

The Colorado Wood Utilization and Marketing Program presents:
A Literature Review on Restoration Thinning Equipment and Systems

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INTRODUCTORY READINGS

- I. "Forest Ecosystem Restoration," Lecture for Kern Ewing's Class, By Amy LaBarge, City of Seattle SPU Watershed Management Division, March 10, 2003
 - A. <http://depts.washington.edu/ehuf473/ehuf473/getach.htm>
 - i. Impacts of logging:
 - a. Little old growth forest left
 - b. Forest structure, species composition/ habit values has been changed
 - c. New forests are generally more even-aged.
 - ii. PNW restoration project focus:
 - a. Restoring forest ecosystems function
 1. Fish and wild life habitats
 2. Decrease forest erosion and sedimentation from forest roads
 3. Improve forest structure
 4. Increase Biodiversity
 - b. Improve forest structure by thinning
 1. Increases understory growth
 2. Increases diversity
 - iii. Thinning reduces stem densities
 - a. Helps trees grow in diameter quicker and longer
 - b. Thinning increases stand complexity and tree crown complexity.
 - iv. Approaches to thinning
 - a. Thin from below
 - b. Variable density thinning
 - c. Create gaps
 - d. Girdling and topping trees
 - v. Other benefits of thinning:
 - a. Stimulates understory development
 - b. Releases intermediate tree growth
 - c. Increase plant species diversity
- II. "Forest Restoration,"
 - A. <http://www.stoneforestservices.com/forestrest.html>
 - i. People really started to care about thinning forests because of large catastrophic fires emerging in recent times. Thinning targets the least desirable trees in a stand. In contrast, loggers and sawmills want the largest and straightest logs possible. Since there is such a high cost of logging, loggers rely on the selling of the downed timber to make the profit. The

Forest Service is paying logging companies to thin areas since they will not make much profit off the selling of thinned timber due to their low quality. The average cost of thinning a stand ranges from 300 dollars to 1,200 dollars an acre.

CONTEMPORARY PROJECTS

- I. "DECISION NOTICE and FINDING OF NO SIGNIFICANT IMPACT" (FONSI)
Fort Valley Ecosystem Restoration Project, Peaks Ranger District, Coconino National Forest, USDA Forest Service Coconino County, Arizona
 - A. http://www.fs.fed.us/r3/coconino/nepa/fort_valley_dn.html
 - i. Thinning project near Flagstaff, Arizona: in the Fort Valley area in the Coconino National Forest, the intent is to reduce the chance of catastrophic wildfires by thinning the ponderosa pine forest. Also, the thinning is designed to create a mosaic of dense and open stands. Trees measuring less than 16 inches in diameter at breast height (dbh) are slated for thinning. Concomitantly, the effort will attempt to balance out the overstory and the understory growth. The thinning will increase the amount of understory growth like grasses and shrubs, which will help reduce the amount of damage that could be caused by future wildfires. Many of the trails and roads will be either closed or destroyed to help restore the natural state of the wilderness.
- II. "Commercial Thinning, Stand Management," Small woodlands Program Of B.C.
 - A. http://www.woodlot.bc.ca/swp/myw/html/08_CommThin.htm
 - i. Use lightweight equipment.
 - a. Good for maneuverability
 - b. Good for multiple entries into the stand area
 - c. Causing little damage to the soil and the residual "crop trees" left standing after thinning.
 - ii. Use small skyline yarding systems for steep slopes (e.g. Mini-Alp).
 - iii. Use a small crawler tractor (e.g. John Deere 450) or a rubber-tired skidder (e.g. John Deere 440).
 - iv. Use horses in the logging operation if there is a gentle slope and few obstacles (e.g. Cariboo Horse Logging Association, woodlot association).
- III. "Forest Fuel Reduction / Firewood management Plan," National Park Service; U.S. Department of the Interior, Lake Chelan National Recreation Area, Washington
 - A. <http://www.nps.gov/noca/svplan/plan4.htm>
 - i. Recommended manual thinning method: use chain saws to prune and thin.
 - ii. Recommended machines: rubber-tired skidder and other four wheeled drive equipment to be used on roads but done so minimally.
 - iii. Recommended cable yarding systems: skyline systems
 - iv. Skidding tractor with a winch.
- IV. "Wild Fire Potential spurs equipment trials-over 70 Million of Acers to be Thinned, but no Mills to Process the Logs," by Barbra Coyer, Capital Press, June 16, 2002.
 - A. http://www.citizenreviewonline.org/june_2002/wildfire_potential.htm
 - i. Small diameter trees are not highly sought after in the wood products market, and the current wood market is not performing well. Many sawmills have closed and loggers are going out of business. What is to be done with the

slash? The slash could be chipped up and sold to energy firms to be burned for energy. If the slash were just left on the forest floor, more carbon dioxide would be put into the atmosphere due to natural decomposition than there would be from thermal decomposition. If energy firms would buy the wood chips, loggers who are struggling to make a living would be put to work using chippers to break up the thinning material.

