Complexity in fire ecology: The Case of the Biscuit Fire

Introduction

Are we ready for ecosystem management? Having my sanity questioned for asserting that the Biscuit fire resulted in various positive ecological benefits maybe an indication. The writer claimed it was like saying bombing the "Twin Towers" was a good event. Biscuit and "9/11" were both toward the tails of the normal distribution, both had a profound immediate effect, and in both cases the political fall-out will continue long after structural recovery. But fire is not an event; it is a process that drives natural selection. Unlike terrorism it is essential and the extremes we label as catastrophic are every bit as important in shaping the landscape and driving natural selection as the chronic effects of insects and diseases.

Ecologically and socially we have difficulty accepting acute change. (Social acceptance is generally inversely related to the rate of change. We can grudgingly accept a penny increase in gas prices, but not Labor Day gouging.) At what point do fires become "catastrophic"? What fire regimes are "characteristic" of current climate? If we solve the fuel build-up problem will we be able to avoid the constipation of suppression?

Society tends to accept or favor stability. Yet, stability and climax are ecological myths. Accordingly the scientists that built the Northwest Forest plan expected succession, disturbance and climatic change. For example, the Late Seral Reserve network together with the Riparian Conservation Strategy was built to absorb fires and epidemics, recognizing that healthy ecosystems are not static, nor stable. However, this coarse filter approach was derailed by an attempt to protect, with an assumed high degree of certainty, a list of rare and little known species. At least two assumptions, that lack of knowledge constitutes risk and that suppressing disturbance minimizes risk, undermine this strategy. In the long run absolute protection may have an unintended consequences. Ecosystems and all species, including humans, exist in an environment that is never risk free. Our imposition of stability on process thwarts, not enhances, diversity and resilience.

Throughout it's history, the Forest Service has tended to concentrate on one thing. After the tragic fires at the turn of the last century, fire suppression became the focus and remained so until we adopted an agricultural strategy to maximize wood production for housing. As habitat and sustainability questions arose we shifted focus from board foot production to old-growth and owls. Now with the accumulation of biomass, the increase in the proportion of high severity fire, and the associated loss in habitat, we have come full circle and are again focused on fire. This time however, the focus is application not suppression. On the other hand, ecosystem management would have an inclusive strategy expanding temporal and spatial scales and focus on sustaining ecosystem and organismic processes.

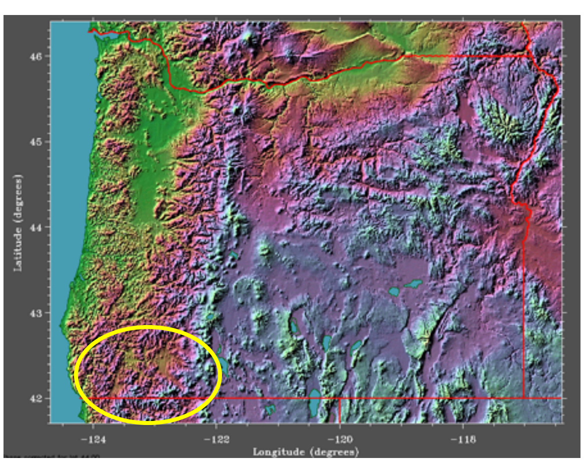
Ideology, politics and agendas are increasingly bastardizing science. Facts can be difficult to tease from emotional rhetoric. Sometimes they are just missing. However, the courts are beginning to accept sciences' own criteria for validity: Independence, blind peer review, repeatability, and general acceptance. Science is basic, essential and. available. We have excellent scientists and an adequate basis for managing ecosystems in the Northwest. Collaboration is the weak or missing ingredient. Collaboration can build the social trust needed for ecosystem management, but total consensus is not likely, nor healthy. Social diversity is also essential for ecosystem health.

A sense of place

The bullets below summarize major factors affecting southwest Oregon diversity, the basis for understanding the Biscuit Fire. Geologic processes, gravity, and climate (solar) are the basic drivers.

