

Intensive Forest Management (IFM) Study

2011-2020 Summary

Background:

- Plant, bird and arthropod responses were quantified across 32 regenerating stands that received one of 3 herbicide treatments (8 stand-level replicates per treatment) or served as untreated controls (8 stand-level replicates). Treatment applications occurred before and after stands were planted. Biological sampling to measure treatment responses on higher level taxa began in 2011 and remains ongoing.
- We separated bird responses into leaf-gleaning and non-leaf-gleaning species as foraging habits may lead to varying levels of sensitivity to the herbicide treatments.
- Moths and pollinators were sampled separately from other arthropods due to their perceived sensitivity to different treatments.
- Only two taxa were measured each year of the study: broadleaf plants and birds.

Plant responses to herbicides (direct) and herbivory (indirect)

- Herbicide treatments following timber harvest simplified the early seral vegetation community, experimentally reducing plant richness and abundance by up to 2x and 4x, respectively, relative to the control.
- Initial removal of forage via herbicides resulted in concentrated deer and elk browsing on regenerating plants.
- Herbivory effect on shrubs was strongest in Moderate and Intensive herbicide treatments.

Non-plant responses to changes in plant community (indirect):

- As expected, leaf-gleaning bird species showed greater sensitivity to treatments. Abundance of leaf-gleaning species was up to 60% lower in the treated stands when compared to the Control during the first 4 years of stand growth. Treated stands had up to 8 fewer species while treatments were ongoing.
- By year 6 of stand growth, abundance of leaf-gleaning birds was similar between Control and treated stands. For non-leaf gleaners, the lag in abundance in treated stands was shorter (3 years) and of reduced magnitude, up to 40% lower than the Control. Treated stands had similar numbers of species to untreated stands by year 5 of stand growth.
- In the study's only assessment of reproductive output of higher taxa (white-crowned sparrow), we found no evidence that either daily nest survival ($n > 760$ nests across all treatments) or post-fledging survival ($n = 70$ individuals reared in control and moderate treatments) varied by herbicide application intensity.

- There was no evidence of significant variation in moth abundance across treatments. We found approximately 10% (5) fewer species in treated stands when compared to the Control, and that difference was associated with variation in plant species richness.
- We found ~ 15% fewer pollinators and 33% fewer pollinator species in Moderate treated stands compared to the Control.
- We found ~ 12% fewer arthropod species but 5% greater abundance in Moderate treated stands compared to the Control.

Tradeoffs:

- Across all species groups, 140,408 detections and 835 taxa, we found 18% fewer species in the Moderate vs. Control treatments; reductions occurred primarily in plants (which were controlled directly by the treatments), pollinators, and leaf-gleaning birds.
- Modelling tree growth measurements through a 40-year rotation suggested a 20% increase wood volume at rotation age from herbicide applications around the time of stand initiation.
- Tradeoffs exist between estimated revenue and biodiversity, but the magnitude of the tradeoff (18% reduction in number of species – 20% increase in wood volume) was less than expected.
- The revenue-biodiversity tradeoff neutralized or reversed at high discount rates (>8%) when, based solely on simulated volume yield at rotation and projected revenue, the rationale for herbicide use becomes more limited.

Conclusions:

- Herbicides were effective at simplifying the early-seral plant community within an experimental framework.
- Regenerating forest stands treated with herbicides contained comparable levels of biological diversity for many taxa compared to stands regenerated without herbicides.
- Some taxa were insensitive to variation in management intensity created through herbicide treatments (moths, non-leaf-gleaning birds, cervids).
- Other taxa were more sensitive to variation in management intensity created through herbicide treatments (pollinators, arthropod species diversity).
- Taxa measured over time show varying levels of resilience to the treatments.
 - Broadleaf plants remain significantly reduced in abundance and total cover in treated stands, due in large part to the competitive dominance of Douglas-fir seedlings.
 - Birds species, even those with greater initial sensitivity to the treatments, had similar abundance and diversity across all treatments by year 6 of stand growth.
- Intensive forest management via herbicide application tends to result in biodiversity-timber production tradeoffs for many taxa although tradeoffs were weaker than expected and dissipated within 3-4 years after treatments were completed.