FHP TECHNOLOGY DEVELOPMENT PROJECT PROPOSAL

PROJECT STATUS: New, not previously funded.

PROJECT NUMBER: R5-1999-01

PROJECT TITLE: Effect of thinning, subsoiling, and prescribed burning on black stain root disease impact in eastside ponderosa pine.

SUBJECT: Forest Disease Management Technical Committee; prescribed burning, root pathogens, disturbance, insect vector (Hylastes), ponderosa pine, black stain root disease (Leptographium wageneri).

PROJECT OBJECTIVES:
1) Quantify amount of damage to trees, fine roots, and woody roots incurred by prescribed fire, thinning, and subsoiling.
2) Evaluate prescribed fire, thinning, and subsoiling effects on stem attacking and root attacking bark beetle populations.
3) Evaluate effects of stand treatments on the incidence of root infecting fungi (Leptographium wageneri and other root pathogens).

BRIEF DESCRIPTION OF PROJECT: This project will develop guidelines for evaluation of black stain root disease risk due to prescribed fire, thinning, and subsoiling. Treatment combinations of prescribed burning, subsoiling skid trails, and thinning will be evaluated on the basis of damage assessments to roots, populations of putative bark beetle vectors, and isolations of root infecting fungi. The degree to which disease is intensified or diminished by individual treatments or treatment interactions will serve to provide silvicultural guidelines focused to minimize adverse root disease impact.

FHP PERSON WHO WILL LEAD THE PROJECT: John Kliejunas

JUSTIFICATION: Black stain root disease is increasing alarmingly in eastside pine stands. The disease is associated with site disturbance and certain soil characteristics. The use of subsoiling to alleviate the localized soil compaction occurring in skid trails is increasing. Little is known of the consequences of this procedure regarding black stain root disease impact. Furthermore, prescribed burning is an important silvicultural tool in eastside ponderosa pine. There is currently no information that would provide guidelines on the use of subsoiling and prescribed burning in ponderosa pine stands at high risk for black stain root disease. In other ecosystems such as longleaf pine in the southeastern United States, research indicates a strong association between mortality, prescribed burning, and Ophiostomoid root infecting fungi and Heterobasidion annosum. Because of these considerations, it is imperative that interactions between prescribed burning and subsoiling be understood and guidelines based upon evaluation of these silvicultural procedures be developed in high risk eastside ponderosa pine stands.

This project will provide additional data to expand applicability of results from a previous study that examined effects of subsoiling on tree root damage (Otrosina, et al. 1996). In addition, the experimental design of this project allows for direct comparison, and subsequent integration, of results being gathered from an existing tdp (R6-97-02) in eastside pine stands in Oregon.

URGENCY: Because of the mandate to increase use of prescribed fire in fire dependent ecosystems, because of the mandate to use subsoiling to alleviate soil compaction, and because of the increasing threat black stain root disease poses to the eastside ponderosa pine ecosystem following disturbance, knowledge of the consequences relative to these silvicultural procedures is essential for promoting forest health and sustainability.

LINK TO NATIONAL FHP TECHNOLOGY DEVELOPMENT PRIORITIES: This proposal directly addresses national high priority number 2, "Develop guidelines for the integration of silvicultural procedures, prescribed burning, and other tools and techniques to reduce the adverse impacts of insects and diseases." This proposal also addresses national high priority number 3, in that research techniques developed by the Tree Root Biology Team will be adapted to measure tree root damage and tree vigor.

SCOPE OF APPLICATION: Principles learned from developing this technology have potential applications throughout the eastside pine type in California and Oregon, and toward other fire dependent ecosystems undergoing similar processes (longleaf pine and sequoia, for example).

RESEARCH BASIS: Current research provides evidence for a strong association between disturbance, prescribed burning, and mortality in many conifer stands. Furthermore, root disease fungi such as Leptographium wageneri and Heterobasidion annosum are associated with black stain root disease of ponderosa pine. Various other Leptographium species may serve as early indicators of stress or declining forest health, as affirmed in other ecosystems. Research techniques developed by Tree Root Biology, Southern Experiment Station, would be applied in this project to quantitatively measure effects of stand treatments on fine root physiology.

Pertinent references:

Kliejunas, J.T., and W.J. Otrosina. 1998. Site factors associated with incidence of black stain root disease in eastside pine. Phytopathology 88:S48 (abstract).

Otrosina, W.J., et al. 1995. Heterobasidion annosum and blue-stain fungi in roots of longleaf pine are associated with increased mortality following prescribed burning. Phytopathology 85:1197 (abstr.).

