ForSys/LTD Case Study List 2022

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Table 1. List of published spatial planning case studies using ForSys, and their science and management application, scale and key findings.

	Published Case Study	Science and Management Application	Spatial Algorithm	Scale	Key Findings
1	Ager, A. A., et al. (2021). Development and application of the Fireshed Registry. Gen. Tech. Rep. RMRS-GTR-425. Fort Collins, CO, USDA Forest Service, Rocky Mountain Research Station: 47. https://www.fs.usda.gov/research/treesearch/62641	Target the Source of Wildfire Transmission to Communities	Predefined planning areas	National	• In corporation of ForSys scenario planning model into the fireshed planning framework • Takes a systems approach to the wildfire problem by moving from a descriptive (assessments) to predictive (risk models) to prescriptive (scenario modeling) environment
2	Ager, A. A., et al. (2016). "Production possibility frontiers and socioecological tradeoffs for restoration of fire adapted forests." Journal of Environmental Management **176**: 157-168. https://www.fs.usda.gov/research/treesearch/52994	Ecological and Economic Tradeoffs and Forest Restoration	Spatial optimization; multiple objectives	Regional (four national forests; 2.5 million ha)	• Clear tradeoffs among the various restoration goals revealing the lack of spatial covariance among different stressors and ecosystems services • production frontiers combined with empirical data on ongoing projects can establish targets and monitoring benchmarks that are needed for restoration programs
3	Ager, A. A., et al. (2021). Balancing ecological and economic objectives in restoration of fire frequent forests – Case study from the Four Forest Restoration	Ecological and Economic Tradeoffs and Forest Restoration	Spatial optimization; multiple objectives	National forest (970,000 ha)	• Forest restoration to increase fire resiliency poses significant financial challenges, but scenario planning can identify treatment locations that project revenue from harvested wood ultimately

	Initiative. Gen. Tech. Rep. RMRS-GTR-424. Fort Collins, CO, USDA Forest Service, Rocky Mountain Research Station: 30. https://www.fs.usda.gov/research/treesearch/62640				improving the likelihood that projects will be implemented
4	Ager, A. A., et al. (2021) "Planning for future fire: scenario analysis of an accelerated fuel reduction plan for the western United States." Landscape and Urban Planning **215**, 104212 DOI: 10.1016/j.landurbplan.2021.104212 https://www.fs.usda.gov/research/treesearch/63129	Target the Source of Wildfire Transmission to Communities; Assessing Planning Risk	Predefined planning areas; ForSys with Fire	Sub-national (59 million ha)	• Scheduling of an accelerated forest and fuel management scenario that targeted the source of wildfire exposure to developed areas • Incorporated uncertainty into scenario planning to understand how the plan might be impacted by wildfires and treatment
5	Ager, A. A., et al. (2019). "Tradeoffs between US national forest harvest targets and fuel management to reduce wildfire transmission to the wildland urban interface." Forest Ecology and Management **434**: 99-109. https://www.fs.usda.gov/research/treesearch/57897	Target the Source of Wildfire Transmission to Communities	Predefined planning areas; Multiple objectives	Sub-national (59 million ha)	• quantified production frontiers to measure how the efficiency of meeting harvest volume targets is affected by prioritizing treatments to areas that transmit fire to the communities • first large-scale assessment of the strong tradeoffs and scale effects on production frontiers, and more importantly substantial variation among planning areas and national forests
6	Ager, A. A., et al. (2012). Overview and example application of the Landscape Treatment Designer. Gen.				

	Tech. Rep. PNW-GTR-859. Portland, OR, USDA Forest Service, Pacific Northwest Research Station: 11. https://www.fs.usda.gov/research/treesearch/40115				
7	Ager, A. A., et al. (2013) "Restoration of fire in managed forests: a model to prioritize landscapes and analyze tradeoffs." Ecosphere **4**, 29 DOI: 10.1890/ES13-00007.1 https://www.fs.usda.gov/research/treesearch/48615	Restoration Treatments to Reintroduce Resource Objective Wildfire	Spatial optimization	Ranger district (14,000 ha)	• Exploring the effect of changing treatment threshold on meeting objectives • Increasing treatment intensity reduced the potential loss of old growth to wildfire within projects, but it also reduced the size of the restored area, thus prolonging the time to restore the larger landscape and increasing the chance for wildfire losses outside of the project
8	Ager, A. A., et al. (2017). "Economic opportunities and trade-offs in collaborative forest landscape restoration." Ecological Economics **136**: 226-239. https://www.fs.usda.gov/research/treesearch/54922	Ecological and Economic Tradeoffs and Forest Restoration	Predefined planning areas; Multiple objectives	Regional (four national forests; 2.5 million ha)	• detailed economic analysis of potential restoration treatments including costs and revenue at the stand-scale • scarce economic opportunities for restoration, but economic viability highly dependent on the prioritization scheme used • trade-offs are scale-dependent and exist both within planning areas in terms of specific stands to treat, as well among planning areas
9	Alcasena, F. J., et al. (2022) "Contrasting the efficiency of landscape versus community protection fuel treatment	Target the Source of Wildfire	Predefined planning areas	Regional (1.3 million ha)	• Comparison of scenarios that targeted exposure and loss from alternative treatment strategies at different scales

