, P. S. Proceeding of the symposium on giant sequoias: their place in the ecosystem and society; 1992 June 23-25; Visalia, CA. Gen. Tech. Rep. PSW-151. Albany, CA. U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Piirto, D. D. 1991. **Giant sequoia groves, a relic to be preserved or a resource to be managed.** Witness statement presented at the September 4, 1991, hearing of the Congressional Committee on Interior and Insular Affairs, Visalia, CA.

Piirto, D. D. 1994. **Giant sequoia insect, disease, and ecosystem interactions.** In: Aune, P. S. 1994. Proceeding of the symposium on giant sequoias: their place in the ecosystem and society; 1992 June 23-25; Visalia, CA. Gen. Tech. Rep. PSW-151. Albany, CA. U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Piirto, D. D.; Cobb, F. W. Jr.; Workinger, A.; Otrosina, W. J.; Parmeter, J. R. Jr. 1992a. **Final report. biological and management implications of fire/pathogen interactions in the giant sequoia ecosystem; part II pathogenicity and genetics of *Heterobasidion annosum*.** San Luis Obispo, CA: California Polytechnic State University, Natural Resources Management Department.

Piirto, D. D.; Piper, K.; Parmeter, J. R. Jr. 1992b. **Final report: biological and management implications of fire/pathogen interactions in the giant sequoia ecosystem; part I—fire scar/pathogen studies.** San Luis Obispo, CA: California Polytechnic State University, Natural Resources Management Department.

Pinchot, Gifford. 1947. **Breaking new ground.** New York: Harcourt Brace Co.

Ticknor, W. D. 1993. **Sustainable forestry: redefining the role of forest management.** In: Aplet, H., N. Johnson, J. T. Olson, and V. Alaric Sample. Defining sustainable forestry. Island Press: 260-269.

University of California, Centers for Water and Wildland Resources. 1996. **Sierra Nevada Ecosystem Project, final report to Congress, vol.** assessment summaries and management strategies.

Weatherspoon, P. C. 1986. **Silvics of giant sequoia.** In: Weatherspoon, P. C.; Iwamoto, Y.; Piirto, D. D., tech. coords. Proceedings of the workshop on management of giant sequoia; 1985 May 24-25, Reedley, CA. Gen. Tech. Rep. PSW-95. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station.