A MANAGEMENT POLICY FOR THE RETENTION OF LARGE DIAMETER PONDEROSA PINE IN THE FLAGSTAFF URBAN WILDLAND INTERFACE

Grand Canyon Forests Partnership Policy Statement

Approved by the Grand Canyon Foundation Board, (date)

Introduction

The Ponderosa Pine forests of northern Arizona have been radically altered during the last 120 years by logging, grazing, fire suppression, and other activities. The changes to the forest have both increased the potential for catastrophic fire and adversely affected many biological processes and aesthetic values. Changes include:

- Decline in large, old-growth trees and snags, both living and dead;
- Loss of native grasses and herbaceous vegetation;
- Decline in native wildlife and plant populations and an increase in non-native species;
- Disruption of natural fire regimes;
- A substantial increase in fuel loads and unnatural crown fires;
- Dramatic increases in dense stands of small diameter, stressed trees;
- Increased mortality from insect infestations and diseases;
- Disruption of vital watershed functions.

The decline in ecological health and the increased likelihood of catastrophic fires and their potential impact on the forests and towns of northern Arizona concerns many local citizens. The possibility of catastrophic fires and the need to restore forest health in the Urban Wildland Interface—where homes and other human development intermingle with wildland vegetation—are particular concerns for land managers, fire service personnel, landowners, and other concerned citizens. Recognizing the importance of these issues, the Coconino National Forest and the Grand Canyon Forests Foundation have formed a partnership to undertake a series of projects to reduce fire risk and begin the long process of restoring local forests. The Partnership is a cooperative agreement between the Forest Service and the Foundation, with the Forest Service retaining full decision-making authority over any activities taking place on lands they manage.

The three primary goals of the Grand Canyon Forests Partnership are:

- Restore the natural ecosystem functions—within the range of natural variability—of the ponderosa pine forests in Flagstaff's Urban Wildland Interface;

- Manage forest fuels within the Urban Wildland Interface to reduce the risk of catastrophic fire;

- Research, test, develop, and demonstrate key ecological, economic, and social dimensions of restoration efforts.

Members of the Grand Canyon Forests Partnership have expressed the need for exploring a retention diameter cap for tree cutting in GCFP restoration efforts. Consequently, members of the GCFP convened a diameter-cap working group to explore the various ecological, economic, and social dimensions of establishing a diameter cap across all GCFP projects. The policies and rationale outlined in this document represent the outcome of that working group.

Assumptions and Rationale

The following assumptions and rationale underpin the development of a policy to restore large diameter trees to the ponderosa pine landscape for GCFP projects in the Flagstaff Urban Wildland Interface. The Partnership defines a large tree as one that is 18 inches diameter (dbh) and larger.

- Structural diversity, or "heterogeneity", is an important characteristic of natural, healthy, and functioning ponderosa pine forest ecosystems. This diversity includes, among other things, both large and small trees. However, producing large (and eventually old growth) trees is the most time-dependent variable in restoring Southwest ponderosa pine forests.
- Past forest management has resulted in severe declines in yellow pine trees, groups, and stands in addition to large trees and large snags. Trees in the 14-18 inch diameter range are the existing stock for the next generation of yellow pine trees, groups, and stands in addition to snags, and large dead and down logs.
- Historical conditions, site capacity, and current stand conditions influence the number of large trees needed for restoration of a site.
- Not every tree has an equal chance for growing into a large tree. Tree density, site limitations, dwarf mistletoe or other diseases, droughts, and stand replacement wildfire impacts tree growth.
- Scientific studies exist on the use of large trees by insects, birds, and mammals. The value of a snag increases greatly in trees exceeding 18 inches diameter.
- Scientific studies have not developed preferences of insects, birds and mammals on trees under 18 inches diameter.
- Concern exists that the cutting of trees, especially in diameter classes over 16 inches dbh, equates to the restoration of large tree, industrial type forest management.
- Monitoring of nearly 2,000 acres of thinning projects undertaken thus far by the partnership indicates a vast majority of trees being cut are less than 126 inches in diameter. Only in our initial full restoration plots were trees up to 22 inches in diameter cut. Since those 330 acres of plots were completed in 1999, some large trees (Arboretum) have been designated for cutting to restore meadow vegetation. Monitoring is needed to verify assumptions and background information relating to a policy statement for restoring the large tree component.

