Establishing and growing aspen stands in the SBS

Presentation to IBWG by Phil Comeau

March 14, 2024

Aspen dominated stands

Aspen and succession with and without spruce

From Bergeron et al. 2014. For. Chron 90:202-213

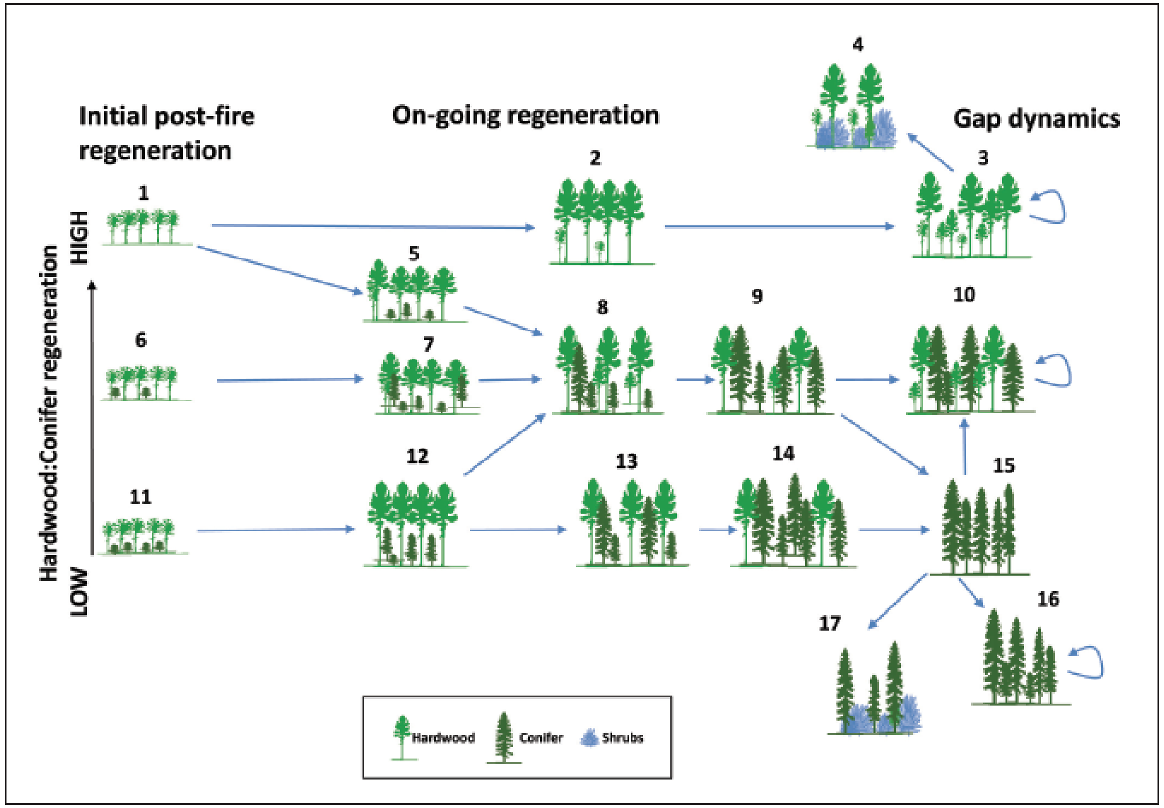


Fig. 3. Generalized patterns of mixedwood stand dynamics as a function of the amount of broadleaf and conifer regeneration in the initial post-fire period and later on during stand development, as well as the influence of canopy senescence and secondary disturbances. The six stand dynamics patterns described in the text are represented by the following transitions between forest conditions: 1) "classic": 6-7-8-9-15-16 or 11-12-13-14-15-16, 16 gap dynamics; 2) No conifer regeneration: 1-2-3, 3 gap dynamics; 3) Ongoing broadleaf and conifer regeneration: 1-5-8-9-10 or 6-7-8-9-10, 10 gap dynamics; 4) Accelerated transition to conifer: same as (1) except faster; 5) Ongoing broadleaf recruitment: 15-10, 10 gap dynamics; 6) Transition to shrub dominance: 3-4 or 15-17.