	strategies to reduce wildfire exposure and risk." Journal of Environmental Management 114650 DOI: 10.1016/j.jenvman.2022.114650 https://www.fs.usda.gov/research/treesearch/65114	Transmission to Communities			• Home ignition zone treatments were more cost-effective, but efficiency varied among planning areas • Variability among planning areas in terms of the treatment efficiency, as measured by both financial and per area leverage, reinforces the idea that mitigation strategies are site specific
10	Alcasena, F. J., et al. (2018). "Optimizing prescribed fire allocation for managing fire risk in central Catalonia." Science of The Total Environment **4**(621): 872-885. https://www.fs.usda.gov/research/treesearch/57191	Prioritizing Prescribed Fire Blocks	Predefined planning areas	County (130,000 ha)	Prioritize areas for prescribed fire Strong trade-offs among different fire exposure metrics, showed treatment mosaics that optimize the allocation of prescribed fire, and identified specific opportunities to achieve multiple objectives.
11	Ariza, A. M., et al. (2015). "Trends in wildfire risk at time-scale: Optimizing fuel treatments configurations in eucalyptus plantations in Portugal. Padua, Italy, University of Padua." https://www.medfor.eu/sites/default/files/editor/martinariza2015_thesis_medforfinal.pdf	Ecological and Economic Tradeoffs and Forest Restoration			
12	Belavenutti, P., et al. (2022). "Designing forest restoration projects to optimize the application of broadcast burning." Ecological Economics **201**: 107558.	Prioritizing Prescribed Fire Blocks	Spatial optimization (Patchmax); multiple objectives	National forest (520,000 ha)	

	https://www.fs.usda.gov/research/treesearch/65117				
13	Belavenutti, P., et al. (In review) Multi-objective scheduling of fuel treatments to implement a linear fuel break network. Fire	Prioritizing Fuel Break Networks	Spatial optimization (Patchmax); multiple objectives	National forest (520,000 ha)	
14	Belavenutti, P., et al. (2021). "The economic reality of the forest and fuel management deficit on a fire prone western US national forest." Journal of Environmental Management **293**: 112825. https://www.fs.usda.gov/research/treesearch/63130	Ecological and Economic Tradeoffs and Forest Restoration	Predefined planning areas	National forest (520,000 ha)	• identified a blueprint and financial plan for addressing treatment needs on a large fire prone landscape including a mix of restoration treatments and associated costs • financial dynamics of projects relative to increasing restoration area examined for break-even points • extent to which the project shape, size and treatment portfolio can be optimized to maximize area treated and minimize reliance on external financial subsidies at the landscape scale •
15	Botequim, B. R., et al. (2014). Addressing trade-offs among fuel management scenarios through a dynamic and spatial integrated approach for enhanced decision-making in eucalyptus forest. Advances in Forest Fire Research. D. X. Viegas. Coimbra, Portugal, Coimbra University Press.	Ecological and Economic Tradeoffs and Forest Restoration			

16	Chiono, L. A., et al. (2017) "Landscape-scale fuel treatment and wildfire impacts on carbon stocks and fire hazard in California spotted owl habitat." Ecosphere **8**, e01648 DOI: 10.1002/ecs2.1648 https://www.fs.usda.gov/research/treesearch/53514	Other Applications		Landscape (55,398 ha)	• landscape fuel treatments can alter fire hazard both within and outside of treated stands • simulated treatments within protected areas significantly reduced potential fire intensity relative to both the no-treatment landscape and a treatment scenario that did not permit treatment within protected areas
17	Day, M. A., et al. (2021). "An assessment of forest and woodland restoration priorities to address wildfire risk in New Mexico." Gen. Tech. Rep. RMRS-GTR-423. Fort Collins, CO, USDA Forest Service, Rocky Mountain Research Station. https://www.fs.usda.gov/research/treesearch/62639	Ecological and Economic Tradeoffs and Forest Restoration	Predefined planning areas; Multiple objectives	State (24 million ha)	• among planning areas the potential to treat two restoration priorities was often correlated, meaning that if you pick a planning area that is high risk for one it will also be high risk to another • but within a planning area there was a tradeoff between locating treatments to address one restoration versus another (which stands to select within a planning area) • risk was concentrated on particular ownerships within planning areas rather than spread out across multiple jurisdictions in terms of the areas identified for treatment
18	Kreitler, J., et al. (2019). "Cost-effective fuel treatment planning: a theoretical justification and case study." International Journal of Wildland Fire **29**(1): 42-56.	Ecological and Economic Tradeoffs and Forest Restoration	Spatial optimization; No spatial constraint	Ranger district (160,930ha)	• using cost-effectiveness increases the expected averted losses from fuel treatments, but also allows a larger area to be treated for the same cost, by incorporating costs and cost-effectiveness into the prioritization routine