Policy Statement

The Grand Canyon Forests Partnership believes that large trees are an important component of a healthy ponderosa pine forest. The recruitment and retention of large trees is best accomplished by:

--Restoring more natural ecosystem functions. This includes reintroducing episodic, low-intensity surface fires and often also reducing the density of small diameter trees. Restoring ecological conditions that lead to the return of the large tree component results in snags and large dead and down logs at appropriate densities and sizes in the future.

--Retaining all yellow-barked pines by not cutting them.

--Retaining large trees in stands and providing growing conditions through active management that will best promote the recruitment of such large trees in the future.

--Emphasizing a small but thriving sector of businesses based on the ecologically sustainable utilization of forest products, primarily, a forest products industry that effectively and efficiently utilizes small diameter trees. We do not subscribe to the removal of large trees simply to increase the value of restoration byproducts. When appropriate, trees excess to ecological needs may be utilized to offset the costs of restoration.

The maximum diameter of trees to be cut evolves from the Partnership's review of ecological conditions and needs and will continue to be evaluated on a project-by-project basis. As existing conditions and sites differ, so will the maximum size of trees to be cut. Where thinning of trees is required, the Grand Canyon Forests Partnership generally subscribes to the cutting of the smaller trees necessary to meet restoration objectives-- unless biological (meadow, aspen, or riparian restoration) or safety reasons dictate the removal of larger trees. Density requirements for snags and large dead and down will be met prior to large trees becoming byproducts of restoration. However, in projects where trees larger than 18" (diameter at breast height) are to be cut, trees to be removed larger than 18" dbh will be documented by the Forest Service with photographs and case-specific rationale for their removal. The Multi-Party Monitoring team will review and assess this information to inform future project planning. The GCFP will continuously and actively promote the monitoring of diameters of trees being cut in GCFP projects.

Summary of Background Information

- Historically in the Flagstaff area, there were 12 trees per acre (tpa) greater than 18 inches dbh (average dbh=25.0 inches). Currently, there are 8 trees per acre greater than 18 inches dbh (average dbh=21.6 inches).

- Historically in the Flagstaff area, large trees with diameters of 24-40 inches diameter were common. Historically, 61% of the trees were in excess of 24 inches dbh. Currently, 31% of the large trees are over 24 inches dbh.

- Historically in the Flagstaff area, tree densities average 34.5 tpa (4” dbh+); currently, tree densities average 136 tpa.

- Historically around Flagstaff, ponderosa pine grew in clumps generally less than 1 acre in size with about 3-50 individuals in the group.

- Historically around Flagstaff, forest cover was approximately 30%, with the remaining 70% as interspaces of grasses, forbs, and shrubs. Currently around Flagstaff, forest cover is in excess of 70%.

- At 8 inches dbh, a tree has approximately 1.0 kilograms of biomass per inch of dbh; at 16 inches dbh, a tree has approximately 1.8 kilograms of biomass per inch of dbh; at 20 inches dbh, a tree has approximately 2.0 kilograms of biomass per inch of dbh.

- At 30 basal area, an average tree grows 3 inches per decade; at 60 basal area, an average tree grows 2 inches per decade; at 120 basal area, an average tree grows 1 inch per decade.

- Trees heavily infected with dwarf mistletoe and greater than 16 inches dbh have a mortality rate of 66% after 30 years.

- Trees heavily infected with dwarf mistletoe grow 2/3 as fast as a lightly or uninfected tree.

- Ponderosa pine tree crowns have no defense against fire. Factors that increase the likelihood of a fire impacting pine tree crowns are: ladder fuels, high amounts of ground fuels, and continual tree canopies. The removal of large trees rarely affects these factors. However, in stand replacing fire conditions, large trees are just as likely to be killed as smaller trees.

