Prepared Statement for the Record
of
Philip S. Aune
Retired Forester
Former Research Program Manager
Redding Silviculture Laboratory
Pacific Southwest Research Station
Redding, California

Before the
Subcommittee on Public Lands and Forests
Senate Energy and Natural Resources Committee
United States Senate

December 13, 2007

Executive Summary

1. Thinning is one of the key practices necessary to restore our forests, reduce excessive fuel accumulations, and make forests sustainable and resilient as we face the uncertainties surrounding climate change.
2. There is a strong scientific foundation for thinning our forests supported by centuries of research and forest management observations.
3. Within the last decade, a large body of research, development and application projects has expanded our knowledge of thinning and its effects on fuels reduction and forest restoration.
4. Thinning can play a major role in reducing the adverse environmental effects of catastrophic events to critical wildlife habitats, key watersheds, wilderness, parks, private timberlands and rural communities.
5. Thinning activities can be an expensive undertaking and therefore projects must consider existing infrastructure, markets for by-products, future silvicultural activities and available funding.
6. Thinning can be sustainable if economic objectives are substantially improved to meet the goals established for restoration and fuels reduction priorities. Social sustainability remains problematic for active forest management programs that require removal of trees.

Testimony

Good afternoon Mr. Chairman and members of the Subcommittee, my name is Philip S. Aune and I am a retired forester with 37 years of service in the United States Forest Service. My last assignment was the Program Manager of the Redding Silviculture Laboratory, a unit of the Pacific Southwest Research Station. After retiring from the Forest Service, I served as Vice President of the California Forestry Association for 5 ½, years retiring in 2005. I am currently a resident of Nine Mile Falls, Washington and I work as a part-time consulting forester for the American Forest Resource Council.

My testimony today represents my views as a professional forester with over 45 years of experience in forest management, silviculture research, and forest policy and government affairs. I am also a member of the National Association of Forest Service Retirees an organization that strongly supports the need for thinning, stocking control and reducing the vulnerability of forests to fire, disease and insects problems. They clearly recognize that thinning is a valuable and necessary practice to achieve healthy and productive forests for Americans.

The focus of this hearing is on forest restoration and hazardous fuels reductions in western national forests and public lands managed by the Bureau of Land Management. The need and foundation for forest restoration is clearly described as part of the U.S. Department of the Interior and Forest Service 2001Cohesive Strategy for Restoring Fire-Adapted Ecosystems on Federal Lands[1]. Reducing hazardous fuels by implementing the National Fire Plan was the major focus area in previous Senate Energy and Natural Resource hearings in 2001[2]. By 2002, in the midst of one of the worst fire seasons on record, President Bush announced the Administration's Healthy Forest Initiative in Central Point, Oregon.[3] A bipartisan effort to provide united leadership concerning these issues came to fruition when the Healthy Forest Restoration Act HFRA was passed and signed into law on December 3, 2003 by President George W. Bush.

Many have questioned why the pace and scale of federal actions has been so slow ever since HFRA was passed. The focus of the land management agencies since then has been primarily to reduce the fuel accumulations in the Wildland Urban Interface (WUI) using a variety of forest practices. Most of the practices utilized require significant federal appropriations to be successful. In the last few years, agencies have been working with generally fixed budgets and strong competition for federal appropriated funding in a highly charged political environment. Generally, only thinning has the potential to produce revenues and the ability to help offset costs and the current reliance on appropriated funding to accomplish HRFA goals and objectives. Thinning will be the focus of my testimony today.

Science basis for thinning. Thinning of forest stands has a strong scientific foundation based on centuries of research, observations, development and application of this fundamental silvicultural practice. Most of the historic research concentrated on thinning responses designed to improve the overall health and vigor of forest stands while improving opportunities for increased growth and yield of forest products. Some of these thinning principles are:

---

[1] Restoring Fire-Adapted Ecosystems on Federal Lands… A Cohesive Strategy for Protecting People and Natural Resources. U.S. Department of the Interior. USDA Forest Service. December 2001.

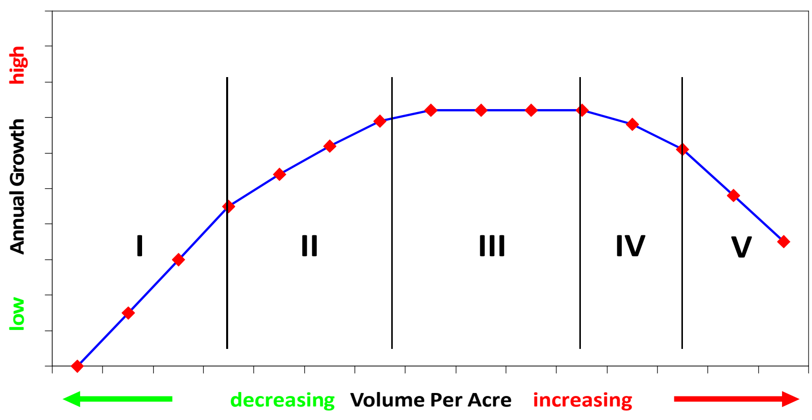
[2] September 25, 2001 Hearing on Implementing the National Fire Plan. Senate and Energy and Natural Resource Subcommittee on Public Lands and Forest.

[3]President Announces Healthy Forest Initiative. Remarks by the President on Forest Health and Preservation. The Compton Arena, Central Point, Oregon. September 13, 2002.

1. *This continual diminution in numbers (of trees) is primarily the results of a vigorous natural selection and is the expression of one of the fundamental biological laws of silviculture*[4].
2. *The struggle for existence in dense, unthinned stands is so fierce as to reduce the growth and vigor of all trees in the stand*[5].
3. *Very few trees ever recover a dominate position after they have fallen behind in the race for the sky*[6].
4. *The total production of cubic volume by a stand of a given age and composition on a given site is, for all practical purposes, constant and optimum for a wide range of density of stocking*[7].

The last key principle has led to the following theoretical graph of growth, development and response to changes in stocking levels on a per acre basis. This graphical representation is part of the basis of silviculture and is known as the "Langsaeter Growth Curve.[8]"

Langsaeter Growth Curve



This graph is extremely relevant today because helps to provide a framework for the overall condition of our public land forests today. The roman numerals represent five major growing and subsequently health conditions of forested stands. Zone I represents the most rapid period of annual growth resulting from ample growing space for individual tree growth. Zone II reflects

[4] Smith, David M. 1062. The Practice of Silviculture. Seventh Edition. John Wiley & Sons, Inc., New York.
[5] Ibid.
[6] Guillebaud, W.H., and F.C. Hummel. 1949. A note on the movement of tree classes. Journal of Forestry, Volume 23: 1-14.
[7] Smith, David M. 1962. The Practice of Silviculture. Seventh Edition. John Wiley & Sons, Inc., New York.
[8] Langsaeter, A. 1941. Om tynning I enaldret gran- ogfuruskog. Meddel. f.d. Norske Skogforsoksvesen 8-131-216. In Smith, David M. 1962. The Practice of Silviculture. Seventh Edition. John Wiley & Sons, Inc., New York.

that point in time when individual trees start to compete with their neighbors for nutrients, water, and light. Per acre annual growth rates are still relatively high and constantly increasing as overall stocking increases. Zone III represent the highest annual per acre growth rate over a wide range of stocking levels. Intertree competition accelerates to the point where stand density approaches levels found in Zone IV. In Zone IV, intertree competition has developed to the point where significant tree mortality begins. Annual growth rate declines begin and this is the Zone where the general forest health begins to decline. Zone V is the point where the effect of too many trees and severe competition is the dominate factor and tree mortality is the major event present in the stand.