19	Martín, A., et al. (2016) "Temporal optimization of fuel treatment design in blue gum (*Eucalyptus globulus*) plantations." Forest Systems **25(2)**, eRC09-eRC09 DOI: 10.5424/fs/2016252-09293	Ecological and Economic Tradeoffs and Forest Restoration	Spatial optimization; No spatial constraint	Project (1,449 ha)	• potential to accomplish multiple objectives such as augmenting profits and sustaining ecological assets while reducing wildfire risk at landscape scale • scenarios without optimization simulate forest owner treatment within predefined treatment thresholds and constraints
20	Palaiologou, P., et al. (2021) Spatial optimization and tradeoffs of alternative forest management scenarios in Macedonia, Greece. Forests **12**, 697 DOI: 10.3390/f12060697 https://www.fs.usda.gov/research/treesearch/62755	Ecological and Economic Tradeoffs and Forest Restoration	Spatial optimization	National (3.4 million ha)	• attainment of ecosystem services and forest production were correlated, suggesting that the same projects have high values for both priorities; however, sharp project tradeoffs between forest production and suppression difficulty • prioritization was critical; decreasing efficiency of treatment after a certain threshold at which attainment ceases to increase substantially
21	Salis, M., et al. (2019). "Coupling wildfire spread and erosion models to quantify post-fire erosion before and after fuel treatments." International Journal of Wildland Fire **28**(9): 687-703. https://www.fs.usda.gov/research/treesearch/58627	Other Applications	Spatial optimization	Landscape (68,000 ha)	• treatment strategies effective at reducing post-fire sediment delivery at both the landscape scale and in treated areas • the local effect of fuel treatments on simulated sediment delivery was substantial and supports the need to optimize fuel treatment location to maximize effects on burn severity mitigation and post-fire soil erosion reduction at the landscape scale
22	Salis, M., et al. (2016). "Evaluating alternative fuel treatment strategies to reduce	Target the Source of Wildfire	Spatial optimization	Landscape (68,000 ha)	• application of fire spread modeling methods to quantify tradeoffs from

	wildfire losses in a Mediterranean area." Forest Ecology and Management **368**: 207-221. https://www.fs.usda.gov/research/treesearch/52997	Transmission to Communities; Other Applications			alternative landscape fuel treatment strategies • when a small percentage of the study area is treated, the effects are localized and not effective at the landscape scale; although the extent varied by strategy • selection of treatment priority for reducing fire exposure to specific values of interest affected overall landscape protection
23	Thompson, M. P., et al. (2022). "Comparing risk-based fuel treatment prioritization with alternative strategies for enhancing protection and resource management objectives." Fire Ecology **18**: 26. doi: 10.1186/s42408-022-00149-0			Regional (8.5 million ha)	
24	US Forest Service, Stanislaus National Forest. (2021) Appendix E. Using landscape condition metrics and ForSys for the Social and Ecological Resilience Across the Landscape Project. Social and Ecological Resilience Across the Landscape (56500) Draft Environmental Impact Statement Stanislaus National Forest. Sonora, CA.			Project (100,000 ha)	

25	Vogler, K. C., et al. (2015). "Prioritization of forest restoration projects: tradeoffs between wildfire protection, ecological restoration and economic objectives." Forests **6**: 4403–4420. https://www.fs.usda.gov/research/treesearch/52992	Ecological and Economic Tradeoffs and Forest Restoration	Predefined planning areas; Multiple objectives	National forest (915,000 ha)	• limited opportunities to achieve multiple management objectives at the stand scale thus creating steep tradeoffs within planning areas • some restoration objectives had greater utility at the planning area scale thus indicating that objectives must be carefully selected to match the spatial distribution of forest stressors
26	Washington State Department of Natural Resrouces (2015) "Forest Health Assessment and Treatment Framework 2020" RCW 76.06.200Office of the Commissioner of Public Lands, Hilary Franz Forest Health and Resiliency Division – Planning, Science, and Monitoring Section	Prioritizing Fuel Break Networks	Spatial optimization	Landscape	