Uneven – aged old aspen stands

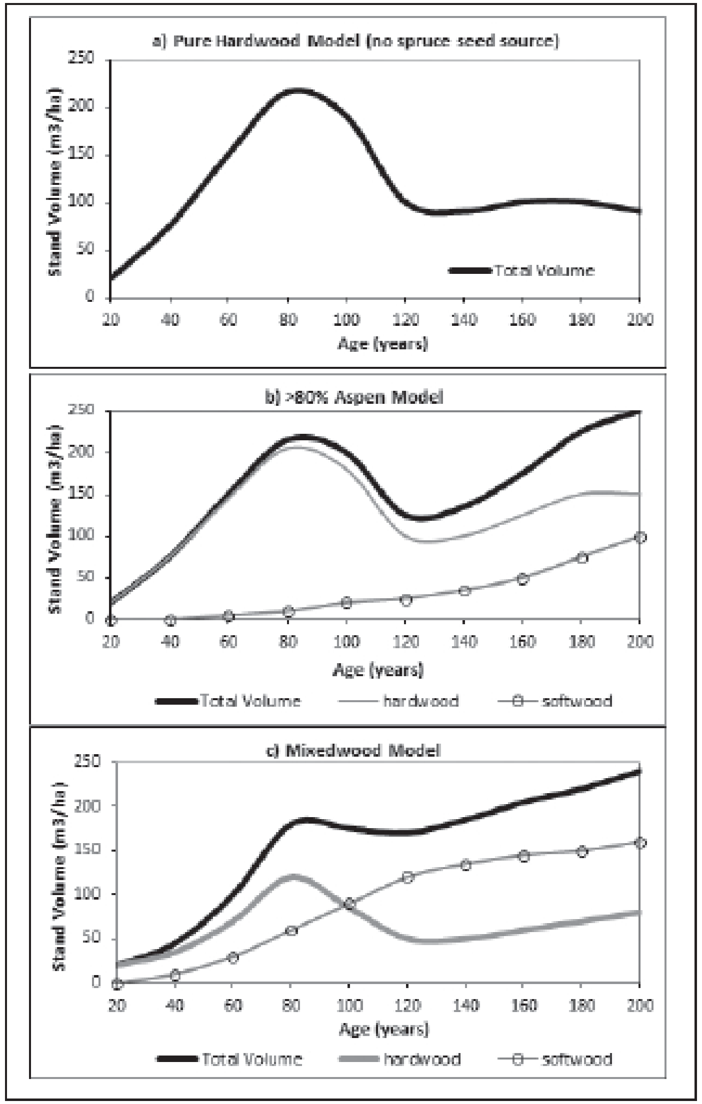


Fig. 5. General successional trends from the Riding Mountain PSP data (Kenkel 2004): a) pure aspen (no spruce seed source); b) >80 aspen; and c) aspen–spruce mixedwood.

- LeBlanc, P. 2014. For Chron. 90: 50-58
- Results from a study in Riding Mountain, Manitoba
- Stands that live past age 80 become multi-aged
    - Aspen regeneration develops in the understory when the canopy opens (starting about age 60)

Aspen regeneration

- Requires removal of apical dominance (logging, fire) – since suckering is inhibited by hormonal control from standing trees
- Usually good suckering following clearcutting of aspen or mixed stands with at least 50 sph of healthy mature aspen (for selection of sites I would suggest 100+)

- Aspen suckering and sucker survival can be inhibited by several factors including:
  - Cold soils
  - Thick forest floor
  - Flooding
  - Root damage
  - Soil compaction
    - Root damage, poor drainage, poor aeration
  - Log decks
  - Slash piles
    - Intense heat from Burning slash piles kills aspen roots
  - Overstory

Harvest Considerations

Season – winter harvesting gives best aspen regeneration (less damage to roots and less soil compaction)

- Want to minimize soil compaction and root damage!!

Harvest Considerations

- Partial cutting and Green-tree retention
  - Retaining more than 35% of the original canopy results in substantial reductions in aspen sucker densities 5 to 10 years after harvest (reduced suckering and reduced survival) (e.g. Gradowski et al. 2009, Prevost and Pothier 2003, Bjelanovic et al. 2022)