- Approximately 50% of the Coconino National Forest is targeted for the restoration of large trees. This is accomplished as described in the Coconino National Forest Plan for the nesting, rearing, and foraging habitats of the Mexican spotted owl and the northern goshawk through the restoration of stands to mature and old growth.

- Birds best utilize snags 18 inches dbh or greater, and greater than 30 feet tall.

- Snag requirements in the Forest Plan call for two snags per acre. This standard is rarely met.

- On the Coconino NF, about 20% of standing snags are lost during prescribed fires.

- Large trees may present safety hazards to residences, power lines, roads and trails, and other improvements in the forest.

- There is concern that cutting large trees equate to revenue generation at the cost of species and ecosystems.

- The cutting and utilization of commercial-sized trees can only be done under a timber sale or land stewardship contract. Such current timber sales operate at a loss; restoration projects bear analysis, contract, and implementation costs similar or the same as timber sales, also resulting in costs exceeding revenues (below cost).

- Precedence has been set within some environmental organizations to utilize some standing forest value to offset the costs of restoration.

- The Forest Service is concerned about setting precedence with any sort of cutting cap.

- Small wood can sustain a moderate sized industry and numerous smaller satellite industries if there is a guaranteed long-term supply.

- Scrutiny on the justification for a 16-inch cap shows faulty or misleading interpretation of the science. Similarly, justification for a 12-inch cap within the Flagstaff Urban Interface also shows faulty reasoning.

Details of Background Information

The GCFP Management Team was charged with reviewing pertinent facts that may inform the Partnership in a discussion about the merits of a tree-cutting cap. The intent of this review is to focus on factors that might display differences in ecological and economic values among and between trees in approximately the 14-24 inch diameter range. Opponents to cutting and utilizing large trees have prompted this discussion amongst the Partnership.

The objective of this review is to lead the Partnership towards a written policy for addressing the recruitment and management of larger trees. Currently, there are three diameter caps of significance to the Partnership.

1. The Coconino Forest Plan does not permit cutting of trees over 24 inches diameter within Mexican spotted owl habitat.
2. The Center for Biological Diversity and the Southwest Forest Alliance have a 16-inch cap as a standing policy. This policy is based on ecological reasons.
3. The Southwest Forest Alliance is now recommending a 12-inch cap on all projects within the urban interface.

Historical Diameter Distribution

Pollock and Suckling (1997) of the Center for Biological Diversity reviewed tree density sources for the southwest. Tree densities on the Coconino National Forest ranged from 10.3 to 34.5, though the smallest tree counted had a dbh of 4 inches.

The number of trees greater than 18 inches dbh ranged from 8-20, though not all sources yielded such data. The high end of this range, however, comes from a tree density study averaging 34.5 trees per acre (tpa) greater than 4 inches, the highest tree density of all historic inventories on the Coconino National Forest.

Historical data (Pearson 1950) on a virgin stand at Fort Valley indicated there were 12 tpa greater than 18 inches dbh, and 15 tpa greater than 16 inches. Average diameter for trees over 18 inches dbh was 25.0 inches. The largest diameter recorded on the Fort Valley plots was 48 inches. Fort Valley is representative of the Flagstaff urban interface.

Current Diameter Distribution in the Flagstaff Urban Interface

There are 655 stands with stand exam data within the approximate boundary of the Flagstaff/Lake Mary Ecosystem analysis area, an approximate 275,000-acre area that fully encompasses the Flagstaff wildland urban interface. The data is represented by 5,732 exam points.

On average, there are 184 trees per acre (tpa) greater than 1 inch in diameter breast height (dbh). There are an average of 50 tpa from 9-14 inches dbh. There are 16 trees per acre 15 inches dbh or greater. There are 8 tpa 18 inches dbh or greater (average dbh 21.6 inches).

Therefore, based on the Fort Valley data, retaining all trees greater than 15 inches dbh in the Flagstaff urban interface *may* reconstruct the large tree component in the shortest amount of time *if* all trees in this size class *will* become large, old trees.