The optimum time to thin forest stands is in Langsaeter Zone III with high annual growth conditions. Thinning practices should reduce the stocking levels to meet whatever the forest management objectives require. Generally speaking, forest management objectives should be established to reduce the stocking to levels found in Zone III to the lower end of Zone III or the high end of Zone II. Determining the specific quantifiable goals should be based on the best evidence from Levels of Growing Stock research (discussed later in this testimony) and objectives, local experience and economic considerations.

The next logical question is, "How much of our forest land needs thinning?" Most of our historic forests were a mosaic of stands in all five Zones of Langsaeter's growth curve. Today, our public forests are dominated by stand conditions found in Langsaeter's Zone IV and V. Regardless of the cause, the facts are that our public forests are significantly out of balance from their historic ranges of variability. These overstocked conditions led the General Accounting Office to conclude in 1999 that 39 million acres of interior western forests have serious forest health problems[9]. The national scope of the forest health problem was expanded and enlarged by 2002 based upon conclusions from the Healthy Forest Initiative. As an example, the American Forest and Paper Association concluded that there are 72 million acres of National Forest System Land at high risk to catastrophic wildfire. Another 26 million acres are at high risk to insect infestation and disease[10]. That is almost 52 percent of all national forest land. Thinning has been and will continue to be the major silvicultural practice to balance stocking levels necessary for a wide variety of forest management objectives that require healthy and sustainable conditions. Thinning will also aid in achieving a balance of stands in all of Langsaeter's Zones necessary for healthy and sustainable forest conditions.

Case studies of thinning experiments. Langsaeter developed the theoretical concepts of growth, competition, and stocking levels that provide the basis for thinning and other silvicultural practices. His concept does not, however, provide the kind of information necessary for specific forest types. Fortunately, such insight is available from carefully control long term

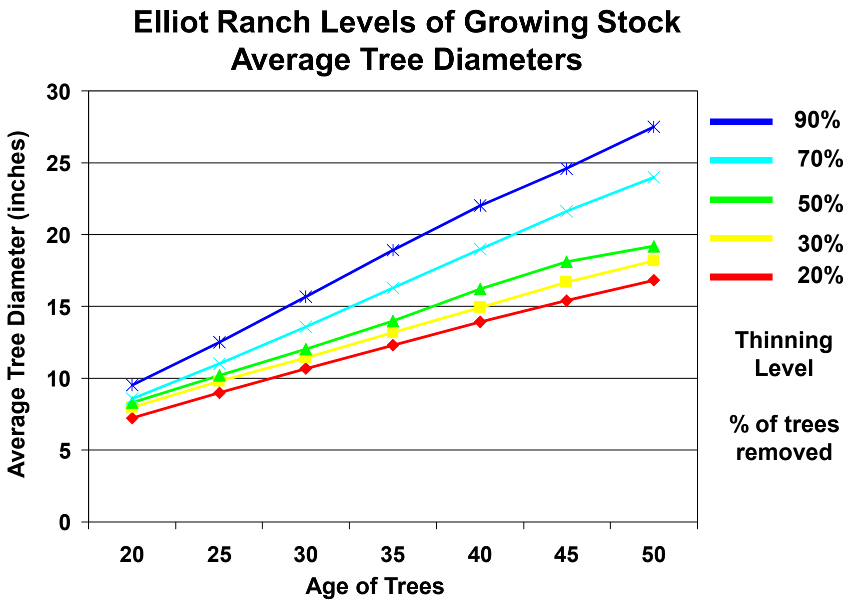
---

[9] Protecting People and Sustaining Resources in Fire-Adapted Ecosystems. A Cohesive Strategy. April 13, 2000. The Forest Service Management Response to the General Accounting Office Report GAO/RCED-99-65.

[10] American Forest and Paper Association. September 5, 2002. Healthy forests don't just happen. A news release of the American Forest and Paper Association. Washington D.C.

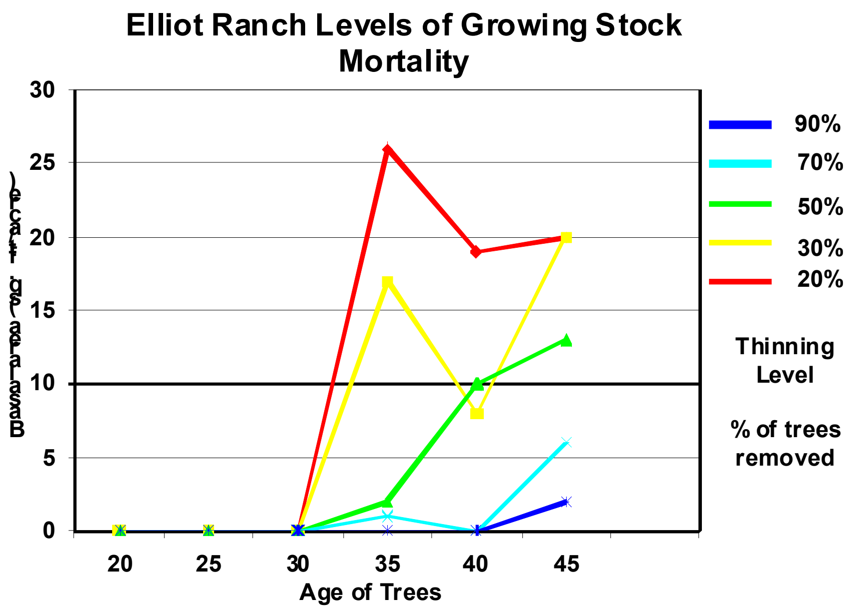
Levels of Growing Stock Studies (LOGS). One such example is the Interior Ponderosa Pine LOGS study with studies scattered throughout the Ponderosa pine range from Canada to Mexico. These study sites balance the range of site productivity variables from very low to very high productivity. One of the highly productive LOGS sites is the Elliot Ranch LOGS plots located on the Tahoe National Forest near Foresthill, California.

At the Elliot Ranch site, five levels of thinning were applied to a 20 year old Ponderosa pine plantation in 1970 that resulted from a 1950 wildfire. Each of the thinning plots had between 500 to 681 trees per acre before the first thinning with tree diameters between 6.6-7.2 inches. The heaviest initial thinning treatments removed approximately 90% trees, the next treatment 70%, the next 50%, then 30%, and the lightest thinning removed 20% of the trees to develop the 5 levels of growing stock. Three additional thinnings were applied 10, 15, and 20 years after the first thinning. All of the trees were measured every five years for a variety of tree characteristics such as diameter, height, mortality, live crown ratio, etc. Per acre values for volume in cubic feet and board feet, growth and mortality were developed from the basic tree measurements. Summarizing some of the key data results in the following illustrative graphs:



After 30 years, the widest spaced treatment yield trees with an average diameter of 27.5 inches. The narrowest spacing resulted in trees with an average diameter of 16.8 inches or 10.7 inches smaller than the widest spacing, a 61.7% reduction in diameter growth. This could be very critical in meeting restoration objectives especially in areas devastated by wildfire and lacking the larger diameter trees necessary for wildlife habitat needs. As an example, California spotted owl guidelines require leaving trees greater than 30 inches in diameter. The LOGS plots provide ample evidence that thinning can play an important role in accelerating diameter growth rates. This does not mean that you will have California spotted owl habitat once the trees reach 30 inches in diameter. But what is informative is that the tree diameter requirements can be substantially influenced by thinning levels.

