Fact Sheet: How Much Is Forest Restoration Worth?
An Example from Southwestern Ponderosa Pine Forests

Implementing forest restoration treatments is expensive, but so is attempting to control the severe crown fires that can take place in overly dense ponderosa pine forests. How do these costs compare?

The costs of severe wildfires can be staggering when all damage is considered. For example, a full-cost accounting of costs of the 2000 Cerro Grande Fire in New Mexico reached $1 billion in 2004. Variables considered in full-cost accounting for catastrophic wildfire include:

- Loss of lives
- Costs of fire suppression
- Destroyed or damaged homes and infrastructure
- Degraded wildlife and human habitats
- Degraded watersheds and water supplies
- Damaged recreation facilities
- Evacuation costs
- Tourism losses
- Burned timber
- Damaged cultural and archaeological sites
- Rehabilitation and restoration costs
- Public health costs

Restoring forests and avoiding catastrophic fire results in an array of resource benefits. Restoring overly dense ponderosa pine forests can result in a wide array of ecological and resource benefits. This analysis is based on the following treatment types:

- No treatment: no thinning or prescribed burning
- Full restoration: thinning excess trees to restore natural tree density as it was before widespread logging, livestock grazing, and fire exclusion
- Partial restoration: thinning excess trees, but leaving 1.5 to 2 times as many trees as are needed to restore natural tree density
- Intermediate restoration: thinning excess trees, but leaving 3 to 5 times as many trees as are needed to restore natural tree density
- Minimal restoration: thinning excess trees, but leaving 6 to 8 times as many trees as are needed to restore natural tree density

Resource values in southwestern ponderosa pine forests

Variable	No treatment	Full restoration	Partial restoration	Intermediate restoration	Minimal restoration
Wood harvested[1] (board-feet/acre)	**0**	**6,500**	**5,500**	**2,700**	**640**
Forage[2] (pounds/acre)	**112**	**860**	**570**	**134**	**112**
Water[3] (feet/acre)	**0.40**	**0.56**	**0.55**	**0.51**	**0.40**

Restored forests produce greater economic benefits. To estimate the economic value of this range of restoration treatment alternatives for wood products, forage, and water production, we have applied the above yield values to four million acres of ponderosa pine forest. We have also calculated costs saved in not having to fight high-severity wildfires or rehabilitate burned areas. Four million acres is equivalent to approximately one-half of the ponderosa pine acreage in Arizona, New Mexico, and Colorado, and one-tenth of the total ponderosa pine acreage nationally.

Economic benefits of restoring four million acres of ponderosa pine forest

Variable	No Treatment	Full Restoration	Partial restoration	Intermediate restoration	Minimal restoration
Wood produced[4]	**0**	**$4,400,000,000**	**$2,200,000,000**	**$500,000,000**	**0**
Forage produced[5]	**$5,000,000**	**$40,000,000**	**$27,000,000**	**$6,000,000**	**$5,000,000**
Water produced[6]	**$400,000,000**	**$560,000,000**	**$550,000,000**	**$510,000,000**	**$400,000,000**
Wildfire savings[7]	**0**	**$6,000,000,000**	**$6,000,000,000**	**$750,000,000**	**0**
TOTAL	**$405,000,000**	**$11,000,000,000**	**$8,777,000,000**	**$1,750,000,000**	**$405,000,000**

The bottom line. Forest management decisions have both ecological and economic implications. They matter.

- Full restoration across four million acres in the Southwest would produce $10.6 billion more in resource benefits than doing nothing.
- Benefits fall off sharply as trees are left in excess of the land's natural carrying capacity.
- Even without considering other benefits, it makes sense to spend **$2,650 per acre** to restore ponderosa pine forests and avoid catastrophic wildfire.
- A full-cost accounting that takes into account all costs of a severe wildfire would justify spending more than this.

[1] W. W. Covington, P. Z. Fulé, M. M. Moore, S. C. Hart, T. E.Kolb, J. N Mast, S. S. Sackett, and M. R. Wagner. 1997. Restoring ecosystem health in ponderosa pine forests of the Southwest. *Journal of Forestry* 95(4):23-29. This paper reports on a partial restoration treatment in which no trees over 16 inches dbh were cut, with a resulting residual tree density (trees greater than 4 inches dbh) that was approximately two times greater than what was present in 1876, before fire regime disruption. Approximately 5,500 board-feet/acre were removed. Had excess postsettlement trees greater than 16 inches dbh been cut, an

additional 3 trees per acre consisting of 1,000 board-feet would have been cut, on average, resulting in a total of 6,500 board-feet/acre. The intermediate and minimal thinning yields are based on unpublished data from tenth-acre plots located in intermediate and minimal restoration treatments in the Fort Valley Experimental Forest near Flagstaff.

[2] Forage estimates are based on overstory:understory regression in J. J. Rogers, J. M. Prosser, L. D. Garrett, and M. G. Ryan. 1984. *ECOSIM: A system for projecting multiresource outputs under alternative forest management regimes.* Fort Collins, Colo.: USDA Forest Service. The method follows the procedure described in W. W. Covington and M. M. Moore. 1994. Southwestern ponderosa forest structure: Changes since Euro-American settlement. *Journal of Forestry* 92(1):39-47.

[3]Water yield estimates (see M. B. Baker, Jr. 2003. Hydrology. Pp. 161-174 in *Ecological restoration of southwestern ponderosa pine forests*, ed. Peter Friederici. Washington, D.C.: Island Press) are based on streamflow:tree density regression in Rogers et al. (1984) using the procedure of Covington and Moore (1994).

[4] Wood values from J. F. Weigand. 1998. *Composition, volume, and prices for major softwood lumber types in western Oregon and Washington*. Research Paper PNW-509. Portland, Ore.: USDA Forest Service. This estimate uses $170/thousand board-feet, a midrange for number 3 utility to 5 common and economy wood.

[5] Forage value from E. T. Bartlett, L. A. Torell, N. R. Rimbey, L. W. Van Tassell, and D. W. McCollum. 2002. Valuing grazing use on public land. *Journal of Range Management* 55 (5):426-438. This analysis uses $9.30/animal unit month. One animal unit month equals 800 pounds of forage.

[6] Water value from unpublished literature review by G. B. Snider. 2002. Value estimates for goods and services by stream/riparian systems. Flagstaff: Northern Arizona University. This table uses $250/acre-foot, which is a midrange estimate. At the upper end, published analyses identify values of from $400 to $1,728/acre-foot.

[7] Wildfire costs savings are from D. L. Lynch. 2004. What do forest fires really cost? *Journal of Forestry* 102(9):42-49. This analysis uses the $1,500/acre costs of the Hayman Fire in valuing full restoration and partial restoration, one-eighth of that for intermediate restoration, and $0 for minimal treatment. To approximate fire suppression costs alone (without other fire costs), divide by five.