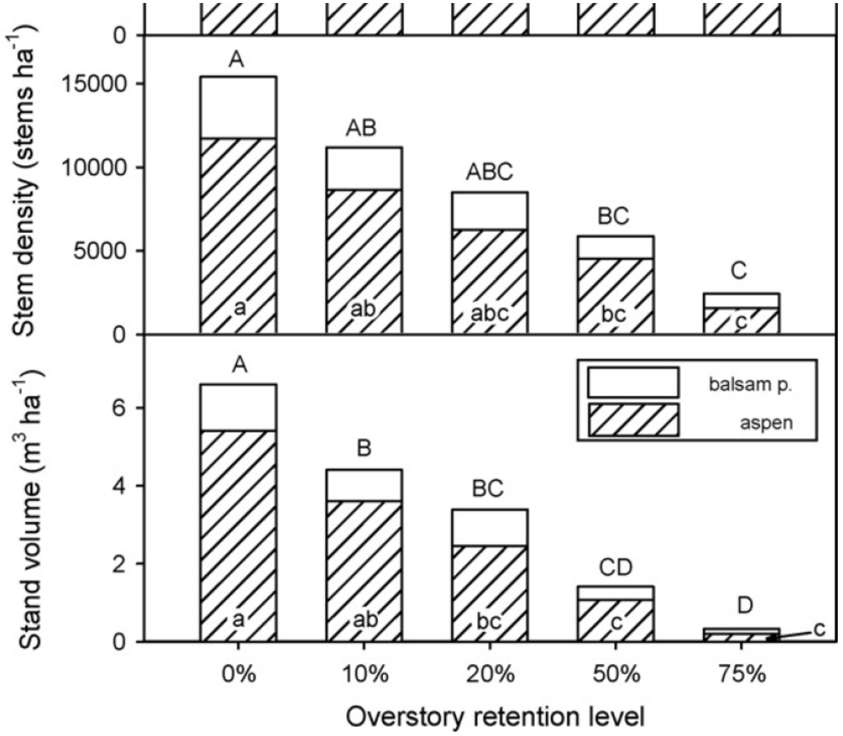


Fig. 2. The effect overstory retention level on stem volume, stem density and volume ha^{-1} of aspen + balsam poplar regeneration in 2007. Bars with the same letter were not significantly different (Tukey's test, $\alpha = 0.05$)—lower case letters related to aspen alone and upper case letters to aspen + balsam poplar combined.

From Gradowski et al. 2009

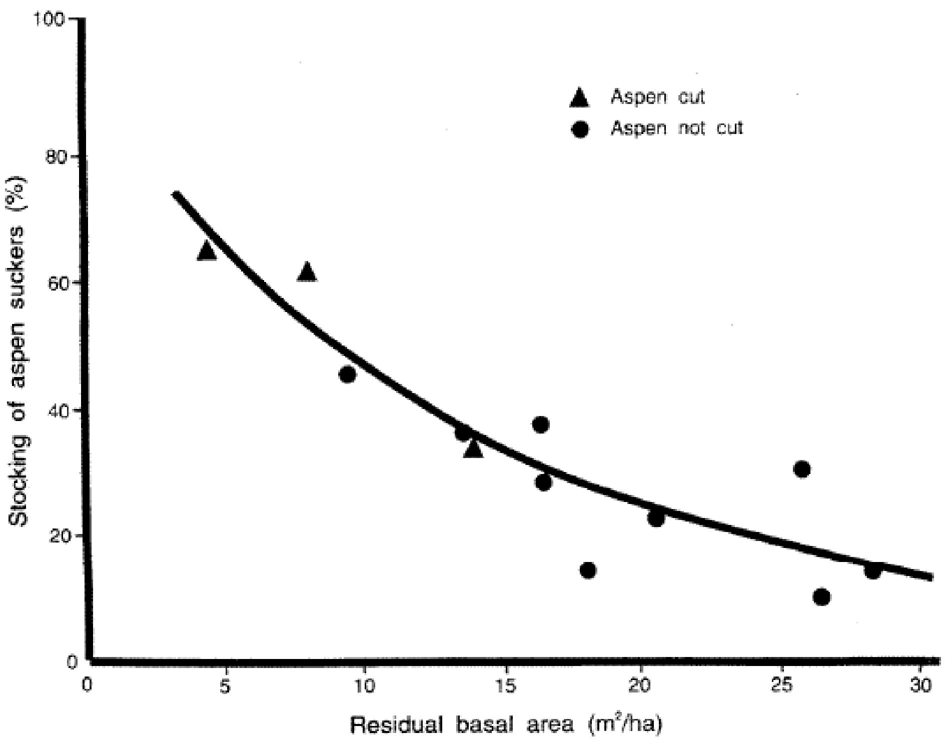


FIGURE 21. Relationships between stocking of aspen suckers and residual basal area of aspen and white spruce 5 years after cutting, based on data from the prairie provinces. Courtesy of Canadian Forest Service, Edmonton.

From Peterson and Peterson 1995

Harvest Considerations

- Soil compaction from skidders etc. (particularly problematic on fine textured soils and if operating when ground is moist or wet and not frozen).
- Log decks left on site over the growing season

- Flooding during the growing season (Bates et al 1998 NJAF 15:169-173)
- Slash
  - Thick continuous slash is problematic
  - Slash piles – no regeneration under piles
    - Burning – heat penetrating the soil kills aspen roots
  - Hog Fuel –can severely inhibit aspen regeneration unless it is patchy or applied in a thin layer (<4 cm) (Conlin et al. 2004)

MSP effects on aspen

(modified from Peterson and Peterson 1995)