There are numerous attributes that can be displayed for all of the measured and calculated variables too numerous for this testimony. However, mortality is one of the key variables for forest health discussions. The general rule from research results is that mortality generally increases as stand density increases. The amount of mortality varies considerably by species and seasonal factors such as drought induced stress. The following graph displays the mortality for the period 1970 to the measurements in 2000 at the Elliot Ranch LOGS site:



At ages 25, 30 and 35 mortality was minor. However, between the age of 35 and 40, mortality started to significantly increase in the highest density plots that only removed to 30% and 20% of the initial stocking. By age 45, all plots had some mortality with the widest spaced trees having only 2 square feet basal area[11]/acre of mortality and the narrowest spaced trees had 20 square feet of basal area/acre. Translating these results in Langsaeter Zones, all of the initial thinning treatments were operating in Zones I and II for the first 15 years. After 20 years, the 90% initial thinning has been in Zone I and II; the 70% level in Zone II and III, the 5o% level in Zone III and the 30% and 20% in Zone III and IV. It is fairly obvious that these two light thinning treatments need another thinning to maintain their health and vigor.

Another excellent example of LOGS studies and benefits from long-term forest management research is that the results can be used to evaluate environmental effects of thinning and

[11] Basal Area. The sum of the square feet contained in the cross section of trees generally measured at breast height (41/2 foot above the ground on the high side of trees). As an example, a tree 16 inches in diameter at breast height has 1.4 square feet of "basal area" which is equal to the area of a circle 16 inches in diameter. If a stand contained 100, 16 inch trees in one acre, the basal area/acre would be 140 square feet per acre.

prescribed burning as common management practices. This was recently accomplished in a long-term study in Ponderosa pine forest located near Bend, Oregon[12]. The study addresses whether their combined use is required to lower present-day fire risk and help restore natural ecological function; or whether fire or thinning alone is sufficient to attain these goals. The use of thinning as a fire surrogate is not well understood. The draft manuscript documents the effects of 16 treatments focused on thinning; a combination of thinning and broadcast burning; broadcast burning alone and fertilization on stand growth, understory development and biological diversity. This study is located on the Deschutes National Forest in the Interior Ponderosa pine forest type in eastern Oregon. This manuscript documents the observations of a study initiated in 1989 and includes all re-measurements through 2006. The results documented nearly two decades of thinning and prescribed fire effects and identified the following five conclusions:

1. *Positive responses of ponderosa pine and understory shrubs to thinning alone;*
2. *Inconsequential effects of surface-applied thinning residues on vegetation response;*
3. *The need for multiple entries of prescribed fire if the abatement of shrub growth is required;*
4. *The ineffectiveness of repeated burning to stimulate herbaceous biomass production or diversity in these nutrient-poor forests, and*
5. *That thinning mimicked most ecological functions attributed to fire and was a key first step to restoring healthy and firesafe forests[13]."*

Thinning to reduce the effects of wildfire. There is substantial antidotal evidence that thinning will reduce the adverse effects of wildfires. Thinning significantly reduced fire severity and stand damage on the following fires: Hi Meadow, Colorado; Megram, California; Webb, Montana; Cerro Grande, New Mexico; Tyee, Washington; Cottonwood, California; Hochderffer, Arizona; Fontainebleau, Mississippi[14]. These and other antidotal evidence from recent fires throughout Oregon and Washington and the interior west provide the best evidence of the potential of thinning to reduce the adverse effects of wildfire.

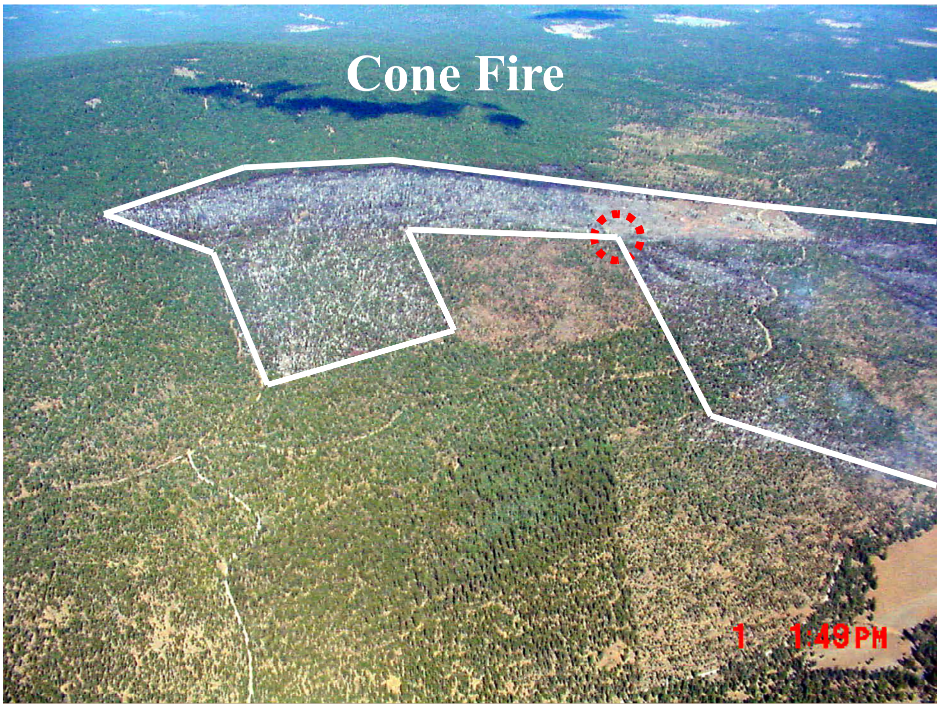
Carefully control research is lacking in the area and it is almost impossible to test the hypothesis that thinning will reduce the effects of wildfires with complete scientific rigor. Placing a statistically sound research design with replications and a variety of treatments would have to be done before the wildfire occurred. Even though wildfires are widespread, the control research problem is exacerbated by the difficulty of predicting where and when the wildfires would occur.