Factors that would limit the ability of all such trees 15 inches dbh or greater to become large, old trees include current competitive influences (density of stand and/or tree group), current health and vigor of tree, site characteristics, presence of disease or damage, and susceptibility to stand replacement wildfire.

Tree Growth

Tree growth is influenced mostly by site characteristics, stand density, tree vigor, and disease (especially dwarf mistletoe).

Site

At a high site index, a large tree is 18 inches dbh or greater. At a low site, a large tree is 14 inches dbh or greater.

Tree Crown

Covington (Covington and others 1998) developed biomass estimates for trees ranging from 8-36 inches dbh. At 8 inches dbh, a tree has approximately 1.0 kilograms of biomass per inch dbh; at 16 inches dbh, a tree has approximately 1.8 kilograms per inch dbh; at 20 inches dbh, a tree has approximately 2.0 kilograms per inch dbh.

In dense conditions, tree crowns develop poorly, unless trees become dominant. About 10% of the 16-inch plus dbh trees monitored at Fort Valley's Unit 16 showed tree crowns that were less than 75% of the full crown.

Tree thinning of very dense 43-year ponderosa pine (6,000 stems to the acre) at Taylor Woods demonstrated significant crown length and width increases on stressed trees with spindly crowns.

Stand Density Influences

At 30 basal area, trees at Taylor Woods Study Area grew an average 3 inches per decade. Trees in stands at 60 basal area grew an average two inches per decade; at twice the basal area (120 ba) trees grew an average one inch per decade. Monitoring data from 16 inch plus dbh trees at Fort Valley indicate growth rates from 1-1.5 inches per decade.

Forest-wide, approximately 230,000 acres of ponderosa pine are currently at or above 120 basal area. In another 20 years an additional 280,000 acres will reach that stand density, potentially representing about 60% of the total ponderosa pine type on the Coconino National Forest.

Most trees on the Coconino National Forest have spent about the first third of their normal lifespan well beyond historical tree density conditions.

Disease

Dwarf mistletoe is a plant parasite that depends on its tree host (ponderosa pine, in this case). Host trees are slowly weakened and are eventually killed. Hawksworth and Geils (1990) have tracked dwarf mistletoe infestation at Grand Canyon National Park for nearly 40 years. Trees between 9 and 24 inches dbh heavily infected (infection level 6) have at least a 2 out of 3 chance of dying within 30 years. Trees 9 inches dbh or less have a mortality rate of 81%. At a slightly less infected level (dwarf mistletoe rating of 5), trees greater than 16 inches dbh have a mortality rate of about 20% (after 20 years). Because of high mortality in small trees, seedlings and saplings grown in mistletoe environments will have poor growth and survival. Growth projections for young stands moderately to heavily infected with dwarf mistletoe indicated stands unable to meet canopy density requirements for the Mexican spotted owl (USDA 1995).

Though larger trees tend to survive another 20-40 years with infection levels of 5 or 6, tree growth is reduced. Shea and Belluschi (1965) found growth rates cut in half for trees heavily infected. Pearson (1950) and Pearson and Wadsworth (1941) found a reduction of board foot increment by 1/3 in heavily infected trees.

Using stand exam data from RMRIS, 873 trees measured for growth within the greater Flagstaff area, the average decadal diameter growth was 1.25 inches (for trees without dwarf mistletoe). By contrast, trees heavily infected with dwarf mistletoe did only 2/3 as well, growing 0.8 inches diameter in a decade.

Trees killed by DM make short-lived snags. On a project that girdled and poisoned dwarf mistletoe infected trees, fall rates on resulting snags were 5X greater than natural fall rates, resulting in all but 5% of killed trees still standing after about 12 years (USDA 1995).

Stand Development

Polluck and Suckling (1997) describe the presettlement spatial structure of ponderosa pine forests from three perspectives: landscape, stand, tree groups. At the landscape level, there are treeless areas (parks, ridges, ravines) ranging from a few acres to thousands. Though many of these open areas still exist today, many of them are being “invaded” by trees.