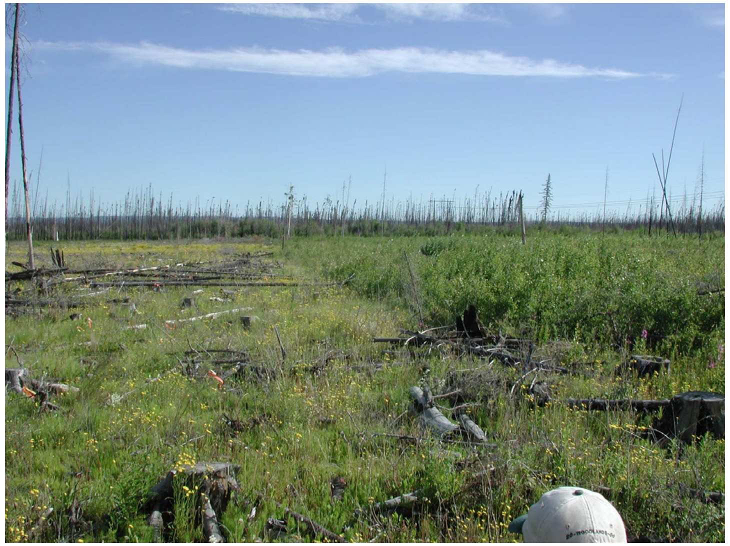
- MSP generally of little benefit to aspen regeneration except when forest floor is thick (>5 cm)
- Brush blades – to reduce slash – piling and redistributing slash can be beneficial
- Drag scarification – can (sometimes) improve suckering especially on sites with thick forest floor
- Disc-trenching – negative or neutral effects
- Mounding
  - small (<10 cm) mounds created with light equipment (e.g. Terrateck, Donaren) usually have little impact
  - large mounds can reduce aspen (but are usually used on hygric sites where managing for aspen is less likely)
- Ripping/Plowing/Tilling –
  - effectively reduces total aspen density
  - aspen is usually concentrated along the “hinge” and areas between berms with no aspen in the trenches
- High speed mixers –GRIZZ, Merricrusher – eliminates aspen

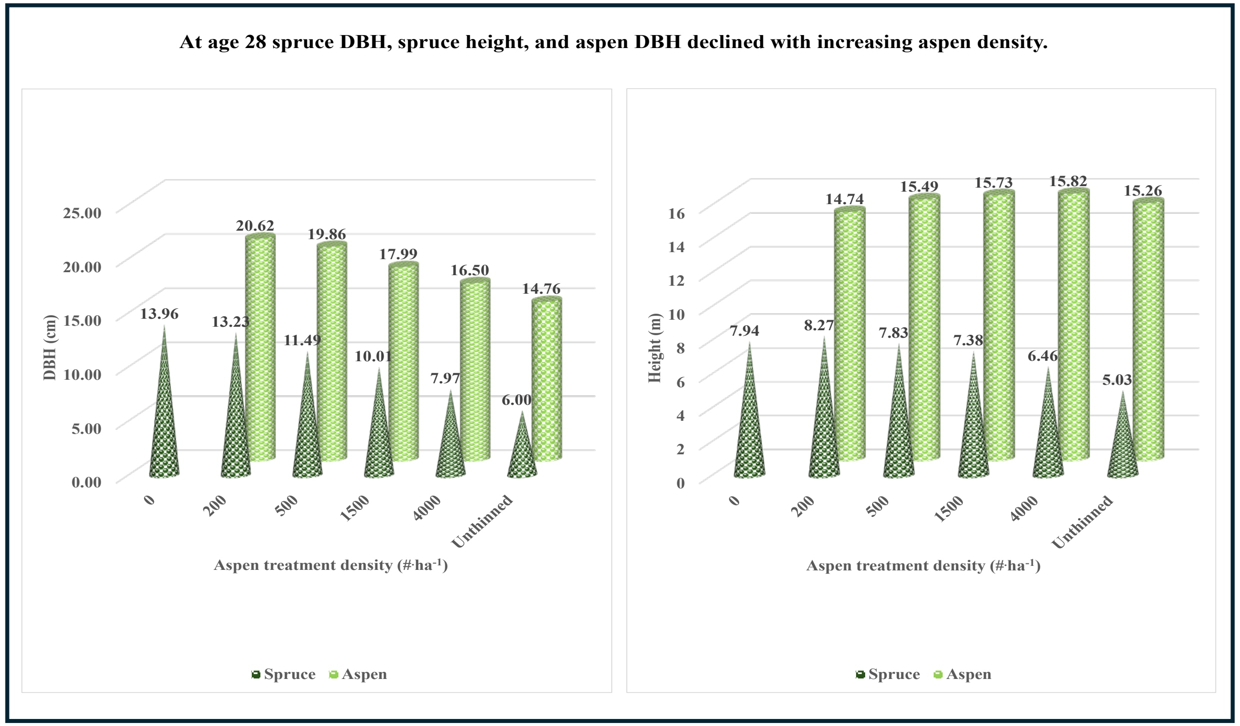
Sulphur Lake – Mounded – year 3 (2009).