In spite of these problems, accidents do occur on research plots that help provide some of the best quantifiable and pictorial evidence of the effect of thinning on fire behavior and subsequent

---

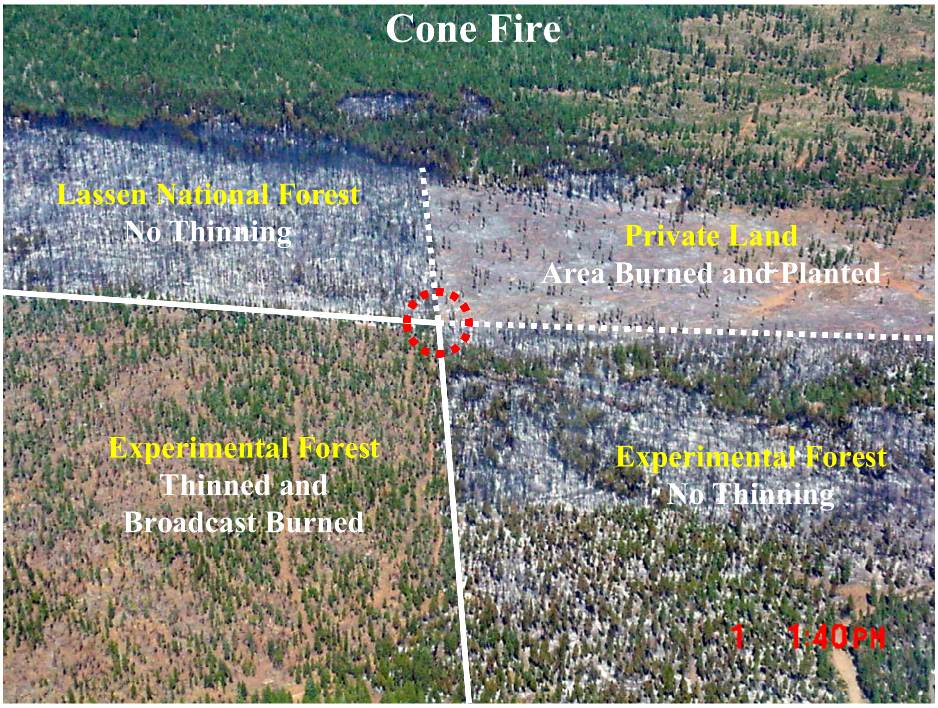
[12] Busse, M.D. et al. 2007. Is mechanical thinning an ecological surrogate for fire in Ponderosa pine forests? Peer Review Draft subject to changes. USDA Forest Service, Pacific Southwest Research Station. Redding California.
[13] Ibid.
[14] Skinner, Carl N. 2003. Forest Fires and Forest Fuels Power Point Presentation. Based upon Omi and Martinson 2002 data. USDA Forest Service. Pacific Southwest Research Station, Redding, California.

stand damage. One such example occurred in 2002 on the Blacks Mountain Experimental Forest in the Interior Ponderosa pine forest type found throughout western United States. Three general conditions were present on the Blacks Mountain Experimental Forest when the Cone Fire occurred. Two large scale thinning treatments (250 acre replicated plots) and the unthinned areas between the thinned plots were present. In addition, substantial areas adjacent to the Experimental Forest were also unthinned. The Cone fire occurred when fuel moistures levels were between one and six 6percent and wind speeds were nine miles per hour with gusts up to 20 mph. The fire was control after burning through a full suite of the experimental research conditions and the unthinned forest. The following pictures vividly demonstrate the results of the wildfire.



The area within the generally square white area was experimentally thinned to create a forest with high structural biological diversity. The area below and to the right of the red circle was designed and thinned to achieve low structural diversity. All of the similar replaced plots were in place before the Cone Fire burned through the Experimental Forest in September, 2002. The Cone Fire started at the pointed area outlined in white on the far left of this aerial photo and burned toward the left side of the photo. The white line delineates the fire boundary. The fire burned through the square area thinned for high structural biological diversity. The low structural diversity plot to the left of the white line and below the red circle did not burn due to the lack of fuels following implementation of the thinning and broadcast burning.

The next photo shows a close up of the area surrounding the red circle in the above photo. Here the thinning and lack of thinning are fairly obvious.



In the upper left quarter of the photo, the area defined by the white lines is the Lassen National Forest with almost 100 percent mortality in an area that was not thinned prior to the Cone Fire. The lower left hand quadrant is the thinned low structural diversity research plot with less than 1-2 percent overall mortality. Most of that mortality occurred at the boundary of the unthinned Lassen National Forest where the fire was very intense heat from the crown-fie. The crown-fie moved rapidly fire through the unthinned portion of the Lassen National Forest to the Private Land in the upper right quadrant of the photo. The private land looked similar to the area immediately above the private land burned in the Cone Fire. This was a young planted sapling forest with annual grasses and brush understory composition.

As the fire moved from the private land back on to the Experimental Forest in the lower right quadrant, it encountered an unthinned portion of the Experimental Forest. Notice how immediately the fire resulted in complete killing of patches as it regained its strength. As the fire continued, it regained full strength as it moved through unthinned forest until encountering other research plots that had been thinned. Every time the Cone Fire encountered another thinned research plot, the crown-fie became a manageable ground fire.

The next two photos show the stark contrast between the unthinned forest and the thinned forest treatments. The most recent research publication documenting the five year results of the Cone fire concluded crown-fire spread and severe tree mortality was significantly reduced when advancing flames reached research areas that were recently thinned and underburned[15].

Unthinned area

Thinned Area

The Cone Fire story is a good example of what can be learned from having a research quality experiment in place before a wildfire occurs.

Similar observations are being developed from careful analysis of other recent large scale wildfires. A recently released 2007 study of a large wildfire's effects in northeastern California describes the effects of wildfire and suppression efforts on areas with in-place fuel treatments, areas with no treatments and impacts on protected areas[16]. The Wheeler fire was caused by lightning and started on July 5, 2007, burning 23,420 acres of mixed conifer and Interior Ponderosa pine forest types. The fire burned through areas treated for fuel hazard reduction, untreated areas, and areas protected for California spotted owl and goshawk habitat (Protected Activity Centers and home range core habitat) as well as Riparian Habitat Conservation Areas. Key findings from Fites et al. research were:

1. *Treated areas had significantly reduced fire behavior and tree and soil impacts compared to untreated areas.*
2. *Treated areas were utilized during suppression along several flanks of the fire for both direct attack with dozers and handcrews, as well as for indirect attack with burn operations.*
3. *Treated areas that burned during the first two days—when suppression resources were limited and fire behavior more uniformly intense—had reduced fire effects*

[15] Ritchie, Martin R., Skinner, C.N. and Hamilton, T.A. 2007. Probability of tree survival after wildfire in an interior pine forest of northern California: Effects of thinning and prescribed fire. Forest Ecology and Management 247, 2007, 200-208.

[16] Fites, JoAnn, et al. August 2007. Fire behavior and effects relating to suppression, fuel treatments, and protected areas on the Antelope Complex Wheeler Fire. USDA Forest Service.

compared to untreated areas. In some areas, these treated sites had moderate to high severity effects.

4. *A Defensible Fuel Profile Zone treated area provided a safe escape route for firefighters when the column collapsed and two other escape routes were cut off by the fire.*
5. *Observations of fire behavior during the first two days suggest that large untreated areas allowed the fire to build momentum and contributed to increased fire behavior (rate of spread and intensity). Thus, the influence of these untreated areas made it more likely that suppression resources could be overwhelmed, treated areas could be threatened and their effectiveness in thwarting fire spread and intensity diminished.*
6. *Satellite imagery reveals that protected areas (owl and goshawk nest stands) had significantly greater tree severity compared to untreated or treated areas. A majority of the larger blocks of untreated areas contained these concentrations of owl and goshawk habitat protected areas*[17].