1. Geology and age (Triassic rocks, maybe older.)
    a. Compositional and structural diversity
        i. Volcanic island arch erosion produced shallow sea sediments
    b. Plates hosting ancient ecosystems slowly rotated northwest
    c. Volcanics and sediments folded, faulted and metamorphosed
2. Library of genetic material for evolving and migrating flora & fauna
    a. Old conifers, new angiosperms, and continuing recombination
        i. A sink for tropical and arctic sources
        ii. A source for emerging surrounding terrain
3. Present Global position
    a. Minimal ice lobe coverage. Scattered alpine cirques
    b. Latitude of transition between Temperate and Mediterranean
    c. Pacific coast high pressure area provides dry summer fire weather
    d. Marine Pacific influx grades into inland continental climates
4. Transverse orientation of the mountain and linkages to adjacent ranges
    a. Blocking of cyclonic storms stabilizes adjacent systems
    b. Links with the Sierras, Cascades and coast ranges
5. Elevation grades from sea level to above timberline (niche variety)
6. Combination of disturbance agents and regimes
    a. Fire is the noticeable agent of change (high rate of change)
    b. Insects and diseases. (Mortality by chronic suffering)

Figure 1. A satellite view of Oregon.



From the satellite view only the major rivers, valleys and mountain ranges stand out. The Cascade-Sierra chain and the California-Oregon Coast ranges appear as north-south parallel tracks, with the Cascades punctuated by occasional white-capped volcanic peaks. The Siskiyou Mountains, of the Klamath Geologic Province, stand out as a crosstie joining the tracks, like the crosstie of a gigantic capital ‘H.' The Klamath and Columbia Rivers completely breach the Cascade barrier. They appear as deep, winding gorges allowing water, air, spores, seeds, fish and other animals lowland passage through the Cascade mountain barrier, effectively joining east with west, sagebrush, juniper and aspen with Sitka spruce, madrone, and shore pine. Both are know for their diversity.

In the Klamath Province the backbone or “crosstie” of the Siskiyou Range provides a high elevation east-west corridor and a sink for genetic material uninterrupted by the glacial advances. The Siskiyous have been an "intersection" for migration and dispersal of fauna and flora for at least the last 60 million years. Genetic material from the Oregon and California Coast Ranges, the Sierras and Cascades, the Klamath River corridor and southern lowland chaparral species, migrate in, recombine and disperse. Wittaker and Axelrod both alluded to this “central significance”.

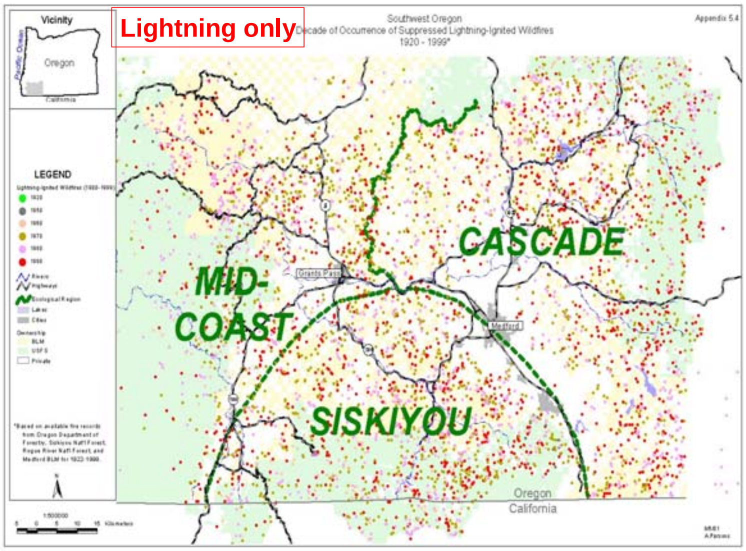
Southwest Oregon, transitional from Temperate to Mediterranean ecosystems, is habitat for 29 conifers including endemics such as Brewer spruce, Baker’s cypress and Port-Orford-cedar. It is the latitudinal extreme for coast redwood, silver fir and Alaska yellow cedar. It has approximately ten fold more sensitive species than typical Temperate forests to the north. Geology ranges from the ultramafic ophiolites of the Josephine Peridotite Mass to the scattered granite plutons of the Nevadan Orogeny that poked through existing metamorphosed volcanics and metamorphosed sediments of Triassic and Jurassic age, including the limestone at Oregon Caves. Continual deformation of the terrain, by forces associated with the Pacific Plate, has resulted in steep, complex geomorphology and chaotic drainage patterns. Elevation ranges from sea level to just over 7,000 feet at Mt. Ashland. Pacific fog often reaches inland valleys even during the early summer, supporting Port-Orford-cedar, particularly in protected drainages, such as Grayback creek.