High Level 15 years after ripper-plow

Effects of tending

- Herbicides (glyphosate, triclopyr, imazapyr)
    - Imazapyr – spot treatments provide long-term control of aspen through killing underlying aspen roots.
    - Glyphosate – Operational aerial application commonly results in 500 to 1500+ sph of aspen at age 10
    - Preharvest hack and squirt of aspen using glyphosate reduces aspen densities after harvest (at PineRidge (EP1080) At sph was about 50% of untreated at age 10)
- Brushing – is followed by stump sprouting of aspen and an initial **increase in the number of stems/ha**
- PCT (age 10 or later) – leaving enough large aspen on site can reduce number and size of suckers (Darquie et al. 2024 For. Ecol. Man. 555, 121703), but retained aspen release and grow well.



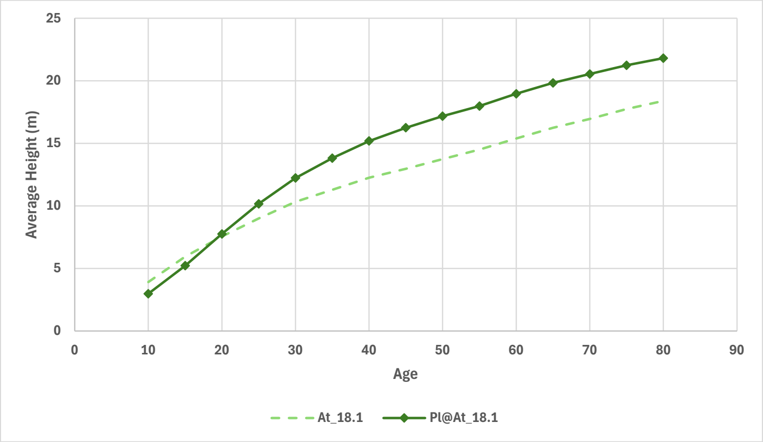


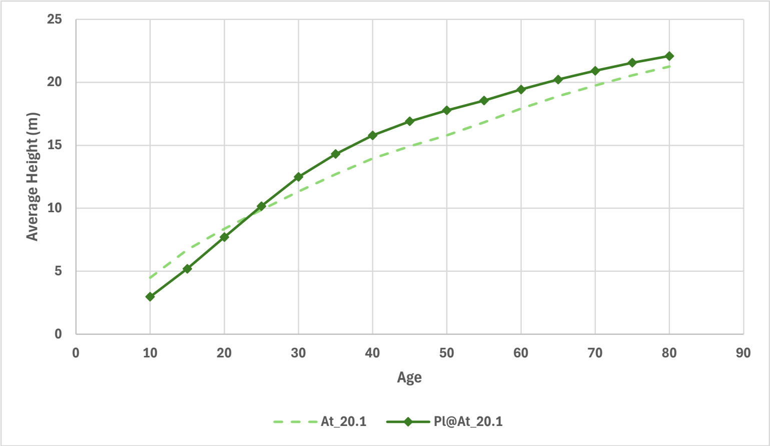
Comeau and Bokalo Forests 2024, 15, 223

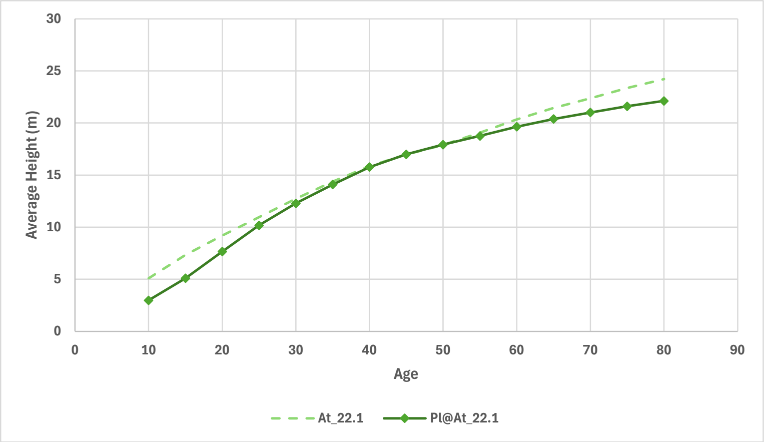
Effects of conifers