SYSTEM SELECTION

- I. “How to chose and use Brushcutters-woodlot thinning-includes related information,” by Kenneth R. Boness, American Forests, May-June 1990.
 - A. http://www.findarticles.com/p/articles/mi_m1016/is_n5-6_v96/ai_8985023
 - i. Brushcutters are useful tools with many purposes from selective thinning small diameter stems to brush cutting and even simple landscape trimming. The new Brushcutters are designed with modern space-age equipment that makes them very strong and lightweight for increased productivity. For selective thinning, foresters want to remove small trees and brush from an area to allow the bigger trees to grow larger and stronger as well as to reduce fire danger. Brushcutters are a great tool for brush removal because chainsaws are not designed to cut brush. Note: consult a local forester to find out when to thin—downed timber can cause the spread of unwanted diseases during specific seasons of the year.
 - ii. Two types of Brushcutters:
 - a. Trimmers: designed for cutting grass and weeds
 - b. Clearing saw: designed for cutting the heavy-duty material.
 - iii. Available blades:
 - a. Knife: used for cutting light brush
 - b. Chain-saw: used to cut small diameter saplings (3-4” dbh).
- II. “Ecological Technologies for Small-Diameter Tree Harvesting,” By Bryce J. Stokes, and John Klepac.
 - A. Harvesting Systems:
 - i. Tree Length System:
 - a. High Productive Feller Bunchers are used to fell, collect, and bunch the small diameter timber into piles.
 - b. Small equipment is used for thinning to protect the residual trees left in the stand after cutting.
 - c. Larger machines can be used to cut rows and corridors; stand densities should be reduced to where these machines could fit.
 - d. Use swing feller bunchers on tracks to reduce residual soil and stem damage.
 - e. While in the woods, the trees are delimbed and topped using chain saws or a delimiting gate w/ chain saw at the deck.
 - f. Grapple skidders are used to extract the trees
 - g. Trees boles are slashed to make them shorter in length so as to increase highway payload.
 - ii. Flail Chip system:
 - a. Similar to the tree length system except full trees are skidded to the deck to be processed.

1. Processed with a flail delimeter / debarker. The tree is then chipped. With no bark or dirt, the chips are clean.
 2. Advantages to In-wood processing:
 - a) Flail Processing and chipping is more economical
 - b) Increased biomass recovery
 - c) Higher value chips
 3. Disadvantages:
 - a) High capital investment
 - b) Restricted product
- iii. Forwarder and Cut-to-length system:
- a. Harvesters are used for felling and processing at the stump.
 - b. Advantages:
 1. Reduced site and stand damage
 2. Fewer roads and landings are required.
 3. Fewer workers needed.
 - c. Disadvantages:
 1. High capital cost with these systems.
 2. Wood lengths that are cut are not very marketable.
- III. "Applications of Small-Scale Systems: Evaluation of Alternatives," by John Wilhoit, Bob Rummer. Written for presentation at the 1999 ASAE/CSAE-SCGR Annual International Meeting, July, 18-21, 1999
- A. Felling:
- i. Manual felling is fairly productive with larger trees but becomes very unproductive with small trees. Bunching is generally not done after manual felling and so productivity is reduced. Safety is also a concern with manual felling, but there is a higher safety concern for processing using a manual chainsaw more so than manual felling. Mechanized felling is preferred now.
 - ii. Three Types of mechanical Felling
 - a. Hydraulic shears
 1. Advantages:
 - a) Low cost
 - b) High productivity
 - c) Potential interchangeability with heads
 - d) Has the ability to cut a wider range of tree sizes
 - b. Chainsaw felling head
 1. Advanatge: Chain saw heads are generally low capitol machines. A small machine can fell large logs using this method.
 2. Disadvantage: Chainsaw heads more expensive and less productive when it comes to felling small trees than hydraulic shears
 - c. Harvesting head.
 1. Advantages:
 - a) Has the ability to process the log along with felling the log
 - b) Boom-mounted
 2. Disadvantages:
 - a) Very expensive (\$50,000 or more)
 - b) Less interchangeable

- iii. Skid steers mounted with mechanical felling machines are greatly encouraged.
- B. Processing and intermediate transport:
 - i. Processing: delimiting and topping if done in log length form.
 - a. Short wood form of processing is inefficient, so tree-length and log-length are the choices to use for small scale thinning operations.
 - 1. Tree length processing: stems are skidded and then processed with a chain saw.
 - a) Skidder is involved. SEE THE TREE-LENGTH PROCESSING SECTION ABOVE FOR MORE DETAILS.
 - 2. Log-length processing: stems are processed at the stump
 - a) Slash mat forms on the forest floor
 - i) Helps reduce the damage to the soil from the mechanical machines of the operation.
 - ii) Nutrients from the slash will be distributed on the forest floor instead of at the landing site.
 - b) This system also reduces the size of the skid trails.
 - c) This process can be done with a chainsaw or a harvester head to make the operation safer.
 - ii. Transporting:
 - a. Use small scale farm-type tractors:
 - 1. A small trailer can be bought that has been fitted with a small hydraulic knuckle boom loader.
 - 2. Tractor/trailer combinations are low capital compared to forwarders.
 - 3. Using a small skidder or a farm tractor that is mounted with a grapple for skidding can be used to skid the logs from the site.
 - b. The use of a farm tractor can be beneficial for its multipurpose ability, especially when it comes to loading. If a thinning project manager used the small tractor system that had a grapple skidder and a trailer to load the logs onto, the manger would not have to buy a separate loader just for loading because the logs are already loaded with the grapple arm of the tractor.