Otrosina, W.J. et al. 1996. effects of subsoiling on lateral roots, sucrose metabolizing enzymes, and soil ergosterol in two Jeffrey pine stands. Tree Physiology 16:1009-1013.

Otrosina, W.J. and Ferrell, G.T. 1995. Root diseases: primary agents and secondary consequences of disturbance. pp. 87-92, In: Eskey, Lane G., Comp. Forest Health Through
Silviculture. Proceedings of the 1995 National Silviculture Workshop; 1995 May, Mescalero, New Mexico. Gen. Tech. Rep. RM-GTR-267. USDA Forest Service. 246 pp.

Otrosina, W.J., et al. 1997. Blue-stain fungi associated with roots of southern pine trees attacked by the southern pine beetle, Dendroctonus frontalis. Phytopathology 81:942-945.

Otrosina, W.J. 1998. Diseases of forest trees: consequences of exotic ecosystems? pp. 103-106. In: Waldrop, T.A., ed., 1998. Proceedings of the Ninth Biennial Southern Silvicultural Research Conference; 1997 February 25-27; Clemson, SC. Gen. Tech. Rep. SRS-20. USDA Forest Service. 628 pp.

Otrosina, W.J., and Garbelotto, M. 1998. Root diseases and exotic ecosystems: implications for long-term site productivity. pp. 275-283. In: Root and Butt Rots of Forest Trees. Delatour, C., Guillaumin, J.J., Lung-Escarpmant, B., and Marcais, B., eds. Proceedings of the Ninth International Conference on Root and Butt Rots: 1997 September 1-7; Caancans-Maubuisson, France. Institut National de la Recherche Agronomique. 457 pp.
Piirto, D.D., and Parmeter, J.R. 1998. Biological and management implications of fire-pathogen interactions in the giant sequoia ecosystem. in press.

METHODS:

Experimental Design: Replicated plots in high risk black stain root disease sites have been established at Poison Lake on the Eagle Lake Ranger District. The experimental design is a 2 X 2 factorial with 4 randomized treatments (burning, no subsoiling; burning, subsoiling; no burning, no subsoiling; no burning, subsoiling) in each of 4 blocks. Each treatment (plot) is 2.5 hectares or roughly 5 acres. Each treatment will be separated by a 66 foot-wide buffer strip.

Initial survey: Pretreatment surveys have been conducted (100% cruise) to determine levels of black stain root disease occurring on plots, and locations of existing disease centers are plotted via gps.

Treatments: All plots will be thinned according to prescription (removal of unmarked trees to leave a residual basal area of 100 to 140 ft2 per acre). Unthinned portions of the stands will be left as undisturbed control areas. All treatments (thinning, subsoiling of skid trails, prescribed burning, and combinations) will be carried out by the Eagle Lake Ranger District, including contracting and implementation.

Data Collection: Pretreatment and post treatment soil mechanical analyses (bulk density, compaction) will be measured by the zone soil scientist, using Region 5 guidelines and standards for these analyses. Insect populations will be monitored, (FPM in Susanville) on all plots both pretreatment and post treatment to determine incidence of putative vectors of black stain root disease. If feasible, both pitfall and funnel traps will be used. Insects will be sorted by species and frequency of catch. Identified insects will be shipped live and in ice packs to Tree Root Biology in Athens and sampled for presence of L. wageneri. Root samples, both fine and woody roots, will be obtained from pre-selected permanent sub plots within treatment plots (4, .025 ha, circular sub-plots in each treatment plot) and analyzed for incidence of root pathogenic fungi, root feeding insects, and fine root damage. Long term sub-plots will be established for permanent monitoring of growth effects of treatments; each plot tree will be marked with a numbered metal tag and data on species, age, diameter growth (10 year and 20 year), height, dbh, crown class, and crown condition will be recorded. Root ingress cores will be places at designated locations in subplots to monitor fine root growth. These cores will be maintained by personnel at Susanville FPM. Treatment plots will be monitored and sampled for a minimum of 3 years post treatment. After that time, long term monitoring (10 years) of plots for disease incidence and changes in stand structure and function will be conducted every two years by Forest Pest Management.

MEASURE OF SUCCESS: A plot establishment report will be submitted. Interim progress reports will be filed yearly. Success will be measured by attainment of data on mortality, insects, and fungi involved during the course of this investigation. Relating these factors to stand structural changes and health functions will be the principal goal of this project.

COOPERATORS: W.J. Otrosina, Southern Research Station, Tree Root Biology Team, Athens, Georgia;
Sheri Smith, entomologist, and William Woodruff, pathologist, FPM shared service area, Susanville;
John Kliejunas, pathologist, Region 5; and
Al Vazquez, silviculturist, Eagle Lake Ranger District, Lassen National Forest.