Recently the Xerothermic (8000 to 4000 years before present) and the Little Ice Age (1400 to 1850) have modified local vegetation. On south slopes, new migrants from southern California (ceanothus and manzanita species for example) were frequently burned. To this day south slopes have shallow soils and xeric vegetation. Looking north from any Siskiyou lookout provides a view of sparse vegetation and occasionally grassy balds. The north aspects support older and denser forests.

Since the average forest on Federal land in southwest Oregon is less than 300 years old, most stands were generated during the Little Ice Age, when selective and competitive stresses were likely different. Survival may have favored species that tolerated higher frequency, intensity and duration of frost. Today as processes, particularly fire, create mortality and opportunities for regeneration, a new generation of genetic material will be selected under different selection criteria. Fire adapted, fire resistant, or species that avoid fire may be increasingly favored. Suppressing selection, by dampening mortality, regeneration and disturbance extremes may result in lowering resilience and diversity in the long run.

Preconditioning

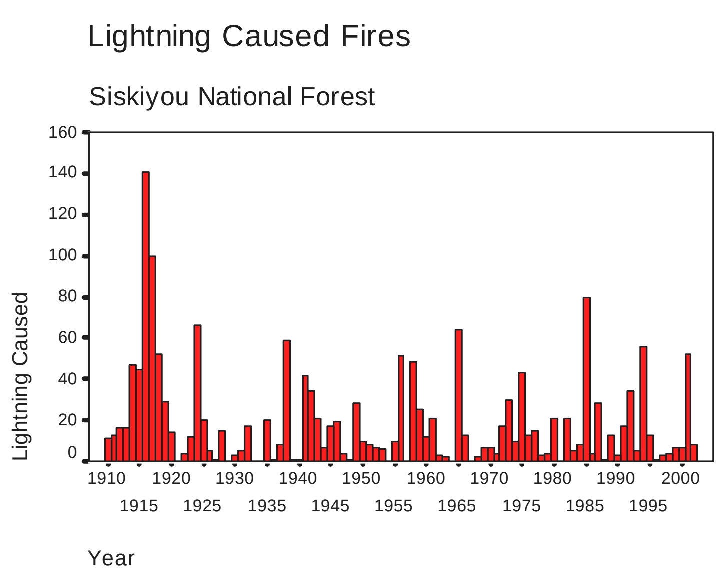
Figure 2. Lightning suppressed fires in southwest Oregon.



Lightning has always been a dependable ignition source. Humans have become increasingly active. Native Americans, for example effectively used fire to manage ecosystems for game, crops and water. Natives were much more than an incidental ignition source. Forests were repeatedly and consistently burned and thinned creating vegetation mosaics and plant communities. Natives also stimulated root and berry crops, planted crops, burned to maintain habitat for game, and cultured materials for tools, ceremonies and lodging. Shrub cover was low, and herb and grass vegetation was constantly recycled. Ranchers and miners burned to replace forest cover, control forest pests, and for fun on a Saturday night.

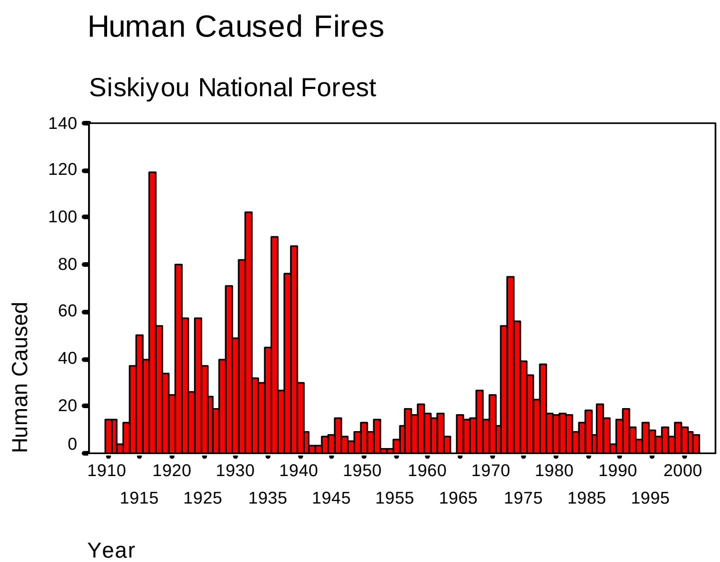
Today records indicate, in southwest Oregon, about 60 percent of the 200 to 300 yearly fires are human caused. On the Siskiyou national forest (included in the database) the proportions are about the same (60 percent human caused), but the average number per year is about fifty. The Oregon Department of Forestry suppresses 70 percent of their fires before they reach a tenth of an acre. Eighty eight percent are less than one acre. On the Siskiyou National Forest 50 percent of the fires are greater than 450 acres.

