

Early Stand Improvement for Multiple Ecosystem Services Using Adaptive Complexity Thinning

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Overview:

- Rocky Mountain forests with simple structure are poorly poised to provide the ecosystem services that society expects in a warming climate.
- Adaptive complexity thinning (ACT), an ecological approach to precommercial thinning in young stands, has the potential to kick-start development of forest complexity, delay snowmelt, and provide hiding cover for snowshoe hares and other wildlife.
- ACT treatments are being implemented on The Nature Conservancy, Bureau of Land Management, and Forest Service lands using active adaptive management.

Summary:

Montane and subalpine forests in the Northern Rocky Mountains produce wood fiber for products, store water in the snowpack, sequester carbon, and provide wildlife habitat, including for threatened Canada lynx and their primary prey, the snowshoe hare. Use of precommercial thinning (PCT) in potential lynx habitat is restricted on federal lands due to short-term reduction of forage and hiding cover for hares. However, dense young forests are slow to develop multiple canopy layers (fig. 1)—habitat preferred by hares and lynx—yet silvicultural thinning can accelerate development of multiple canopy layers and complex structure, a tension between short-term and long-term objectives. Additionally, forests with dense canopy cover accumulate less snow and have shorter snow cover duration than areas of low canopy density. Shorter snow duration can increase predation risk for snowshoe hares when their winter white coat is mismatched against snowless ground.

Agency specialists have identified the need for information about long-term PCT treatment responses and new management options in dense young forests regenerating after high-severity fire or even-aged harvest to balance competing societal expectations for ecosystem services. We present new results for vegetation structure and hare relative abundance and habitat use following PCT. Horizontal cover (2-m coverboard) was not significantly different between thinned and unthinned stands 17–34 years post-treatment; live tree density was higher in unthinned stands, while live tree diameter was larger in thinned stands. Snowshoe hare pellets were present in every stand, but pellet relative abundance was significantly higher in unthinned stands. In a separate long-term experiment, Griffin and Mills 2007 designed to test effects of PCT treatments with embedded unthinned reserves (PCT-R) and found significantly more hare pellets at locations adjacent to reserve patches compared to areas > 50 m from reserves, suggesting hares preferentially use dense reserve patches within thinned areas. Treatment-wide average horizontal cover was higher in unthinned control stands, lowest in uniformly thinned PCT treatments, and intermediate for PCT-R treatments.

Silvicultural Concepts:

- Based on findings from these long-term studies and Kumar et al. (2018), we developed a novel silvicultural approach called adaptive complexity thinning (ACT). ACT is a form of variable density thinning (fig. 2) designed to accelerate the development of complex multistory forest structure preferred by Canada lynx and snowshoe hares (and other wildlife species) while also balancing objectives for snow accumulation and duration, potential fiber production, carbon sequestration, and short-term hare habitat suitability. ACT recognizes forests as complex adaptive systems and is designed to foster long-term ecological resilience and provision of ecosystem services.
- We developed two ACT treatments—focal tree release or “daylighting” in an unthinned matrix, and retention of unthinned reserves within a thinned matrix—forming a continuum of treatment intensity (fig. 2). In ACT treatments, focal codominant trees are released, but smaller shade-tolerant trees and shrubs are retained for wildlife cover and forage in the short-term and to accelerate development of multiple canopy layers in the long-term.
- Thinning the overstory allows for greater potential snow accumulation and duration due to reduced canopy interception and lower total radiation (shortwave plus longwave) reaching the snowpack. ACT increases forest heterogeneity further by incorporating unthinned areas, which provide high-cover habitat for snowshoe hares, as well as high carbon sequestration potential.



Management Applications:

- New operational-scale ACT treatments are being implemented on Forest Service, Bureau of Land Management, and The Nature Conservancy lands using an adaptive management (AAM) framework to assess effectiveness. AAM uses principles of experimental design to test alternative management approaches at operational scale (Larson et al. 2013).
- Contract language was codeveloped with project partners for seamless integration into a standard federal precommercial thinning contract. The goal was to create contract language that is simple to understand and successfully creates the desired complex stand conditions.
- Where and how to lay out retention patches is a practical management concern. Expert opinion was used to select “hot spots” for actual or potential hare habitat (e.g., especially dense conifer patches) within ACT treatment areas. GIS polygons delineating reserve locations (2.5-acre and 5-acre squares oriented in the cardinal directions) balance the requirement for simple, systematic layout and coverage of identified hotspots. Contractors are expected to lay out retention areas to a specified precision. This approach was designed to reduce agency staff time required for layout while creating specifications that can be administered in the field.
- Thinning contracts commonly include a minimum tree height for thinning, though that height varies by forest type, ownership, and local management practices. Managers on the Flathead National Forest noted that not thinning understory regeneration below 2 feet is typical in operational PCT contracts, while the BLM Missoula Field Office usually does not thin below 1 foot in height. ACT retains seedlings up to 4-feet tall outside reserve areas to promote development of multiple canopy layers, which also may reduce contractor hours and costs. The minimum height of cut trees can vary based on stand structure.
- Collaboration has been at the heart of this project from the beginning, which currently spans three forest ownerships and even more partners. The knowledge coproduction model used here has been integral for developing and implementing management-relevant research in potential Canada lynx habitat, but long-term commitment will be necessary to reap the benefits of this work.