<u>Expanding thinning research beyond growth and yield studies</u>. As mentioned earlier, most the research basis for thinning was designed to improve opportunities for increased growth and yield of forest products. Secondary goals included addressing questions on how to improve the overall health and vigor of forest stands. The concept of thinning has growth well beyond those earlier growth and yield objectives especially with the notion that thinning has utility in meeting a wide variety of forest management objectives such as restoration and fuels reduction. Modern thinning research, development and application programs focus on thinning to achieve a wide range of objectives rather than traditional growth and yield objectives. As an example, electronically searching the Forest Service Research Web Page (literature citations sub page) using "thinning" as the key word for a literature search from the period 1988 – 1997 was conducted during the week of December 3, 2007[18]. The electronic literature search listed 106 publications responding to the keyword thinning. Using the same thinning keyword and changing the date to the last ten years resulted in 634 publications. That is a 598 percent increase in the number of publications over the previous decade. The vast majority of the recent thinning papers addressed restoration, fuels reductions and other ecological values. An excellent example of this is the publication:

> "*Restoring Fire-Adapted Ecosystems: Proceedings of the 2005 National Silviculture Workshop. June 6-10, 2005. United States Department of Agriculture, Forest Service. Pacific Southwest Research Station General Technical Report PSW-GTR-2003. January 2007."*

---

[17] Fites, JoAnn, et al. August 2007. Fire behavior and effects relating to suppression, fuel treatments, and protected areas on the Antelope Complex Wheeler Fire. USDA Forest Service.

[18] Forest Service. December 2007. Research Tree Search Web Page http://www.treesearch.fs.fed.us/pubs/results.jspErU

This General Technical Report contains 27 individual papers from across the nation dealing with research, development and application projects. Just about all of them address thinning as a tool for restoring our forests or reducing fuels.

Even though we have this developing body of knowledge, we must keep in mind that the principles gained from historic thinning experiments and management results have application to a wide variety of forest management objectives. Long-term studies demonstrate the natural ability of forest trees respond within thinned stands and regain full site occupancy. This fact leaves land managers with valuable options for current future ecological consideration in thinning operations. Stands that have been thinned regardless to the original objective, respond with rapid growth rates on the remaining trees. Depending on how much has been thinned, the stands fill in the thinned areas in a relatively short period of time. That is a dramatic opposite of long time required for stands recovery in stands devastated by the effects of wildfires or epidemics of diseases or insect infestations. The results from the LOGS plots and other control research clearly demonstrate this principle. This resiliency and re-growth will aid land managers in achieving current and future ecological or environmental objectives.

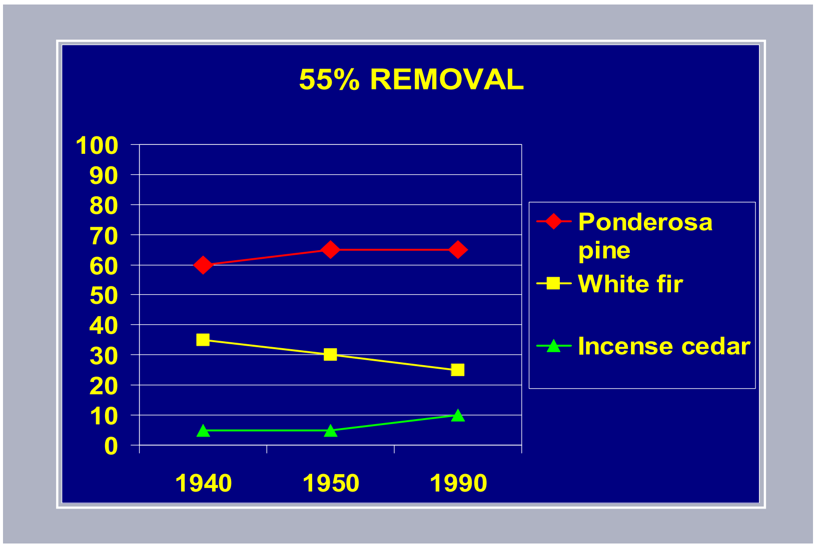
Even if these goals were not specifically addressed in older thinning operations, most thinnings rarely eliminate future ecological considerations options. An operational example of this occurred in 1973 when I was a silviculturist on the Mad River Ranger District of the Six Rivers National Forest. During this time, the Forest Service was charged by Congress to accelerate our harvest volumes using thinning or sanitation harvest practices that are generally referred to as intermediate harvests. Our clear goal was to put additional timber sale volume in the marketplace. I was given that task for our share on the Mad River Ranger District. I chose to thin a 200 acre 110 year old stand of overstocked Douglas-fir. The stand had a basal area 240 square feet per acre. My prescription cal for thinning the stand to 55% of normal basal area. The stand was thinned down to 130-140 square feet/acre utilizing a classic thin from below approach using skyline logging system to harvest the trees. The sale generated around 10 thousand board feet/ acre of high value Douglas-fir trees that generated around $2 million of revenue for the treasury.

Ten years later, Six Rivers National Forest personnel invited me back to see the results of the thinning and re-measure the stand growth response. Immediately after thinning, the stand was opened with 30% of the area open to blue sky when viewed from the ground. By 1983, there was very little blue sky available since the crowns had completely filled in all of the open growing space. The basal area per acre was back to 240 square feet per acre. The amount of live crown ratio on the trees was between 30-40 percent. Prior to thinning, the trees averaged around 20% live crown ratio. These results indicated the individual trees were very healthy and the stand was healthy with very little new mortality.

But the most important story was the northern spotted owl story. Spotted owls were not a special concern in 1973. By 1983 they were the crucial environmental issue for older forest conditions. In 1973 the sale area was never surveyed for spotted owls. By 1983, trees in the sale area were now 120 years old and definitely qualified as nesting habitat for the northern spotted owl. At that time, the thinned area was occupied by nesting spotted owls and was one of the best nesting habitats on the Six Rivers National Forest. Thinning of the entire 200 acre stand ten years earlier did not render the habitat unsuitable for owls.

One of the unintended consequences of "doing nothing" in special areas like spotted owl habitat, streamside buffer zones and old-growth reserves is the severe consequences from wildfires, insect and disease problems and other biological risks. Thinning definitely has a place in special areas and "doing nothing" will lead to some unintended consequences. A good example of this is long-term changes in species composition. Forests are obviously dynamic ecosystems constantly changing. Forest health goals could be easily achieved by "doing nothing" if they were static entities without risk. The dynamic nature of stands is emphasized in research results from "Methods of Cutting Trials" initiated in the late 1930's on the Blacks Mountain Experimental Forest. These results provide insight into species composition changes based upon ten year remeasurements data of the changes that occurred for a period of 50 years.