Figure 3. Lightning caused fires on the Siskiyou National Forest



The average number of fires over the last 90 years on the Siskiyou National forest is about 20 per year. The number of ignitions has been relatively small when compared to the number of cloud to ground strikes. Five to ten thousand cloud to ground strikes may be recorded by the automated lightning mapping system. However, less than one percent are positive and have the potential to start a fire. Thus, several dozen starts are often detected after a major storm. Extreme fire years have been correlated to cyclic climatic oscillations, such as sun spot cycles, and El Nino.

Figure 4. Human caused fires on the Siskiyou National Forest.



The average number of human caused fires on the Siskiyou National Forest over the last 90 years is approximately 30 per year. By the end of World War II, fire suppression became a patriotic issue, access was improved, pumps and chain saws were more portable, and a system of lookouts was well established. The Cave Junction smoke jumper base was installed in 1940. Forest use increased as Forest access increased. Logging roads and mining roads along with the Wimer and Happy Camp roads provided access. Speed and ease of access was greatly improved.

Figure 5. Fires suppressed by year in southwest Oregon.

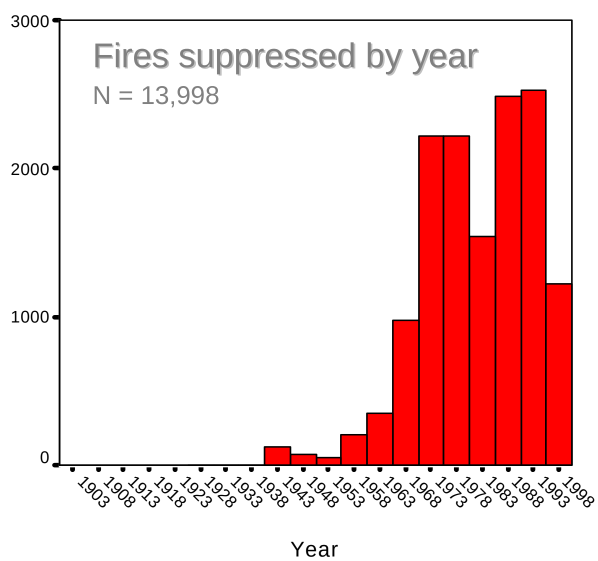
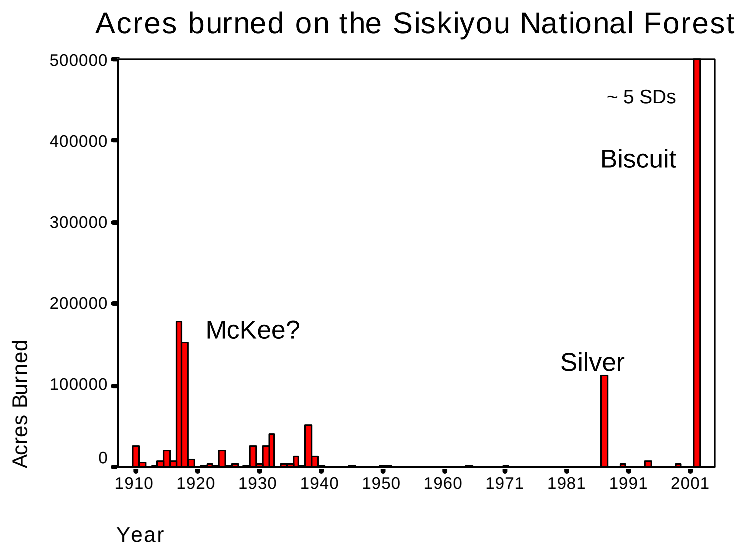


Figure 2 gives a spatial rendition of suppression across southwest Oregon (the Oregon Department of Forestry database includes the Rogue and Siskiyou National Forests). Figure 5 provides a temporal view. There is a gradual increase in the number of fires suppressed from the late thirties, until the sixties when the numbers balloon to over 1,000. Part of the change may be explained by the lack of early records. Regardless, fire suppression became much more effective in the post War era.

