Piecing the Puzzle of Successional Trajectories

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Starting conditions: Alaskan black spruce forest burned by wildfire
Objective: Predict the likely trajectory of post-fire succession, up to 100 years

You will need information on the following **factors**:

A. Site drainage (based on topography and soil texture)
B. Presence of near-surface permafrost
C. Stand age at the time of burning
D. Pre-fire depth of the soil organic layer (SOL)
E. Fire severity, measured as % combustion of the SOL
F. Deciduous seed availability in the year after the fire
G. Potential wild-cards, such as high hare density, black spruce trees fallen down after fire, or drought in the summer after fire

Look-up table for information cards: Use this table to translate your draw of info cards into levels of the different factors used in the key.

Factor	Card=1	Card=2	Card=3
Site drainage	Poor	Moderate	Well
Permafrost	Lots	Little	None
Stand age	>100 yrs	60-100 yrs	<60 yrs
Pre-fire SOL depth	>20 cm	5-20 cm	<5 cm
Fire severity (%)	0-30%	30-60%	60-100%
Deciduous seed	little	some	lots
Wild-card	peak hare	trees fallen	drought

Information cards assigned to groups:

Group #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Site drainage	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Permafrost	1	2	3	1	2	3	1	1	1	2	2	2	3	3	3
Stand age	3	3	3	1	1	1	2	2	2	3	2	3	3	3	2
Pre-fire SOL	1	3	2	1	2	3	2	2	3	2	2	2	2	2	2
Fire severity	2	1	3	2	3	2	2	1	1	2	2	3	3	2	1
Decid. seed	1	2	2	3	3	2	1	2	3	3	3	2	1	1	1
Wild-card	0	0	0	0	3	1	3	2	1	0	0	3	0	2	0

Use the information you have on the different factors to predict the successional trajectory of your site using the key on the following page.

Take some notes so you can tell your successional story to the larger group!

Successional trajectories key

(For more information and the full key, see USDA General Technical Report PNW-GTR-767)

1. Site is poorly to moderately drained
    a. There is sufficient near-surface permafrost to continue to impede drainage after fire
        i. The pre-fire SOL was thick and the majority was unburned, with low exposure (<5 percent) of deeper soil layers (go to 3)
        ii. The pre-fire SOL was thick and has been severely burned, leading to shallow (<5 cm average depth) residual organic layers and at least moderate exposure of deeper soil layers (go to 5)
    b. The site has little to no permafrost and drainage increases after fire (go to 2)
        i. The pre-fire SOL was thick and the majority was unburned, with low exposure (<5 percent) of deeper soil layers (go to 3)
        ii. The pre-fire SOL was thick and has been severely burned, leading to shallow (<5 cm average depth) residual organic layers and at least moderate exposure of deeper soil layers (go to 5)
2. Site is dry with little to no permafrost
    a. There is an intact organic layer remaining after fire and low (<15 percent) mineral soil exposure
        i. There are multiple standing black spruce trees with open cones at the site that provide a strong onsite seed source for black spruce. Expected trajectory: **black spruce forest**
        ii. The pre-fire black spruce trees are immature (<60 yrs old) or have fallen over after being burned, limiting seed availability. Expected trajectory: **open spruce-lichen woodland**
    b. Much of the organic soil was consumed by fire, providing extensive (>15 percent) mineral soil exposure
        i. There are mature (> 60 yrs) standing black spruce trees at the site that provide a strong onsite seed source for black spruce.
            1. There is a strong seed source for deciduous trees in the area and normal climate conditions. Expected trajectory: **mixed spruce-deciduous forest**
            2. There are few deciduous seeds available or severe drought during the first 1-2 years after fire. Expected trajectory: **open black spruce forest**
        ii. The pre-fire black spruce trees are immature (<60 yrs old) or have fallen over after being burned, limiting seed availability.
            1. There is a strong seed source for deciduous trees in the area and normal climate conditions. Expected trajectory: **open deciduous forest**
            2. There are few deciduous seeds available or severe drought during the first 1-2 years after fire. Expected trajectory: **spruce-lichen woodland**
3. There are abundant mature black spruce trees still standing after fire, providing a strong local seed source.
    a. The residual organic layer is thick (>20 cm), favouring cold soil temperatures that are likely to limit seedling growth.

        i. A peak in the hare cycle while seedlings are young causes high mortality of black spruce. Expected trajectory: **open shrubland**
        ii. Seedling growth is not inhibited by herbivory. Expected trajectory: **open-canopy black spruce**
    b. The residual organic layer is less than 20 cm thick. Thinner moss layers combined with moist site conditions allow higher rates of black spruce establishment.
        i. A peak in the hare cycle while seedlings are young causes high mortality of black spruce. Expected trajectory: **open-canopy black spruce**
        ii. Seedling growth is not inhibited by herbivory. Expected trajectory: **intermediate- to closed-canopy black spruce**
4. The pre-fire black spruce trees are immature (<60 yrs old) or have fallen over after being burned, limiting seed availability. Expected trajectory: **open shrubland**
5. Moist sites with shallow soil organic layers or exposed mineral soil. These sites generally have a high recruitment potential for both conifer and deciduous species and thus have a range of possible successional trajectories.
    a. There are multiple standing black spruce trees with open cones at the site that provide a strong onsite seed source for black spruce.
        i. There is a stand of live deciduous trees in the area that can provides an abundant seed source for deciduous trees. Deciduous seedling recruitment is high and they quickly shade out the black spruce seedlings. Expected trajectory: **deciduous forest**
        ii. Deciduous trees have only a moderate seed source, and recruit about equally to black spruce. Expected trajectory: **mixed deciduous-black spruce forest**
        iii. There are few deciduous trees in prefire stand or surrounding unburned forest to provide a seed source. Expected trajectory: **black spruce forest**
    b. The local seed source for black spruce is limited by most trees having fallen over, trees being too immature (<60 yrs) to bear many cones.
        i. There is moderate to high availability of deciduous tree seed. Expected trajectory: **deciduous forest**
        ii. There are few deciduous trees in the area leading to low seed availability for both deciduous trees and black spruce. Expected trajectory: **nonforested shrubland/grassland or open spruce-lichen woodland**