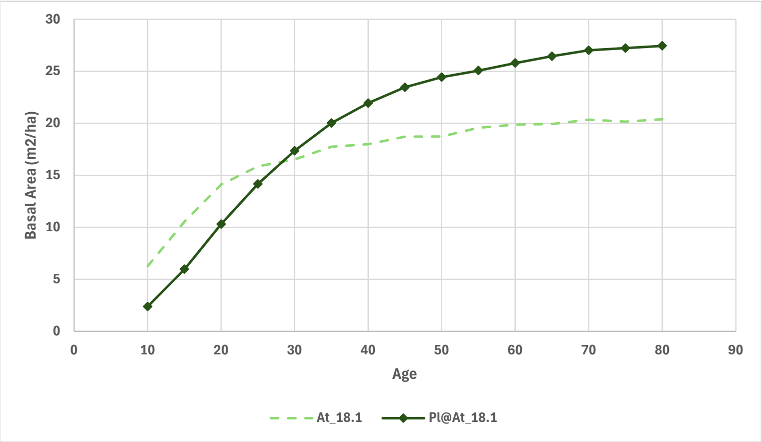
- Pine – +/- codominant from early years, overtopping pine reduces aspen growth and survival. Subtle differences in site index and other factors result in shifts in which species dominates. Patchy distributions of both species believed to be important to development of Aspen-Pine mixtures
- Spruce – in the understory during the first 40-80 years, but suppresses aspen when it overtops them
- Natural regeneration vs planted
    - In the case of spruce, natural regeneration shows slow initial growth - planted stock will grow into the canopy sooner than naturals
    - Planting of improved stock – likely to further accelerate transition of stands to conifer
- Densities
    - effects of planted conifers likely to increase with increasing conifer density

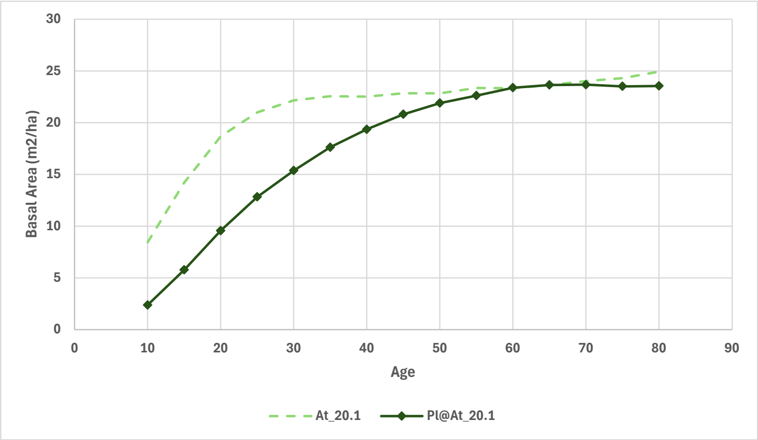
Effects of lodgepole pine: MGM21 simulations of aspen and pine height and basal area for Pl SI=20.1 and 3 levels of aspen SI. At age 10 : At sph=10000 and Pl sph=1500