Figure 6. Acres burned on the Siskiyou National Forest.



The number of acres burned on the Siskiyou National Forest reflects the general southwest Oregon pattern. Few fires were suppressed before 1940. After the War, suppression became more effective, when occasional spikes became the norm. The spikes in the late teens maybe attributed to Simon McKee, a compulsive arsonist who was responsible for starting hundreds of fires yearly. He was arrested in 1919 and the number of acres burned fell to the background rate. During the whole 90-year period an average of about 13,600 acres burned per year. The presuppression rate (1910 to 1940) averaged about 30,000 acres burned per year. Between 1940 and 1986 (pre-Silver fire) the average fell to approximately 300 acres per year. Adding the Silver acres would increase the post War average to about 3,000. Adding the Biscuit acres would increase the post War average to about 10,000, somewhat similar to the average of 13,600 for the total 90-year period The extent of the Biscuit fire, roughly 500,000 acres, is about 5 standard deviations from the average number of acres burned since 1910. The data indicate suppression can be effective in all but a few cases.

Figure 7. Acres burned and acres cut on the Siskiyou National Forest.

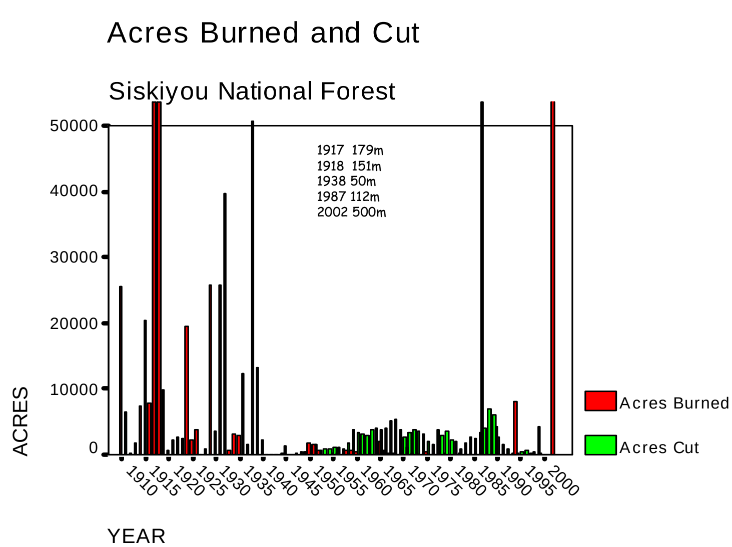


Figure 7 illustrates the difference in time and extent of harvesting and fire on the Siskiyou National Forest. Since 1937, 6,222 million board feet, (lumber volume) averaging 141 million per year has been harvested. That total amounts to about 2% of live standing volume in the year 2000. Cumulative acres harvested since 1937 total approximately 11% of the all Siskiyou National

Forest acres. If lands formally reserved from harvest are removed from the calculation, the cumulative percent would more than double to 24 percent. All Forest acres burned since 1905 total 1,271,338 acres, or about 116 percent of Siskiyou acres (obviously some acres burned more than once). Using 15% as the average proportion of high severity burn would result in approximately 200,000 acres burned over the years, approximately 20 percent of the total Siskiyou National Forest acres. The Biscuit fire burned about 500,000 acres, 240,000 at high severity, which is approximately 24 percent of the total acres National Forest acres.