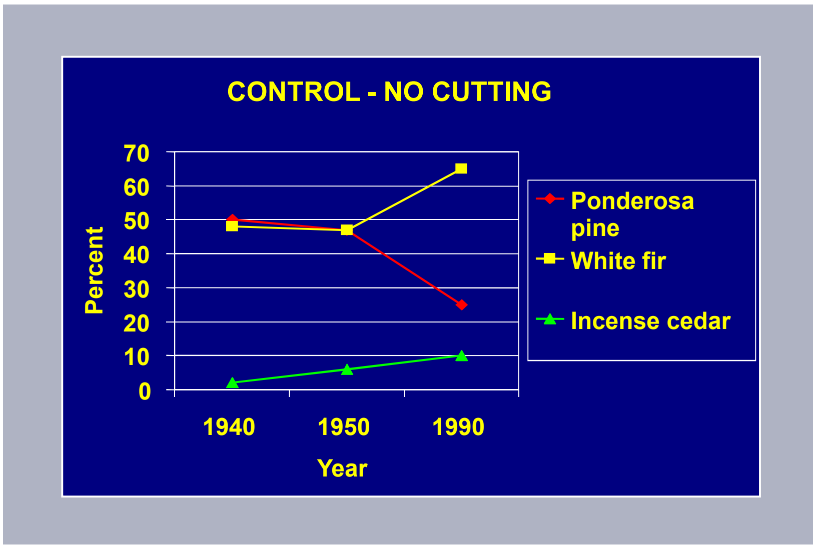
Five replicated research thinning treatments increasing the volume removed from a light thinning removing 10-15 of the volume to complete removal of all merchantable trees was span of the treatments.[19] For comparison, a control with no cutting was included in the experimental design. The research plots were re-measured every 10 years for 50 years. For this testimony, one of the five treatments is displayed below to demonstrate the effect of thinning contrasted to no thinning. The thinning treatment selected for this example removed 55 percent of the volume in 1940. This is compared to no thinning throughout the 50 year period. The graphs represent the effects on species composition as follows:



[19] Dolph, K.L., Mori, S.R., Oliver, W.W. 1995. Long-term response of old-growth stands to varying levels of partial cutting in the eastside pine type. Western Journal of Applied Forestry. 10, 1-1-108.

Notice that the percent of Ponderosa pine remained relatively constant over the 50 year measurement period. The predominate old-growth species was Ponderosa pine on this site before the treatment and Ponderosa pine maintained that dominance 50 years later. White fir declined from 35% of the species composition in 1940 to 25% in 1990. Incense cedar increased slightly during this period. The general conclusion from this data is that overall species composition remained relatively constant over the 50 year period even though 55% of the volume was initially thinned in 1940.

Contrast that with "doing nothing" from similar data gathered on the control plots in the following graph:



Ponderosa pine declined from 50% of the stand composition to 25% during the 50 year period. Insect mortality was the cause of the decline in species composition as the old-growth pine trees declined in health and vigor at the same time shade tolerant white fir began to occupy and compete for growing space in the unthinned stand. Incense cedar also increased by almost 10% over the 50 year period. Today, the control plot continues to have the highest amount of annual mortality. Unfortunately, most of this mortality is in the remaining old-growth Ponderosa pine. White fire is rapidly becoming the dominate species on a site that was once dominated by old-growth Ponderosa pine. These data indicate that "doing nothing" will have consequences. The importance of these critical changes and consequences is dependent upon the objectives established for the stand or forest.

Economics of thinning. The classic reason for lack of strong thinning programs on federal lands is the value—or lack thereof, for the products removed. This is especially true for the smaller diameters. Stands with diameters too small to allow commercial thinning have been thinned with appropriated funding on federal lands. Early thinning in the life of a stand has historically been classed as "precommercial thinning." Policy established in the 1960's placed restrictions on precommercially thinning trees greater than eight inches in diameter. Trees greater than eight inches were considered close to the meeting most of the minimum diameters for sawlog trees in those days. Trees less than eight inches limit were routinely precommercially thinned prior to the 1990's in western national forests. Most of the effort was in natural or planted stands with very high densities per acre. The rate of precommercial thinning was determined by annual federal appropriations and the amount of Knutson-Vandenberg funding generate for this purpose from timber sale activities.

Today the situation has changed. Stands that were precommercially thinned before 1990 are now being sold as commercial products if the local infrastructure is in place. Sawmill technology has been developed to improve utilization of trees down to six inches in diameter. Some plywood veneer plants can easily process logs from small diameter trees and can peel logs to a core of around 2 inches in diameter. In northeastern California, there is a strong infrastructure in place for processing biomass into electrical energy. Successful thinning programs selling a combination of sawlogs and biomass chips can be sold by the federal agencies. These are all positive steps to help improve utilization of small diameter trees. It is imperative that national energy policies recognize the important role woody biomass converted into electric can place reducing oil imports. In this case, our forest management policies are directly related to energy policies. Energy policies that encourage use of excess biomass off of our federal forest lands should be encouraged and supported in the next round of energy bills.

Unfortunately, this infrastructure is in not in place universally throughout the western, intermountain and southwestern areas of the United States where most of the fire risk and thinning opportunities occur. Establishing a sound energy policy that encourages, rather than discouraging investments in biomass plants can go a long way in attracting industry to areas where the forest products industry has been devastated by the dramatic drop in federal timber sales that began in the 1000's. Fortunately, small log processing and thinning programs are less problematic in the Midwest, southern and eastern forests. The infrastructure is generally in place and small log processing has been a staple of the forest products industry for decades.

The pace and scale of thinning on federal lands lags far behind what is necessary to effectively reduce the threats to fire, insects and diseases. The Stanislaus National Forest adjacent to Yosemite National Park is fairly representative of a typical western national forest. The following table indicates fire condition classes on the Stanislaus National Forest. Fire Condition Class III represents the worst situation, II the next, and Condition Class I the least overall risk to fire[20].

Fire Condition Class	Acres	Percent of Land Base
III	313,566	35.0
II	359,356	40.1
Sub-total	672,922	75.1
I	222,578	24.9
	895,500	100.0

Seventy-five percent of the entire forest is in the higher condition classes and is a priority for treatment to meet the goals of the National Fire Plan. Approximately 85% of the class II and III lands are forested and the remainder is highly flammable brush and grass areas. How many acres per year would have to be treated to reduce the Condition Class by at least one level if one wanted to accomplish that goal in 10 years? Obviously, the answer is 67,292 acres. The forest is actually accomplishing substantially less than 1/10 of the 67,292 acres. The irony is that near the Stanislaus National Forest a substantial industry infrastructure exists including sawmills and a 30 megawatt biomass power plant. The biomass plant is capable of burning 240,000 bone dry tons of biomass every year to produce their electricity. If all of that woody biomass was to come from typical Class III and II forested acres with two products removed, sawlogs and biomass chips, the 30 megawatt plant could utilize the chips off of approximately 17,700 acres per year. Similar relationships are found on every western national forest. This is an extraordinary opportunity from one standpoint, and a disaster waiting to happen from another.

Why is the pace and scale so slow? The easy answer is lack of sufficient federal appropriations but the answer is much more complicated than simply budget problems. In order to develop some information on possible causes, I conducted an informal survey of American Forest Resource Council (AFRC) members and staff. AFRC has a federal timber sale monitoring system in place that monitors on a quarterly basis the progress of timber sales and stewardship contracts on every national forest in Washington, Oregon, California and some national forests in Idaho. Based upon this informal survey, the following reasons were identified as delaying progress of thinning timber sales or stewardship projects designed to reduce fuels. All of these are related to economics including use of scarce appropriated funds.