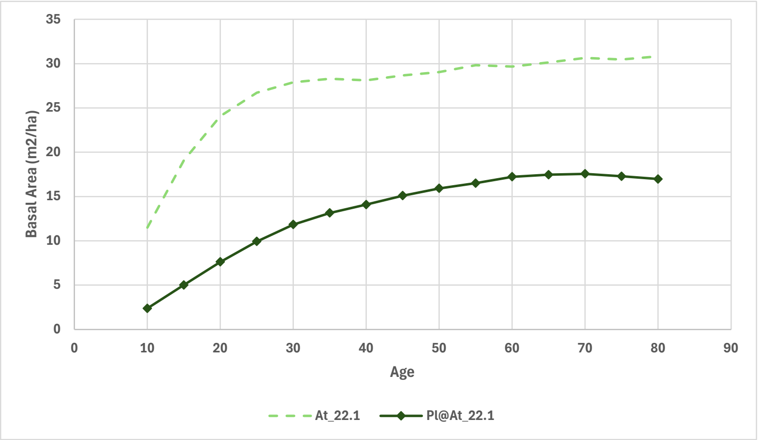






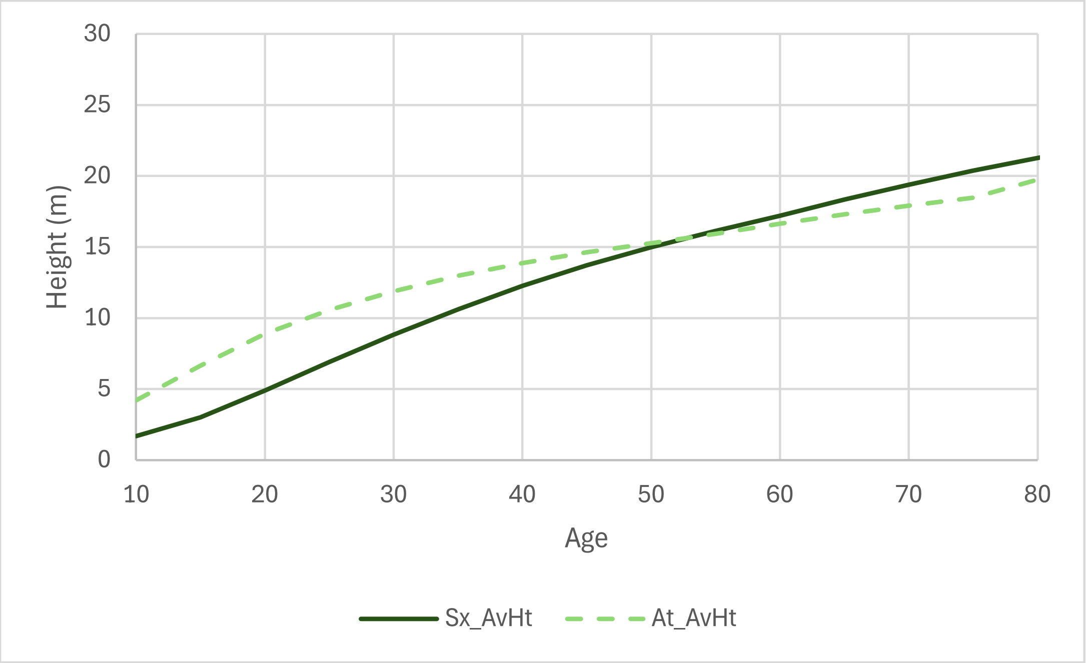


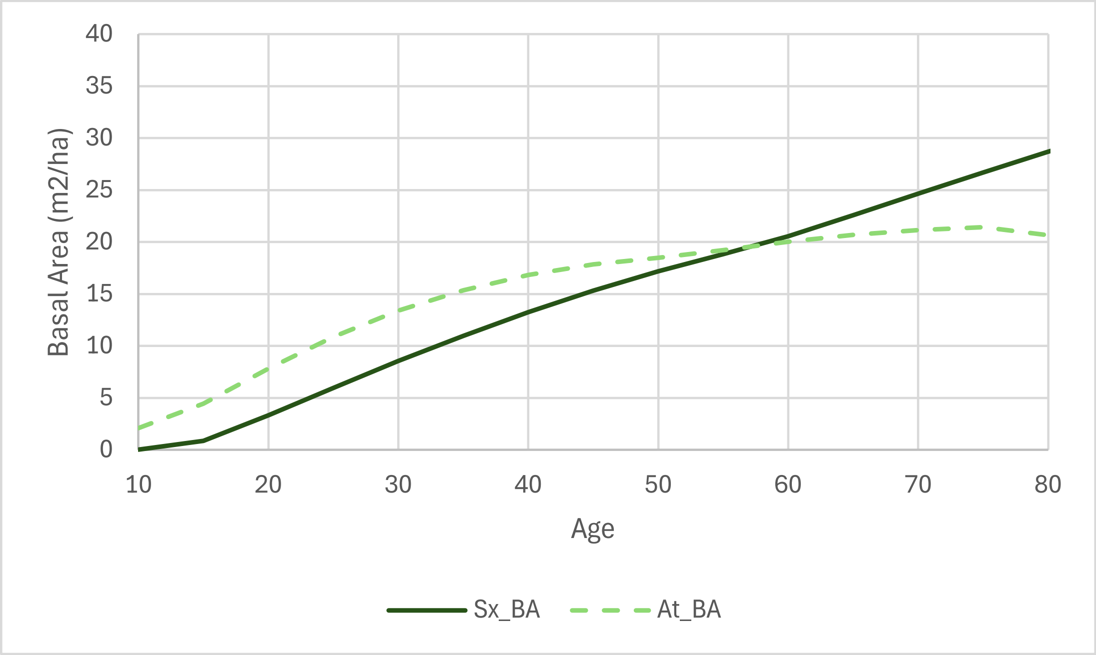




Effects of spruce

MGM21 simulations of aspen and spruce height and basal area for Sx SI=21.6 and At SI=19.1. At age 10 : At sph=10000 and Sx sph=1500





Self-thinning

- Following harvesting of an aspen stand- aspen densities can surpass 200,000 sph in year 1
- Aspen self-thin rapidly (down to 100,000 or less by age 5, and 50,000 or less by age 10)
- Desirable to have high initial densities since stand vigor is best when initial densities are high (initial densities below about 5,000 sph at age 2 indicative of problems).