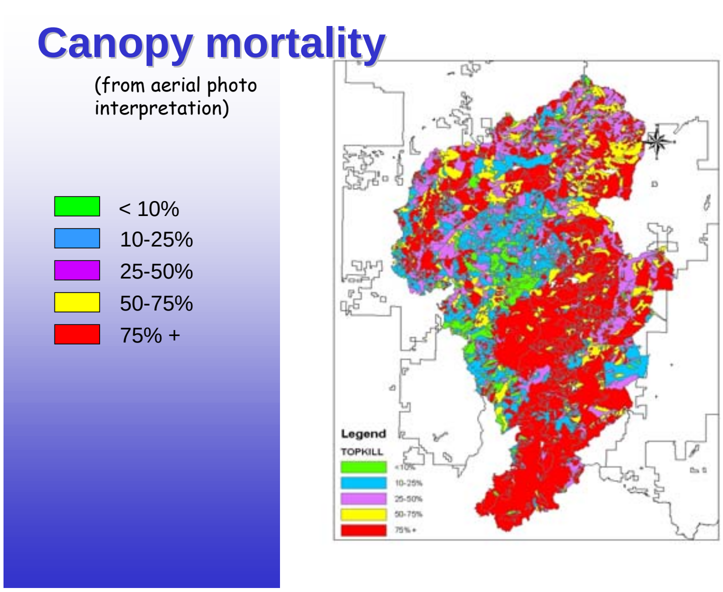
Fire and harvest have left significant footprints. The footprint of harvest is less a concern than the coincident roads. We have lessened our impact with improved methodology and technology and that will continue. However, we may increase the impact of fire without considering changes in our approach to suppression.

Biscuit

The Biscuit fire started from a lightning strike on July 13, 2002. It burned about 500,000 acres in 120 days. It was controlled on November 8 after reburning many areas that had previously been burned, including the Silver fire of 1987, a 97,000 acre fire that burned half in and half out of the Kalmiopsis Wilderness Area. The fire burned within 12 miles of the coastal city of Brookings and threatened Selma, Kerby, and Cave Junction. Various evacuation alerts were issued for these cities as the fire burned within a few miles west.

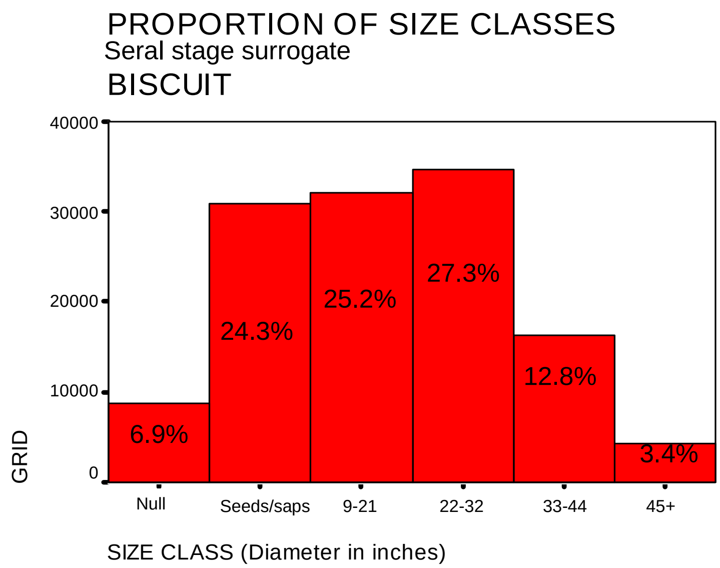
The fire burned at various intensities, leaving a mosaic of effects. Approximately 172,000 acres of Northern Spotted owl habitat was burned. An estimated 40 percent had old-growth character.

Figure 8. Canopy mortality within the Biscuit fire.



Although Burned Area Emergency Rehabilitation (BAER) assessment estimated 19 percent of the area had significant soil damage, canopy mortality estimates were near 50 percent. BAER estimates are made with remote sensing, canopy mortality was estimated with aerial photos.

As with the Silver fire in 1987, there has been speculation about how previous burns, wilderness, management activities, and policies affected fire behavior. There are several studies underway to carefully tease temporal from spatial variation. Figure 9. Proportion of size classes before the Biscuit fire.

