Wildlife-vegetation interactions in regeneration of Alaska boreal forest

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1. Wildlife roles in forest regeneration

2. Potential effects of regeneration practices on wildlife abundance

3. Ecological context of “site” and “time” in regen. practices and monitoring
1. Wildlife roles in forest regeneration

- Herbivory and seed predation (--) 
- Fungal inoculation (+) 
- Predation on herbivores (+) 
- Concept of “damage” 

Bark removal by voles 
Northern hawk owl 
Flying squirrel eating truffle fungus
Herbivory during stand initiation (seedlings)

Bill Casselman

Slater Museum

Clethrionomys rutilis, Tamiasciurus hudsonicus (forest)

Seed predation

Micromus spp. (grassland)

Bark removal*

Root removal

Lepus americanus (forest/shrub)

Twig clipping

Bark removal*

*girdling = mortality
Herbivory during stem exclusion (saplings)

- Tree stocking density
- Tree species composition

*Lepus americanus*
- Twig clipping,
- Bark removal

*Alces alces*
- Leaf stripping,
- Twig clipping,
- Stem breakage

Coniferous and Deciduous

“Deciduous “ (pine in AK?)
Herbivory of crop trees

*Erethizon dorsatum*

Bark removal

*Castor canadensis*

Felling for bark removal

*Alces alces*

Bark removal

Rateeveryanimal
# Herbivore effects on trees: individuals vs. population

<table>
<thead>
<tr>
<th>Trees</th>
<th>Stands</th>
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<tr>
<td>• Stress (predisposition)—winter browsing worse for conifers</td>
<td>• Differential species mortality affects composition (+) ?</td>
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<tr>
<td>• Height and radial growth rates—compensation (+) ?</td>
<td>• Stumpage by tree species (+) ?</td>
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<td>• Growth form (defect)</td>
<td>• Reduced litter fall lowers soil nitrogen</td>
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<td>• Wood properties (stain)</td>
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Generally positive correlation of herbivore density and tree/stand effects, but site factors have influence

- Ground cover, woody debris, and understory vegetation influence habitat use (predation risk)

- Forage selection -- a mixture of tree species (and sizes) receives unequal risk of herbivory

- Small patches of “forage” in matrix of mature forest may be heavily affected even at low hare/moose density

- Caution on translating findings from Eurasia to Alaska
  - dominance of intensive pine forestry in Fennoscandia
  - if few mountain hares, microtine rodents important (snowshoe hare dominant in N.A. boreal ecosystem)
Managing herbivore abundance to maximize tree regeneration

Natural history traits of abundance regulation

**r-selected**
- Large, multiple litters annually
- Short lived, variable abundance ("cycles")

**K-selected**
- 1-3 young
- 1+ yr. maturity
- Long lived

Public interest in harvesting

- Low
- High

Managing herbivore abundance to maximize tree regeneration
Ecological effects individual tree events translate to changes in abundance or biomass at stand level.

Herbivore “damage” changes in abundance or biomass are judged to be an economic liability warranting mitigation (no longer tolerable).

Defining “damage” requires an explicit definition of silvicultural objective(s) for context:

“Stocking density and size of >1 tree species at rotation age”
Soil inoculation with mycorrhizal fungi following disturbance (stand initiation)

*Glacomys sabrinus*

Feeding on “truffles” (*hypogeous fungi*)

Flying squirrel digging truffle

Images Slater Museum
2. Potential effects of forest regeneration practices on wildlife abundance

- Habitat (arrangement of food, cover, and structure)
  - wildlife fitness

- Cover: prey protection
- Structure: predator advantage

- Maintaining fungal dispersers and herbivore predators
  - resilience to short-term disturbance
  - adaptation to long-term change

Task force report on sustaining long-term forest health and productivity (SAF 1993:14)
Maintain habitat of predators on voles, hares, and potentially detrimental insects

- Northern goshawk (nest)
- Marten (subnivean access)
- Great gray owl (nest with young)
- Olive-sided flycatcher (hunting perch)
- Northern flicker (cavity nest)
Beneficial wildlife effects in forest regeneration and health

• Jacobs and Louma 2008: Lesser degrees of tree retention in PNW reduced fungal spores in small mammal diets. “Island” retention for small mammal and fungi refugia benefits micorrhizal inoculation

• Huitu et al. 2012: Reducing vole damage in Fennoscandia reforestation
  • Avoid peak vole years for planting; use enough larger seedlings
  • Use variable-retention instead of clearcut (less grass cover, forage)

• Fayt et al. 2005: Empirical observations, exclosure experiments, and modelling all suggested that woodpeckers (esp. 3-toed WP, occurs in AK) play a significant role in regulating bark beetle populations

• Mantyla et al. 2011: Meta-analysis (tropical, temperate, boreal) indicated sapling and mature plant biomass positively correlated to presence of avian predators (insectivores, carnivores)
Monitoring temporal risk factors (snowshoe hare abundance)

*Capture – mark-recapture estimates; other study sites used pellet indices

Graphs courtesy Dr. Knut Kielland, University of Alaska-Fairbanks
Monitoring temporal risk factors

Hares counted during bird surveys

“Status of grouse, ptarmigan, and hare in Alaska, 2014” (ADF&G)
Spatial (scalar) factors predisposing herbivory

- Patch
- Stand
- Landscape
Logging (mean = 24 acres, total = 35,000 acres, N = 1488)
- Controlled disturbance
- Harvest & scarification...
- Salvage dead wood?

Fires (mean = 26,045 acres, total = 8,500,000 acres, N = 326)
- Limited control
- Patchy w/ variable severity
- Standing dead / debris
Unburned inclusions and patchiness of fire severity (unburned areas akin to “green tree retention”)
Spatial (scalar) factors predisposing herbivory

Are small logging units attractive environments of herbivore food and cover in a less inviting mature forest?

Plant in large burns during hare highs?

- Patch
- Stand
- Landscape
3. Ecological context of site and time in regen. practices and monitoring

- No universal guidelines (“checklist” of factors...)
- Use silvicultural prescription to optimize habitat for “beneficial” wildlife interactions
- Reduce tree mortality risk by using wildlife (and insect?) data sources
- Ensure temporal (and spatial?) flexibility in standards to allow adaptive management