1. Appeals and lawsuits. Dealing with appeals and lawsuits demands so much time, effort and financial resources from federal line officer's, staff and specialists. Some forests appear to just be afraid of the hassle of potential appeals and litigation that their programs lack a targeted and aggressive approach focused on minimizing the risk of appeals.

[20] Stanislaus National Forest Planning File Data. March 5, 2005. Stanislaus National Forest, Sonora California.

2. Budget. Forests work with the uncertainty of Continuing Resolutions, coup with declining resource management budgets. Fire suppression costs are draining natural resource budgets in a constrained federal budget perspective. Annual fire suppression costs are constantly increasing while resource management funds are constantly decreasing. For more information on this issue see the National Association of Forest Service Retiree's Wildland Fire Fighting issue paper.[21]

3. Accountability. The lack of real accountability in the system, for meeting targets or taking on difficult priorities, is hurting the system.

4. Inexperience. Too many line officers do not have a reasonable resource and management background. Supervisors and Rangers whom have never been responsible for meeting targets, budget preparation and accountability have been weakening the process. Most new Line Officers at the Ranger level are also poorly trained in fire fighting management which may correlate to their lack of understanding of the urgency for fuel reductions and dealing appropriately with their overstocked forest conditions.

5. Downsizing of the ranks of field foresters. Preparation of thinning projects requires highly skilled timber sale and stewardship contract personal. Personnel with strong backgrounds in sale layout, silviculture, logging systems, and contract administration are generally found on successful thinning projects. Where they are absent, those projects are the most problematic. The missing skills are often the result of loss of qualified people to retirement and a lack of recruiting replacements in the forester ranks for the past 15 years. The agencies have been unable or reluctant to fill these crucial positions because of constant downsizing to react to and ever decreasing budget.

Value consideration plus the generally high cost of removal of smaller diameter logs and high transportation costs require careful economic considerations throughout the decision process for thinning programs. Unfortunately, that is not the case on small log sales and stewardship projects. The following economic considerations are problematic on the national forests and Bureau of Land Management programs AFRC has monitored.

1. Low volume per acre. Marking is too light to achieve fuels reduction, restoration, silvicultural or economic objectives. Conservative marking is problematic on just about every sale offered or sold. Conservative marking also results in minimally effective fuel reduction efforts and continuation of fuel ladder problems throughout those stands treated.

2. High cost logging systems. Poor road location, timber sale layout and harvest system choices have resulted in excessive logging costs. This is especially true when helicopter yarding is selected for thinnings. Opening or constructing temporary roads could be employed to utilize

[21] National Association of Forest Service Retirees. January 25, 2007. NAFSR ISSUE PAPER Funding Wildland Firefighting. Lincoln, California.

conventional logging systems and eliminate or greatly reduce the need for high cost helicopter logging.

3. Low product value (small diameters). Most of the higher value from trees sold as sawlogs comes from clear wood associated with larger diameter trees. Smaller diameter trees do not contain large amounts of the high value clear grades. The lower value sawlogs coup with large amounts of non-sawlog material such as chips or biomass that must be removed, chipped, or burned substantially lowers the value of the products removed. A key solution for improvement is to increasing the amount of merchantable sawlog to economically cover the cost of removal, chipping or burning of non-sawlog material.

4. Product understanding. Not every sawmill can process the low end of the small diameter trees. Even with mills that specialize in small diameter logs, they also need a mixture of larger diameter trees to balance economics of manufacturing of small diameter trees.

5. Diameter Limits. It does not make sense to enact a diameter limit in a stand that needs to be thinned or is being attacked by insects or diseases. Forest managers generally understand the need or objective to achieve a healthy forest stand condition. Diameter limits, however, are the absolute wrong limitation to place on thinning prescriptions. The paramount objective should be leaving healthy individual trees that meet stand management objectives, overall stocking goals and economic considerations necessary to achieve the healthy condition. A classic example of diameter limits that hinders achieving healthy forest objectives is the 21" diameter rule from the “Eastside Screens” for eastern Washington and Oregon forests.

6. Standards and guidelines limit effective economic practices. Some forests are using outdated standards that are based on logging equipment used in the ‘70’s and ‘80’s. This results in severely restricted operating seasons. The most severe example is using helicopter logging while flying over roads already in place and serviceable because of the fear of ground compaction. In addition to outdated standards, a plethora of new standards have significantly restricted operating seasons to the point where it is problematic to find windows where the purchasers can log the sales.

7. Appraisal system. The current appraisal system does not do a good job of separating types of sales when they group sales in large geographic areas to acquire their base sale values used in transaction evidence appraisals. The appraisal system does not respond to rapid changes in market conditions since it is based upon past transactions. Appraisal personnel have limited understanding of logistics or costs involved in doing a project because of the reliance of computer based transaction evidence appraisal.

Most of the economic problems cited can be resolved without compromising or adversely affecting resource values. National, regional, and local efforts must be substantially improved in order to improve the economic viability of federal thinning programs.

Social aspects of thinning. The public willingness to thin our forests and reduce the threats from wildfire has greatly changed in the last decade. During this time, vivid images on television of catastrophic wildfires have dominated the news concerning national forests and public lands. Major wildfires have occurred in just about every state west of the Mississippi. Lives have been lost and property destroyed. Suppression costs have ballooned into billions of dollars every year. The most significant impact on threatened and endangered habitat has been loss to wildfires. Watersheds have yielded tons and tons of sediments into our nation's rivers, lakes and reservoirs. Calls for action have been posted in editorials from small town weekly papers to major city dailies. Western Governors have held numerous conferences encouraging and demanding action. The Healthy Forest Restoration Act was passed. Given all of this, it is easy to say the national will to do something has been established and is there to support our federal agencies actions—but "how" to do this has never received unified support.

Support for local solutions has been very prevalent in local communities adjacent to and surrounded by federal forest lands. The problems of overstocked stands and wildfire threats are universally understood. This has led to wide acceptance of the need for aggressive active programs in local communities to deal with the problem. Realization of the threats from wildfires on the Wildland Urban Interface has led to the formation of community coalitions and Fire Safe Councils throughout the West. The need to undertake fuels reduction efforts is generally well supported by local citizens and county officials. As a generalization, the closer one is to the problem of overstocked forests, the greater the support for thinning to reduce the problem.

Active citizen coalitions designed to help the federal agencies develop effective programs are present in just about every location near federal lands. They are generally focused on improving the pace and scale of thinning and fuels reduction by providing unified support for active programs. As a recent example, a coalition of diverse individuals near Bend, Oregon is working together to develop prescriptions for encouraging thinning of overstocked stands near the Black Butte Ranch. Their goal is an attempt to reach common ground and develop support for thinning programs, reduce conflicts and improve trust between diverse groups. The Bend Bulletin highlighted this program in a recent newspaper article:

> *"The 20 or so people from the U.S. Forest Service, timber industry, conservation groups and some who just live nearby stood in the ponderosa pine forest next to Black Butte Ranch. Armed with 11 different colors and patterns of marking tape, they set out with a goal to flag which trees they would save, with the other ones left to be cut, if they were making the decisions.*[22] *"*

Their solution will undoubtedly be relatively consistent for removing small diameter trees and brush as such actions are relatively free of conflicts. As the diameter of trees identified for removal increases, potential conflicts increase. Unfortunately, to be effective in dealing with

---

[22] Ramsayer, Kate. November 16, 2007. Field trip helps forge trust among diverse interests. Bend Bulletin. Bend, Oregon.

current and potential forest health considerations, trees must be removed from all size classes. The critical problem for community is how to develop support for this concept. Based upon personal observations from critical situations, this is the essential problem in building effective solutions.