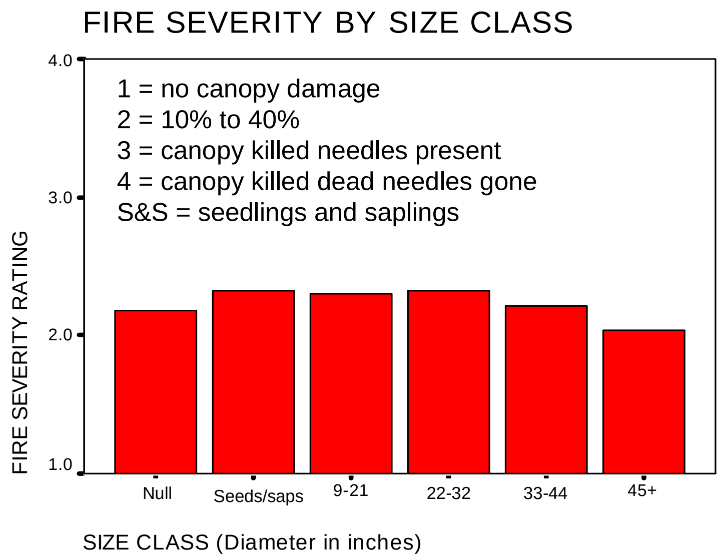


Size class by diameter (Figure 8) provides a rough estimate of pre-fire seral stage distribution since only five percent of the total fire acres were managed. I would assume that the managed acres would have been in the last three upper diameter classes. Since about 70 percent the area is in series (Tanoak Series ~ 35 percent, White Fir Series ~ 15 percent, Jeffrey Pine Series ~ 20 percent,) that have missed fire cycles in the last 60 years of suppression, this distribution is only slightly affected by management. The distribution may represent a healthy array of cohorts. The Douglas-fir Series covers approximately 30 percent of the burned area and is likely to have missed one or more fire cycles. Much of the acreage is in the southeastern third of the fire where the proportion of high severity effects is high.

Table 1. Percent of burned area by plant series

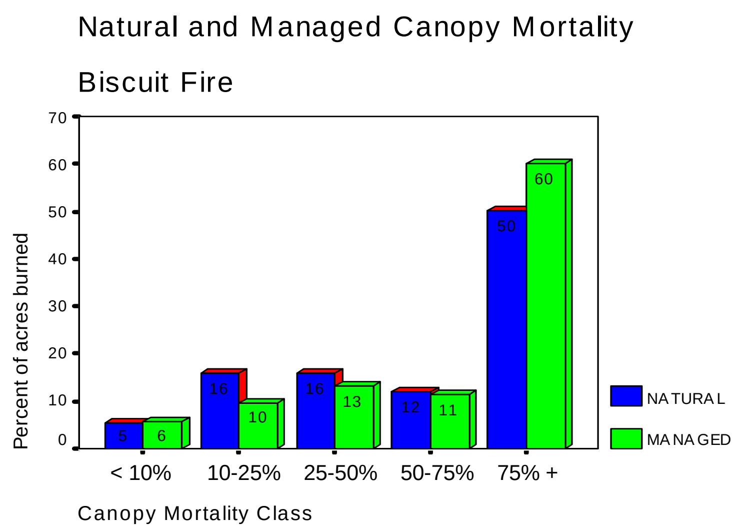
Series	**Percent of burned area**
Douglas-fir	~30
Tanoak	~35
Jeffrey Pine	~20
White fir	~15

Figure 10. Fire severity rating by size class.



Generally, severity was inversely proportional to tree diameter. Diameter from 22 inches to 32 inches ranked highest in canopy damage. Seeds and saps, less than nine inches and "poles" from nine inches to 21 inches sustained slightly less damage and diameters greater than 33 inches sustained the least. However, Figure 10 should be compared to Figure 9. If the fire were purely a random event, the proportions of size classes burned, should mirror the existing proportions of size class (Figure 9). Although the scale is different, the overall pattern is similar, indicating random effects. More in depth analysis is needed. Jonathon Thompson and Tom Spies of the Pacific Northwest Experiment Station in Corvallis have begun a multi-year study to examine landscape patterns, and their relationship to land use.