PRODUCTS: As sound information is developed, seminars and informal meetings are proposed to be held targeting appropriate districts and users. The final product will be written recommendations (3420 evaluation) on minimizing losses in ponderosa pine in at-risk stands as they relate to prescribed fire and subsoiling.

PUBLICATION: Publications in refereed Journals, Station Technical Reports, and FPM evaluations/reports distributed to NFS land managers concerned with the issue addressed by the proposal.

TECHNOLOGY TRANSFER: FPM 3420 biological evaluations; presentation of the project intent/progress/results at annual silvicultural workshops.

The Lassen National Forest has already committed personnel to implementation of this project in anticipation of the results. The plots are being used by Forest botanists to record/monitor changes in understory vegetation resulting from the treatments.

PROJECT DURATION: 3 years (for funding); measurements will continue over a 10 year period.

LONG TERM BUDGET:

Fiscal Year	Estimated FHP Funding	Estimated Funding, Other Sources	Total
FY 1999	$21,500	$49,500	$71,000
FY 2000	$12,500 (-$7,000 supplies; - $2,000 travel TRB)	$39,500	$52,000
FY 2001	$12,500	$39,500	$52,000
TOTAL	$46,500	$128,500	$175,000

FY1999 BUDGET REQUEST:

Item	Requested FHP STDP Funding $	Other Sources amount $	Organization name
Admin. items:			
temp salaries	$3,000	$20,000	Tree Root Biology
temp salaries	$3,000	$10,000	Lassen NF
scientist salary	---	$18,000	Tree Root Biology
travel	$7,000	---	Tree Root Biology
travel	$1,500	$1,500	Forest Pest Management
Procurements:			
supplies (lab media, (chemicals, field supplies)	$5,000	----	Tree Root Biology
supplies (insect traps)	$2,000	----	Forest Pest Management
TOTAL FY 1999 BUDGET:	$21,500	$49,500	

STDP PRODUCTION FUNCTION

PROJECT NUMBER: R5-1999-01

PROJECT COST: $175,000

PROJECT OBJECTIVE (DESCRIPTION OF PROJECT AND EXPECTED OUTCOME):

The objective of this project is to develop guidelines for timing of prescribed burning and subsoiling to avoid attracting insect vectors and subsequent impact of black stain root disease on final harvest volume in eastside pine stands.

ASSUMPTIONS:

- Without FPM input developed from the project, prescribed burning and subsoiling would occur at the wrong season, resulting in about 50% of the total area thinned each year being out of production due to black stain root disease.

- With FPM input, correct time of prescribed burning/subsoiling to reduce soil compaction would be used, resulting in no increase of the black stain vector over background levels, and only about 5% of the total area thinned each year would be out of production due to black stain root disease.

- Treatment costs (thinning, prescribed burning, subsoiling) are the same with or without development of the guidelines.

BACKGROUND DATA:

- average yield/acre of eastside pine type forests = 1.5 MCF

- 20,000 acres/year are thinned in the eastside pine type

- rotation age = 80 years

- green stumpage = $1,030/MCF

CALCULATIONS

EXPENDITURE & OUTPUT VALUES (EOV) WITHOUT THE PROJECT:

20,000 acres - (20,000 acres X 50% loss) = 10,000 acres harvested

(10,000 acres harvested X 1.5 MCF/acre) X ($1,030/MCF) = $15,450,000, discounted 80 years

= $15,450,000 /23.05 = $670,282

EXPENDITURE & OUTPUT VALUES (E0V) WITH THE PROJECT:

20,000 acres - (20,000 acres X 5% loss) = 19,000 acres harvested

(19,000 acres harvested X 1.5 MCF/acre) X $1,030/MCF) = $29,355,000, discounted 80 years

= $29,355,000/23.05 = $1,273,536

BENEFIT (CHANGE IN EOV) ATTRIBUTABLE TO PROJECT:

= $(with) - $(without)

= $1,273,536 - $670,282 = $603,254

BENEFIT/COST RATIO:

B/C = $(with) - $(without) / $(STDP cost) + $(treatment cost, where applicable)

= $603,254/$175,000 = 3.45

BENEFIT ATTRIBUTABLE TO STDP:

= $175,000 X 3.45 = $603,750

PNV OF PROJECT:

PNV of project = $(Benefit) - $(cost)

= $603,254 - $175,000 = $428,254

PNV OF STDP:

PNV of STDP = $(Benefit attributable to STDP) - $(STDP cost)

= $603,750 - $175,000 = $428,750