At the stand level, there are presettlement forest cover estimates ranging from 17-33%, but data is limited to mostly the Fort Valley Experimental Forest. However, Polluck and Suckling note that both early survey data and written documentation indicate a wide range of stand level conditions across Southwest ponderosa pine. Indeed, observations of remnant stand conditions (Long Valley Experimental Forest and along the Mogollon Rim) on the south half of the Coconino National Forest indicate a much more continuous treed condition than that noted around the Flagstaff area.

Where groups were distinct, they were located within a grassland matrix. White (1985) partially reconstructed the age of these groups and found them to range from as little as 33 years between trees to as much as 268 years. He found the size of these groups to be from less than 1/10th to about 3/4 acre in size. White also found these groups to contain from 3-44 individuals.

Thus, while ponderosa pine stand conditions appear to exhibit a broad range, the Flagstaff area had low forest cover with distinct tree groups and scattered individual trees within a grassy matrix.

Current stand conditions lack the discrete, grassy openings with forest cover being well in excess of the historical 17-33% forest cover. While historically groups were defined by the grassy opening surrounding them, currently groups are distinguished by characteristics such as tree density, and size and age differences.

Fire Adaptations

Ponderosa pine is adapted to periodic, low intensity wildfire. It has no defense against high intensity (crown) fire events. Thick bark on ponderosa pine allows the tree to resist damage from low intensity wildfire. In general, the older/larger the tree, the more resistant it is to fire.

The tree crown, however, has no defense against flame and intense heat. In a crown fire, survival of larger trees is no greater than any other sized tree. Factors that increase the likelihood of a crown fire are presence of ladders (small trees providing a mechanism for fire to get into the crowns of larger trees); high levels of ground fuels (other than grasses, forbs and shrubs); tree canopies close to the ground; and continous tree canopy.

Reducing ladder fuels by thinning small trees, reducing ground fuels by prescribed fire, and breaking up continuous tree canopy by thinning trees making up the continuous canopy layer greatly reduce the risk of initiating and sustaining a crown fire. Such preventative management actions do not involve the removal of many, if any, larger diameter trees.

Wildlife Use--Live Large Trees

About half of all mammals, birds, reptiles and amphibians that are found on the Coconino National Forest depend on ponderosa pine habitat for part or all of their life cycles. As the number of large trees has declined, so has the available habitat for species that depend on large trees for all or part of their life cycles.

Not all studies cited to justify retaining large trees were designed to single out the large tree variable. Hence, it is improper science to take a habitat component (like large trees) out of context, as the interpretation of that variable leads to erroneous application in management situations.

Studies of large tree use by wildlife have been focused on threatened, endangered, sensitive, and forest indicator species. Recovery plans and management guidelines for such species specifically list standards to meet the habitat requirements involving large trees.

The Coconino National Forest Plan provides for the emphasis of managing toward or sustaining old growth (hence, large trees) within Mexican spotted owl nesting and rearing areas (PACs), pine-oak stands (MSO restricted habitat), northern goshawk nesting and rearing areas (PFAs), and 40% of the northern goshawk foraging areas. As all of the pine and mixed conifer forest types follow Mexican spotted owl or northern goshawk management direction, the Coconino National Forest is directed to create or sustain large trees (18 inches plus) at a minimum of 20 per acre on better than 40% of the lands.

Wildlife Use—Large Snags and Large Dead and Down Logs

Size of Snags

Many researchers have documented the importance of snags to birds for nest and roost sites, hawking, singing, or perching sites, and for a feeding substrate. In northern Arizona, most nesting occurred in snags that were 5 to 20 years old; while most foraging occurred on snags 1 to 5 years old (Cunningham and others 1980). In a study in Arizona, Scott and Oldemeyer (1978) found that birds selected snags that were greater than 18 inches dbh and taller than 75 feet. This same study was reported by Scott (1978) that birds preferred snags over 15 inches dbh (an apparent editing error?). Most snags had 40 percent bark, and had been dead 6 or more years. While utilization of snags as small as 12 inches dbh occurs, most cavity nesting birds and mammals that utilize snags or dead wood prefer snags in excess of 18 inches dbh (Cunningham and others 1980).

