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**SPRUCE PER SITE: EFFECTS OF SPECIES MIXTURES AND SITE EFFECTS ON LONG-TERM YIELD ESTIMATES (4Picea)**

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**Goal:** Compare and contrast growth and productivity between spruce (white spruce, red spruce, black spruce, Norway spruce) growing in both monocultures and mixtures

**Objectives:**

* Quantify stem and stand volume (m³ (within species mixtures to determine if (i) they are overyielding compared to pure mixtures, (ii) how the growing space is being occupied, and (iii) what are long-term (rotation length), and productivity (site index) implications
* A group of trees with green tops

  Description automatically generatedDetermine if microsite variations in soil and topographic features influence tree and stand development and lead to overyielding

A grid with black and white text

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Figure 1. Layout of 4Picea. 20 m x 20 m treatment plots across 3 acres planted at 2 m by 2 m spacing for 11 treatments total. B = black spruce; N= Norway spruce; R = red spruce; W = white spruce; C = control.

**History:** Prior to planting the stand was a poor-quality hardwood stand comprised of mainly American beech. The stand was harvested by May 1995 via a combination of hand felling and cut-to-length system. All plots were planted in 1995 at a 2 m by 2 m spacing with a JDI seed source. Initially the survival of red spruce was poor and plots were refilled in 1996. In 2001 spruce sawfly damage was observed on black spruce and white spruce stems with weevil damage affecting Norway spruce. Periodically, hardwood sprouts were eliminated via basal spraying with triclopyr (Seymour, personal communication).

**Planted Forests:**

* Plantations are primarily established to provide timber products, but also provide direct and indirect ecosystem benefits such wildlife habitat and soil erosion control (Pawson et al., 2013).
* There is a growing interest in the ability of planted forests coupled with intensive silviculture to mitigate future wood supply shortages (Liu et al., 2018) and sequester carbon, contributing to climate change mitigation (Pawson et al., 2013).
* ~4% of Maine’s forests are planted

**Methods:**

* Plots measured in 2011 and 2023
* Site variables lifted from raster (e.g., elevation, roughness, slope, aspect, flowdir, etc.)

A map of a map with a grid

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Figure 2. Split in aspect (East/West) across the study area at the Penobscot Experimental Forest (PEF).

A screenshot of a computer generated image

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Figure 3. Topographic site variables across the study site at the Penobscot Experimental Forest (PEF)

A grid on an orange background

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Figure 4. Site suitability results based on predictive models for [A] black spruce (0.01), [B] red spruce (0.42), and [C] white spruce (.12).

A graph with numbers and letters

Description automatically generated with medium confidence**Results:**

A graph of a class distribution

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Figure 6. Basal area per acre and tree per acre by treatment.

Figure 5. 2” diameter class distribution across all treatments.

Overyielding: occurs when a mixture produces a greater combined yield (e.g., biomass, wood volume) than the average yield of the monocultures of the component species grown individually

Transgressive Overyielding: occurs when the yield of a mixture not only exceeds the average yield of the monocultures but also surpasses the yield of the best-performing monoculture

A graph of different types of overlaying

Description automatically generatedA graph of a number of gray rectangular bars

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