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Project Title: Adjacency – is it a relationship that remains necessary?

Principal Investigator: Kevin Boston, PhD, JD, PE, RPF (Calif)

Affiliation and Address: [redacted]

Applying Organization: Center for Forest Business, College of Forestry, Agriculture, and Natural Resources

Primary Contact Number: [redacted]

Primary Email: [redacted]

Project Description:

The project's duration is 24 months.

Background and Justification:

Adjacency is a constraint in many forest regulations. Versions of this rule are included in California, Oregon, and Washington. It is a component of the Sustainable Forestry Initiative (SFI) and is applied in many regional standards in the Forest Stewardship Council (FSC) certification guidelines.

The ecological goals of the maximum opening size constraint, California Forest Practice Rules 913.1, 933.1, 953.1, Regeneration Methods Used in Even-aged Management, often called the green-up constraints, are unclear. This constraint is imposed on forest managers limits the size of the opening using even-age on forestry for five years or until the trees have an average height of five feet. Some suggest that limiting the size of the openings limits erosion that can occur in a concentrated place. However, modern logging equipment and practices such as operating on slash mats and developing low-impact logging systems such as shovels, harvesters, and forwarders have significantly reduced the ground impact. Additionally, mitigation of the sites has limited their production. The widespread adoption of complex riparian buffers further captures the surface runoff from harvesting units. Others have commented that the adjacency restrictions maintain a closed-canopy forest for wildlife habitat. Boston and Bettinger (2006) showed that the smaller opening more quickly fragmented the forest than larger restrictions when the goal was to maximize the sustained yield harvest targets. However, the economic impacts were considerable with a large decrease in harvest volume as the spatial restrictions become binding. The road system is the largest source of sediment from forests (MacDonald & Coe 2008). Under a management scenario to maximize the sustainable harvest of material, it is our hypothesis that the smaller green-up constraint requires more of the transportation network to be accessible for trucks and not placed into a state to minimize sediment production and delivery.

The objective and Scope:

The objective and Scope will demonstrate the impact of the maximum opening size constraint on the ecological process in working forests. The Scope will be to demonstrate the impact of the maximum opening size on the miles of road required to be open to support management and the impact of the rule on the fragmentation of mature, closed canopy forests. The planning period will be 30 years.

The results will demonstrate the impact of various opening size constraints on the miles of open roads when harvested at a sustained yield rate, which contributes sediment at a higher rate than a closed road. Finally, the model will show the fragmentation of the closed canopy forest due to the dispersed cutting pattern.

Data sets will be obtained from organizations in the northern and coastal zones to demonstrate their geographic applicability throughout California.

Research Methods

This project aims to use a spatial harvest scheduling model with a variation of adjacency constraints from 20 to 120 acres in 10-acre increments. The model will be deployed on various spatial data sets provided by companies throughout California. The model will analytically vary the size of the adjacency constraint and determine how many additional miles of roads must be open to support the harvesting. A vehicle routing model will be incorporated into the harvest scheduling algorithm to determine the most efficient route for log delivery. In addition to the length of open roads required, the model will estimate the impact of the various maximum opening sizes. It will determine the area in mature, closed-canopy forest, and the fragmentation of the closed-canopy forest by measuring the edge length between mature and closed-canopy forests.

The meta-heuristics have been used to solve spatial harvest scheduling algorithms for over 25 years and have found solutions to large, nonlinear combinatorial problems that are unable to be solved exactly within 5% of the solution. The algorithm combines multiple heuristic techniques, such as simulated annealing, tabu search, and genetic algorithms, to solve this difficult class of problems (Boston and Bettinger 1999, Boston and Bettinger 2002).

Critical Question:

Is the dispersed harvesting pattern forced by the maximum opening size constraint, resulting in more miles of open roads and defragmenting the forest more rapidly than if large maximum opening sizes were used? Are more miles of roads required to be open to support the distributed harvesting pattern that can increase chronic sedimentation from forest roads.

Requested Funding:

Request funding

Tasks Time

Tasks	Descriptions	Time	Cost
1	Validate data from cooperators	2weeks	4500
2	Link harvest units and the transportation network	6 weeks	13500
3	Growth and Yield Analysis	4 weeks	8500
4	Algorithm modification	3 weeks	6750

5	Analysis area 1 Redwood Region	2 weeks	4500
6	Analysis area 1 Mendocino Region	2 weeks	4500
7	Analysis of the interior area of California	2 weeks	4500
	Total		46,750

Funding will support the principal investigators' time to perform the work on this project. Tasks 1 – 4 will be completed in the first year, and tasks 5-7, the analysis, will be completed in the second year. The total amount requested is 46,750.

Literature Cited

Boston, K., & Bettinger, P. (1999). An analysis of Monte Carlo integer programming, simulated annealing, and tabu search heuristics for solving spatial harvest scheduling problems. *Forest science*, *45*(2), 292-301.

Boston, K., & Bettinger, P. (2002). Combining tabu search and genetic algorithm heuristic techniques to solve spatial harvest scheduling problems. *Forest Science*, *48*(1), 35-46.

Boston, K., & Bettinger, P. (2006). An economic and landscape evaluation of the green-up rules for California, Oregon, and Washington (USA). *Forest Policy and Economics*, *8*(3), 251-266.

MacDonald, L. H., & Coe, D. B. (2008). Road sediment production and delivery: processes and management. In *Proceedings of the first world landslide forum, international programme on landslides and international strategy for disaster reduction* (pp. 381-384). Tokyo, Japan: United Nations University.