Rosenstock (1996) found that snags greater than 18 inches dbh and 30 feet tall were frequently used for nesting. Horton and Mannan (1988) also found a preference by birds for snags greater than 20 inches dbh.

Management recommendations for the northern goshawk call for snags greater than 18 inches diameter and greater than 30 feet tall.

About 20% percent of snags greater than 18 inches diameter are lost during prescribed fire (USDA Forest Service 2000).

Ffolliott (1983) summarized the scant literature on cavity-nesting animals. He found 10 species of mammals, and numerous species of insects and herptofauna used tree cavities in Southwestern ponderosa pine forests.

Number of Snags

The Coconino Forest Plan requires 2 snags per acre greater than 18 inches dbh. Researchers have recommended leaving 2.5 snags/acre greater than 17 inches dbh (Balda 1975; Scott 1978). Ffolliott (1983) showed that the 2.5/acre snag rate could only be sustained in a virgin forest. Much of the nesting substrate, historically, was available within the dead wood of large, live trees.

Dead and Down Logs

Downed logs (>12 inches in diameter and 8 feet long defined by goshawk guidelines) provide cover, feeding and nest sites for many species including woodpecker feeding sites and chipmunk, squirrel and rabbit den sites—all important goshawk prey species.

Safety

There are instances where trees present a hazard to private property, camping areas, power lines, or other infrastructures frequented by the public. In such cases, these trees, whether large or small, will need to be removed.

The Timber Sale Program

Not long ago in Northern Arizona, many big, old trees fell at the cost of species viability and overall ecosystem integrity. This has led to a perception by environmental communities that cutting big trees equals revenue generation at the cost of species and ecosystems.

Within a National Forest, there are differences in maximum tree size diameters being harvested between projects. In the Southwest Region of the Forest Service, some forests are cutting large trees and some are not. In other regions like the Pacific Northwest old growth tracts are still being harvested. Therefore, general opposition and campaigns against the cutting of large trees affects forests where such cutting is not occurring. Environmentalists cite polls and studies to indicate that the majority of Americans do not want to see the logging of old growth, or logging at all.

The battle cry against timber sales from an economic perspective is widespread among environmentalists. The National Forest Protection Alliance (Talberth and Moskowitz 1999) provided a report detailing the economic case against national forest logging. The report stated that there is an incentive to log big trees, as the resulting revenue helps pay for the timber sale institution, even though the timber sale program overall operates at a loss. The negative economic value of timber sales nationwide should be enough to eliminate the program the report states. In a slightly different angle, the Taxpayers for Common Sense argues that the Forest Service should be responsive to taxpayers regarding the huge annual losses in the timber sale program (Missoula Independent).

The economic issue is convenient to use in the debate over the timber sale program. In reality, very similar analysis, preparation, contracting, and implementation costs will be borne by restoration projects as are associated with timber sales. Restoration projects (not a timber sale) like the Southwest Forest Alliance's "Forests Forever" restoration prescription implemented at Fort Valley will indeed lose hundreds, if not thousands, of dollars per acre (Larson and others 2000).

The notion that some remaining "forest capital" (other than old growth or very large trees) should be used to help defray the costs of restoration efforts has been acknowledged by Sierra Club, the Lands Conservancy of Seattle and King Counties (WA), and others (Seattleweekly.com 2000). In Vancouver, British Columbia groups like Greenpeace and the Sierra Club have formed a logging company to collaborate on an economically viable, and ecologically sustainable approach to harvesting trees (Environmental News Network 2001).

Setting Precedence

Managers of the Coconino National Forest are concerned about setting a precedence for Arizona, the Southwest Region, and possibly beyond with the continuation of the 16-inch cap set for Fort Valley, or with establishing a new or extended cap. Evidence that such may be the case is exemplified by recent statements by the Southwest Forest Alliance that the Forest Service broke an agreement to have a cap for all Grand Canyon Forests Partnership projects (*Arizona Daily Sun 2001*). Such was never an agreement (well documented in Partnership meeting notes in meetings attended by members of the Southwest Forest Alliance). And while the Partnership is still debating the merits of a 16-inch cap, the Southwest Forest Alliance has moved toward a 12-inch cap (Southwest Forest Alliance Action Alert, July 3, 2001).