As an example, the community of Lake Arrowhead in the mountains surrounding Los Angeles has been a beautiful and restful place for thousands of southern California citizens. The residents and visitors to the community love their trees, their urban forest and the surrounding mountains. Their love for their urban forest manifested into City ordinances that made it very difficult to cut any tree within the city limits. Hence, very few trees were removed over the last two decades. As early as 1994, some people were predicting that lack of management in the area surrounding Lake Arrowhead would lead to potential problems with overstocking, insect mortality and ultimately severe wildfires.[23] At a Congressional Subcommittee Hearing Dr. Thomas Bonnicksen stated that he had, "been working on restoring beetle-killed forests in these mountains with Forest Service professionals almost continuously for most of this year, and I had warned of a possible tragedy as early as 1994.[24]" Even though Bonnicksen's early warning was sounded, little action was taken in subsequent years by those who had chartered and received his 1994 situation analysis.

Over the last few decades, their once beautiful urban forest (and most of the San Bernardino National Forest) reached Zone V stocking conditions found in Langsaeter's growth curve with the predictable increases in insect caused mortality. By 2000, bark beetle insect populations began to expand as they thrived in this favorable environment exacerbated by adverse effects of drought. Within three years, over 600,000 acres of forest lands surrounding Lake Arrowhead were suffering severe insect mortality. The local call to finally do something was loudest in Lake Arrowhead and other mountain communities. Unfortunately, it was too late—especially for the old-growth pine. Massive efforts were then undertaken to remove thousands of dead trees within Lake Arrowhead and other communities. The problem dramatically changed from insect mortality to wildfire prevention which unfortunately devastated the Lake Arrowhead and other communities in 2003 and 2007. The social question was, "which of our forest communities would be next and how can we develop support to protect our communities and forests?"

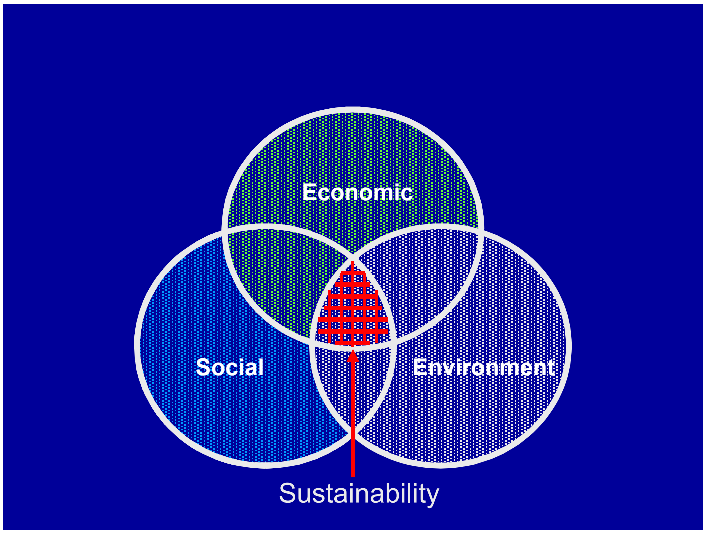
Some of the communities have been listening and have attempted implementing preventative actions. One of the biggest hindrances to implementing community based solutions is frustration with the process--especially the appeal and lawsuit aspects. The best example of this is the suite of appeals and lawsuits that have been placed in front of full implementation of the Herger-Feinstein Quincy Library Group Forest Recovery Act ("QLG Act"), P. L. 105-277. Ever since the law was passed and the Forest Service prepared their draft Environmental Impact Statement,

[23] Bonnicksen, Thomas M. December 5, 2003. Witness testimony. Hearing on recovering from the fires: Restoring and protecting communities, water, wildlife, and forests in Southern California. Before the Committee on Resources, Subcommittee on Forests and Forest Health. Lake Arrowhead, California.

[24] Ibid.

numerous process delays, appeals and lawsuits have been put in the path of implementing this classic community based solution for a large portion of the Plumas, Lassen and Tahoe National Forests. Most of the projects initiated under the QLG framework have now been through NEPA three times due to appeals and lawsuits; some have been through NEPA five times. It is absolutely amazing that members of the QLG coalition are still aggressively working to implement reasonable programs supported by the QLG legislation. The local communities are still willing to support the federal agencies, but certain segments of society remain obstacles as they wield one process delay after another.

<u>Conclusion - Sustainability of thinning</u>. Three major factors are critical for sustainability of thinning programs. These have been highlighted in many forums over the last 15 years. They are often represented by the theoretical blending of social, environmental and economic considerations in the following manner with sustainable solutions at the intersection of all three circles.



With thinning, the environmental need is huge for restoration and fuels reduction on our national forests and B.L.M. public lands. The economic opportunities are there if the agencies are willing to cut the necessary trees to make their efforts economically viable. If not, they will have to rely on ever increasing federal appropriations in a highly competitive federal budget. Both the environmental aspects and economic aspects are bound by substantial time tested realities. There is a "bottom line" that these boundaries cannot be crossed in order to achieve sustainability for these two elements. Fortunately, there is a broad solution space for sustainability in these two elements. Unfortunately, the agencies are generally not using the entire solution space.

The question is, "Why are the agencies not using more of that solution space?" The answer is that the social aspect of sustainability is the most problematic. Some have been seeking the elusive consensus that is so easy to talk about, but so difficult to achieve. People still have vastly differing solutions ranging from aggressive management to “doing nothing”. Until people realize there is a problem—little action will be initiated. Even when actions are proposed, appeals and lawsuits will inevitably be used by those opposed to actions. Especially when those actions require removal of trees in a commercially viable timber sale or stewardship project. Developing socially acceptable solutions that truly blend with the environmental and economic considerations will be impossible if those who oppose actions continue with their ability to use the process, appeals and courts to override economic and environmentally sustainable solutions.

The Lake Arrowhead example and others indicates that local socially acceptable solutions can be achieved. However, it usually takes a potential or real crisis to achieve local actions. Those who support early aggressive actions are usually over-ruled until the crisis actually occurs. People will come together to help develop socially acceptable solutions only at the time of crisis. Once they realize there is or will be a significant problem, they will cooperate and work with the agencies to develop solutions. They may still have vastly different views of the range of possible sustainable solutions. Generally, the closer they are to the problem and more likely to receive benefits from the solution, the quicker they will agree on socially sustainable solutions. Once they unite on a solution, they will aggressively support the action similar to the Quincy Library Group.

However, there is a relatively narrow window in time of when this local support will continue. If the communities do not see meaningful results and aggressive cost effective programs from their federal land managers, their support will disappear. That is the case in many of the western communities because of a relatively tepid agency approach in dealing with the problems. There are many in local communities who honestly question the relevancy of the Forest Service and to some extent the BLM to local communities. Agency leaders and political entities must step forward and provide the leadership and programs where their actions truly speak louder than words.