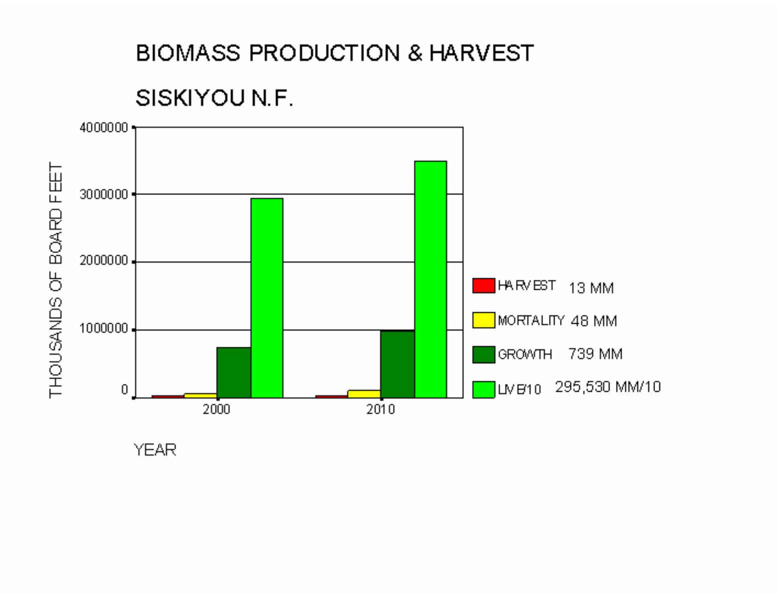
Figure 11. Canopy damage contrasting natural and managed stands.



At all fire severity classes there is little difference between the percent of acres burned whether managed or "natural". The greatest difference is 10 percent in the 75 percent canopy mortality class. Fuel distribution, size, surface to mass ratio topography, all affect burn intensity. Prescriptions to reduce the risk of high severity fire account for all factors affecting the burning process, including weather. Weather, however, is the spoiler during wildfire, adding chotic variation that is difficult to predict.

The Future

Figure 12. Growth and inventory and projections for the Siskiyou National Forest.



Growth on standing trees in the year 2000 was approximately 739 million board feet. Mortality, 48 million, is in addition to growth. Decomposition is not measured. Today expected harvest is about 13 million board feet. The most ever harvested in one year on the Siskiyou National Forest was 309 million board feet in 1973. Canopy reductions will decrease growth potential for several decades, but biomass accumulation is expected to continue and lightning will continue to ignite fires randomly across the landscape.

Decades ago Leopold, Weaver, Biswell, Kilgore Arno, Agee, Mutch, Martin, Atzet, Skinner, Pyne, all predicted the consequences of fire suppression. Although fire policy is changing, many of these predictions are still relevant:

- an increase in total forest biomass
- an increase in the percentage of high severity fire
- an increase in the number of total acres burned/time
- an increase in insect activity
- an increase in the effects of diseases
- an increase in extent and abundance of exotic species
- a decrease in vigor of older stands
- lowering of crown ratios, increasing inter-tree competition
- increasing risk to late seral landscapes and early seral pines
- increase in hardwood carbohydrate reserves (hardwoods on steroids)
- decreasing conifer abundance and extent
- change in competitive relationships

As long as we continue to attempt to force stability on ecosystems we will continue to be disappointed in the outcome. Change creates diversity; it should be welcomed. Dampening the extremes, the “tails ”, may in the short run eliminate “catastrophic” events. But it creates uniformity and in the long run magnifies system response. Biscuit may be an example. Ecosystem management is about saving the “tails”.

Every animal takes daily risks just fulfilling basic, survival needs. There seems to be an interactive agreement (a memorandum of understanding) to keep each other fit. Without stress, selection by predation, and competition for resources, health suffers. The concept is basic. The animal that stays in his hole will surely die. Filling basic human needs will not be risk free. Staying in your hole also has consequences.

I suspect we should continue to work for consensus. Bring together those wanting to work toward common goals regardless of values. I don't realistically expect to achieve consensus, but I do expect to operate on both spatial and temporal standards. Ecosystem based goals keep process rates in the solution. Biomass accumulation, fire starts, fecundity, mortality, and decomposition are not related to analytical time frames, judicial review or public comment periods.

Learning by our mistakes is an ancient but valid concept. Our Adaptive Management Areas were established with learning in mind. Our no risk stance has eliminated their potential utility. We have joked about having at least three "get out of jail free" cards to weaken the resistance to innovate. We accept mistake for learning but not too many.

I remember a seminar in Medford 14 years ago, particularly the discussion on the "let-burn" strategy. After what seemed like an eternity of discussion on suppression, control, prescribed wildfire, and the associated political hoopla, a speaker from our local Weather bureau remarked, "I don't understand what all the fuss is about, in the Weather Bureau, we have a "let blow" policy and we don't get any crap". I think we all understand we do not have the last word