The challenge, should a cap be implemented, will be to make it clear that any cap is a product of collaboration for the Flagstaff Urban Interface Community—and that members of Partnership may disagree with the Forest Service over cutting/cap issues outside of Partnership boundary.

Center for Biological Diversity's Justification for a 16-Inch Cap

The Center's justification appeared in comments to the Fort Valley project, and in a paper (April 1999) proposing to preserve all ponderosa pine trees greater than 16 inches dbh. The Center compared regional timber inventories done in 1962 with those in 1986 and determined that trees greater than about 16 inches dbh were declining in 1986, and trees less than 16 inches dbh have increased. They called this a "break point". The Center uses this "break point" to simply point out that large diameter trees have been heavily logged over the past century, or so. No one disputes the latter.

The Center further justifies a 16-inch cap with extrapolations of goshawk habitat preference studies (Beier and Drennan 1997), though no direct relationships between goshawks and diameter limits have been done. Beier and Drennan (1997) state that while "*it is tempting to suggest that goshawks prefer high densities of large trees and highly closed canopies…it seems more likely that goshawks prefer vegetation that permits them to approach prey unseen and to use their flight maneuverability to advantage*…" (p. 570).

Beier and Drennan further state that the goshawk management recommendations to manage 40% of the landscape in stands dominated by trees greater than 18 inches dbh (VSS 5 and VSS6) should improve goshawk foraging habitat.

The Center further equates the cap with habitat requirements for the tassel-eared squirrel, a food source for the northern goshawk. A study by Dodd and others (1998) concluded that areas with large trees, interlocking canopies and canopy clumpiness were beneficial to the Abert squirrel. While the study did not single out the large tree variable, the Center for Biological Diversity and the Southwest Forest Alliance cite the large tree recommendations to help justify a 16-inch cap. Dodd (pers. comm.) stated that there is no direct link in his research toward justifying a 16-inch cap. Dodd did note, however, that squirrels disproportionately favor larger trees over smaller ones, but that stand density and spatial arrangement of trees are just as important.

Furthermore, the Center for Biological Diversity noted that Covington's restoration experiment at the decommissioned portion of the Gus Pearson Natural Area did not require the cutting of any trees over 16 inches. The Center fails to note that the stand in this experiment was a dog-hair thicket of dense, small trees with remnant yellow pines. The largest tree cut was 10 inches dbh. Such stands are not reflective of the Flagstaff area. At Covington's experimental sites at both Mount Trumbull and at Fort Valley, numerous trees larger than 10 inches dbh were cut. However, the Center notes correctly that Covington favors restoration in absence of cutting trees over 16 inches, if proposals to cut larger trees means no restoration takes place, at all.

Noting the deficiency of large snags, and that cavity nesting birds prefer snags greater than 18 inches dbh, the center equates the retention of every tree over 16 inches dbh with a potential future snag. They fail to address that not all trees over 16 inches dbh (especially 16-18 inches) will become a desirable snag.

Finally, the Center notes that the removal of trees 16 inches dbh and greater does nothing to reduce the risk of catastrophic wildfire. They note that such trees are not part of the surface fuel loading, that such trees do not act as fuel ladders, and that such trees are fire tolerant. In conditions where large trees form continuous canopies, the removal of ground fuels and small tree ladder fuels would suffice to greatly reduce the risk of crown fire. These points regarding crown fire reduction are generally true.

Markets

The current primary markets within a reasonable trucking distance from the greater Flagstaff area (even over two hour one-way hauls for low-value material) are low-value, low-volume firewood (Camp Verde), pallet stock (Phoenix) and some saw timber (Heber). Occasionally, small loads of larger logs are brokered to high-value end users (such as niche market vigas, latillas, posts & poles in Phoenix, as well as saw timber), some as far away as California, generating substantial income per load. These markets have been heavily cultivated over the years though, and remain due to the fact that local, N. Arizona operators have consistently and reliably supplied these higher-end users.

