FRST211: APPLIED FOREST ECOLOGY - CLASSIFICATION AND SILVICS
MOUNTAIN FORESTS: DISTURBANCE AND DYNAMICS

OUTLINE:
- NDTs and BEC
- Alternate Understanding of Fire Regimes
- Natural Disturbance as a Template for Sustainable Forest Management
- Other Disturbances and Climate Change

A. TRADITIONAL CLASSIFICATION OF “NATURAL DISTURBANCE TYPES” (NDT)
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/biodiv/biotoc.htm

<table>
<thead>
<tr>
<th>NDT</th>
<th>Description</th>
<th>Return interval (yrs)</th>
<th>BEC units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rare stand-initiating events</td>
<td>~250 yrs</td>
<td>wetter subzones and high elevations of ICH and ESSF</td>
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<tr>
<td>2</td>
<td>Infrequent stand-initiating events</td>
<td>~200 yrs</td>
<td>drier subzones and lower elevations of ICH and ESSF</td>
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<tr>
<td>3</td>
<td>Frequent stand-initiating events</td>
<td>~150 years</td>
<td>MS, dry subzones of ICH and dry subzones at low elevations of ESSF</td>
</tr>
<tr>
<td>4</td>
<td>Frequent stand-maintaining events</td>
<td>2-50 years ≥ 150 years</td>
<td>IDF, PP and BG zones</td>
</tr>
<tr>
<td>5</td>
<td>Extremely rare events</td>
<td>&gt;250 years</td>
<td>ESSF Parkland and AT</td>
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NDT and BEC
5 = ESSF Parkland + Alpine zones
1 = ESSF and ICH wetter subzones + high elevations
2 = ESSF and ICH drier subzones + lower elevations
3 = MS, driest subzones of ICH, driest subzones at low elevations of ESSF
4 = IDF, PP + BG

For forests of the ESSF, ICH and MS, the stand-replacing fire regime described by NDTs has been used as ‘template’ to justify:
- even-aged silviculture
- rotations of c.100 yrs
- proportion of old-growth forest in the landscape
- fire suppression (assuming all fires will be high severity)

However, further analyses of the mid-elevation MS and ICH Forests:
- currently ~25% complex, mixed-species forests
- many stands uneven-aged and include large, old veteran trees that are much older than “stand age”
- abundant trees with single and multiple fire scars = physical evidence of past surface fires
- tree-ring analyses indicate surface fires occurred every 25-40 years in many MS, ICH and some ESSF forests; oldest living trees with fire scars often exceed the average fire return interval

B. ALTERNATE UNDERSTANDING OF FIRE REGIMES
- mixed-severity fire regimes = include frequent stand-maintaining fires + infrequent stand-initiating fires
- low-severity, stand-maintaining surface fires were common even in mid-elevation forests (MS and ICH)
- return intervals for lower-severity fires in mid-elevation forests = 10s of years (not 150-250 years!)
- fires of a range of severities result in landscape heterogeneity = variation within and among stands
  - uneven age and size structures
  - mixed species composition as different species are adapted to survive and regenerate after fires of various severities resulting in different seedbeds and seed sources
C. NATURAL DISTURBANCE AS A TEMPLATE FOR SUSTAINABLE FOREST MANAGEMENT

Many tree species are adapted to fire, which provides a template for management. Silviculture that “emulates” natural disturbance regimes will result in combinations of forest composition and structure that historically occurred on the landscape. If managed forests are similar to historic forests, then critical habitats to which flora and fauna are adapted would be maintained – sustaining timber production and biodiversity.

1. Trees adapted to stand-maintaining fires as well as stand-replacing fires

Fire-tolerant Species = resist surface fire

- ponderosa pine, western larch, Douglas-fir
  - thick, protective bark, self-pruning lower branches
  - regenerate in open forests or after fire
  - Pp and Lw = shade intolerant, exposure tolerant
  - Fd = shade tolerant, protection requiring on warm/dry sites

Alternative Silviculture
Many tree species are adapted to fire and improved understanding of the fire regime can provides a template or framework for a range of management options with respect to silvicultural systems.

- management of interior Douglas-fir
  - clearcuts (mesic sites)
  - shelterwood or other retention systems provide protection (dry sites)
  - natural regeneration but limited by seed dissemination and need for protection
  - artificial regeneration= aerial seeding + planting

- management of western larch
  - seedtree or shelterwood or other retention systems provide seed source, suitable substrate and light environment needed for natural regeneration
  - artificial regeneration by planting to supplement natural seed production/dissemination

1. Trees adapted to stand-replacing fires

Fire-intolerant species = thin-barked trees that do not resist stand-maintaining or stand-replacing fires. Some “fire-intolerants” are adapted to fire through their regeneration dynamics and are well suited for regeneration in clear cuts. Some species are “evaders” with persistent propagules in the soil or canopy to avoid elimination by disturbance (e.g. serotinous cones of lodgepole pine). Others are endurers, sprouting or vegetative regeneration following fire (e.g. root suckering in aspen).

Traditional Silviculture
Lodgepole pine and trembling aspen are “fire intolerant” species that regenerate after stand-replacing fires and are strong indicators of past stand-replacing fires (or other stand-replacing disturbances). They readily regenerate and grow in clearcuts to create even-aged stands.

- management of lodgepole pine
  - regenerates readily in the “open” environments in clearcuts to meet “stocking standards” and grows rapidly reaching critical size for “free-to-grow criteria” (essential for adjacent sites to be harvested)
  - natural regeneration but can be limited by seed availability and dissemination
  - artificial regeneration= planting

- management of trembling aspen
  - shade intolerant and exposure requiring
  - regenerates largely by root suckering facilitating natural regeneration within 3 years of fire
  - shared nutrients enables tolerance to limiting resources
D. OTHER DISTURBANCES AND CLIMATIC INFLUENCES

1. Altered fire regimes and climate change – “the fire suppression paradox”

To protect forests from damage, fires have been actively suppressed in BC for several decades. As a result, surface fires have been largely removed from the mixed-severity fire regime of many dry forests (PP, IDF, MS and ICH zones). In absence of these lower-severity fires, fuels accumulate and understory trees persist in high density. Increased fuel abundance, including ladder fuels connecting the subcanopy and canopy strata, can lead to more severe fires that spread into the crown, killing trees. Thus, by trying to protect forests from fire we have created the conditions for more severe fires in many places – the fire suppression paradox.

The chance of a severe fire increases during hot dry summers. Given projections of lower snowpacks, longer growing seasons, warmer and drier summer months in much of the southern interior of BC, fire regimes may be changing as a result of these cumulative impacts.

2. Potential climate change impacts on ponderosa pine
   • mortality directly linked to severe summer drought, as well as mountain pine beetle
   • increasing chance of stand-replacing fires

3. Potential climate change impacts on lodgepole pine
   • widespread lodgepole pine mortality due to mountain pine beetle
   • increased over-winter survival of mountain pine beetle in absence of sufficiently cold weather
   • increasing chance of stand-replacing fires

4. Potential climate change impacts on interior Douglas-fir
   • on-going, widespread defoliation by western spruce budworm is possibly climate-triggered
   • susceptible to bark beetles, also affected by climate
   • increasing chance of stand-replacing fires