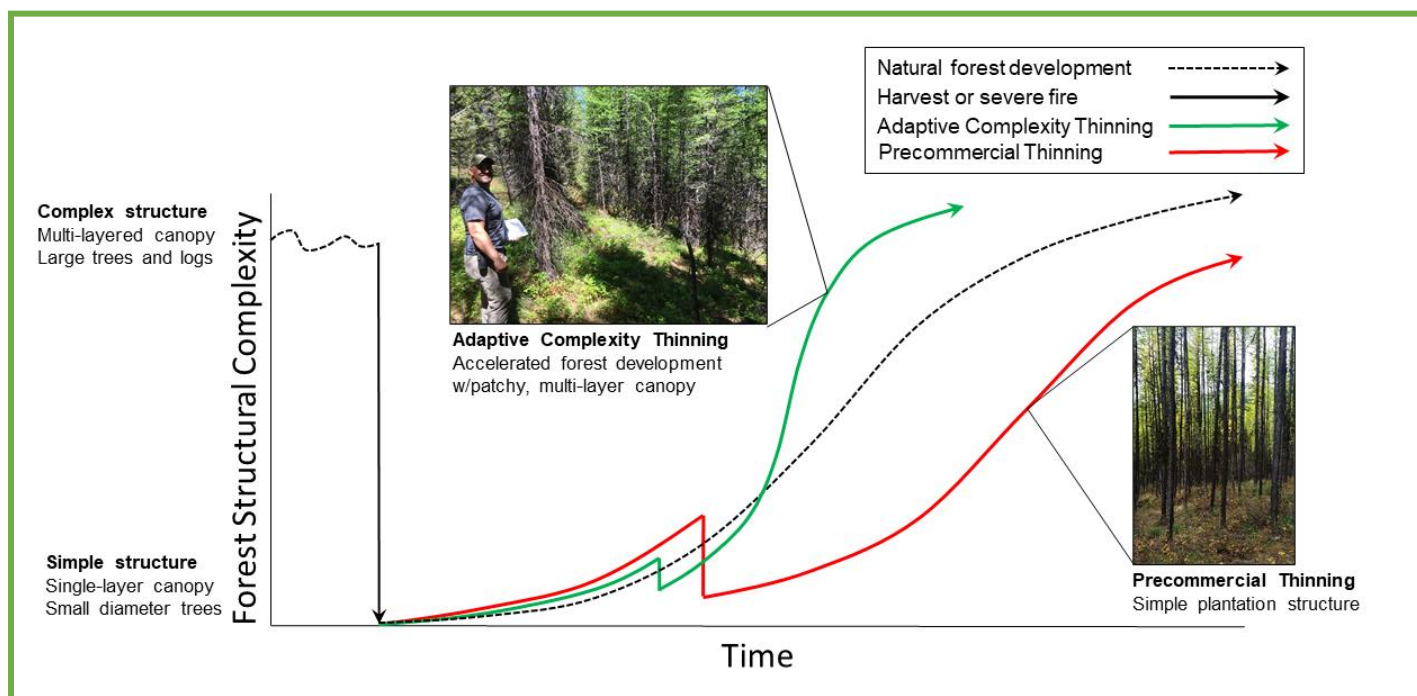


Figure 1—Conceptual model showing forest structural complexity (vertical axis) as a function of time (horizontal axis) and treatment history (different curves).

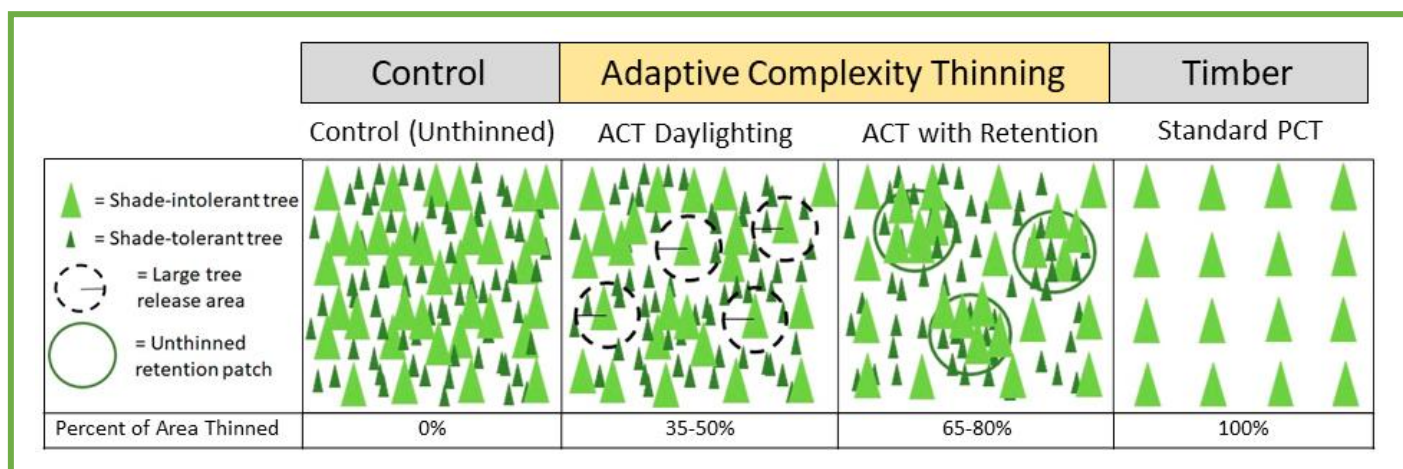


Figure 2—Conceptual diagram of the Adaptive Complexity Thinning (center two panels) methods being implemented using active adaptive management experimental treatments on Forest Service, Bureau of Land Management, and The Nature Conservancy lands.

References

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