Larson and Mirth (in press) show that a cap of 16 inches for projects in the Flagstaff area cannot be sustained without a regional pulpmill or oriented strand board facility to add value to the by-products of forest restoration, primarily small-diameter roundwood. While providing only 2-3 trees per acre in excess of 16 inches diameter, the Fort Valley Research and Demonstration blocks generated sufficient income to cover the cost to pay for thinning and harvesting work. Larson and Mirth have also determined that:

"those uses that provide some potential of profitability and hence opportunity to fund fuel reduction and forest restoration programs appears to fall within one of two categories:

1. Large volume, high-speed, high-tech manufacturers with complimentary buyers of by-product residuals. These manufacturers can compensate for commodity-type product pricing through volume.
2. A small volume operation with low conversion costs that manufactures a higher-value, often specialty, product."

Conversations with the few remaining forest workers in the Flagstaff area bear out this assessment. However, for operators, as is highlighted in a report now in progress for the GCFF by Mater Engineering, all discussion of tree size, cutting caps, associated costs and markets becomes moot before first addressing volume of supply (though not necessarily a high volume) and, most important, consistency of the volume being supplied. Before any industry providing an outlet for low-value, small-diameter wood would consider locating a facility anywhere in N. Arizona, these two critical elements—volume of supply and consistency of supply—must be satisfactorily addressed. In other words, in order for small-diameter utilization of any consequence to occur throughout N. Arizona, a consistent and sustainable supply would need to be defined. As this is not occurring, discussions about cap size are often considered premature: there is nothing to fear if there is no enticement, and volume is the foremost incentive, not necessarily tree size.

Preliminary work by Mater Engineering also indicates available and sustainable markets for various high technology, added value, small wood products; but only if there is a steady and consistent supply of raw material over time. Mater estimates the need for 20-30 million board feet (lumber) be available annually to sustain a single core industry, which in turn would attract and sustain numerous other small, community-based, feeder industries. Not surprisingly, Mater--as do other industry members--suggests that large diameter material is not necessary to create and maintain a small wood industry. However, all agree that a single larger industry will be necessary to process the amount of restoration by-products and other small diameter material available and necessary to allow for such an industry to take advantage of economies of scale (such as described in #1 immediately above). Comments from one SW saw mill manager verify this belief:

> Sorting will be the key to any small diameter operation. A merchandising system is necessary to get the best value for the material available. The market value of tree sizes is not the issue, as new industry would build an operation to fit the available wood source (small diameter).
>
> Fit the log into the right product; this requires the proper equipment. If done properly, large log capacity would have to be built into any small diameter operation, and this would be very expensive (a disincentive actually, for obtaining large logs).

Finally, as alluded to, there has been a constant concern among both supporters and detractors of forest restoration that large trees will only lead to "sweetening the project pot" for operators, thereby providing a “negative” incentive for industry to participate. Obviously, any cap will inevitably raise the cost per treated unit simply due to smaller trees requiring a greater amount of time to cut and process any given log for the available return (market value). In other words, the faster a logging system can cut, the more money they will ostensibly make; fewer, larger trees often is the difference between making money and losing money on any given piece of ground. Larsen has found that a 16” cap increases the fiber cost at least $5/ccf regardless of the cutting system utilized. Without a local market for the few larger trees cut throughout the forest though (not even just GCFP project areas), there is no risk of sweetening the pot of restoration projects. In reality, there is simply no place throughout N. Arizona that takes larger logs and pays according to size (per ton is primary payment method).

Alternately, with a consistent and sustained volume of small diameter roundwood there is no diameter size that really affects any operation set up to handle this type of small material. If large logs are available in this small diameter scenario, they may help offset restoration costs (per acre costs to the FS and taxpayers to accomplish thinning) if, through sorting and brokering, a distant market can be found to pay higher values for increased size. A local industry set up to handle small diameter is not affected one way or the other by a cap as their focus would be on the sustainable supply of small diameter wood while any larger logs, unable to be processed, would be sorted, brokered and the cost SAVINGS would be tallied in the per acre cost of restoration on the ground. This becomes a cost savings benefit for all.

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