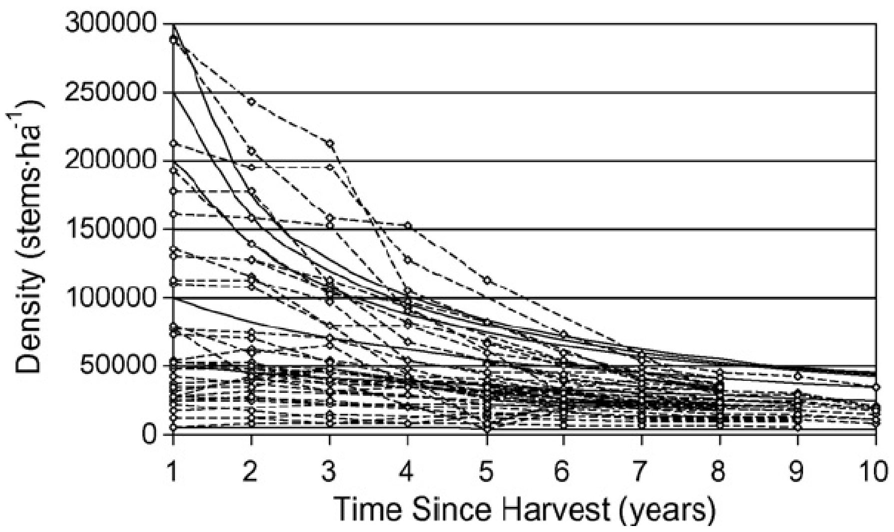


Fig. 3. Changes in observed densities (stems ha^{-1}) with time (years) (dashed lines) and five representations of model predictions using Eq. (7) (solid lines), for starting densities of 5000, 50,000, 100,000, 200,000, 250,000 and 300,000 stems ha^{-1}.

for four WESBOGY LTS installations

(Grovedale AB, Hinton AB, Peace River AB, and Prince Albert SK)

from Bokalo et al. 2007. For. Ecol. Manage. 242: 175-184

Site Selection for Aspen

- Preharvest:
  - stands with more than 50 (ideally >100) aspen sph
  - Aspen are healthy (Phellinus and Armillaria low-to moderate)
  - Site not likely to “wet up” (ie. subygric, mesic or submesic)

Site Selection for Aspen

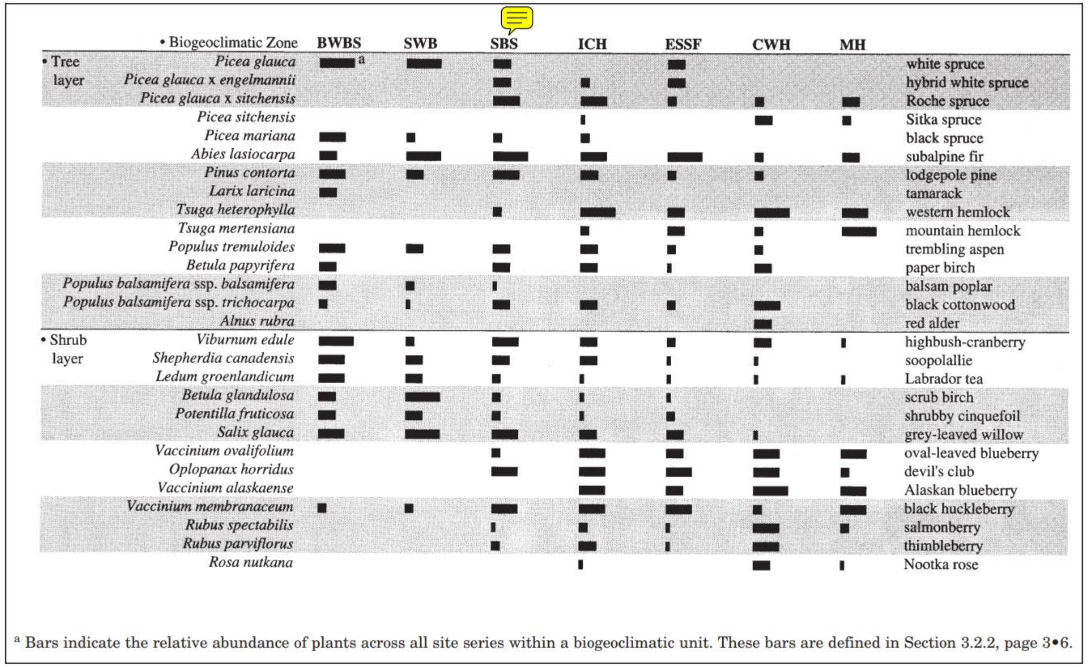
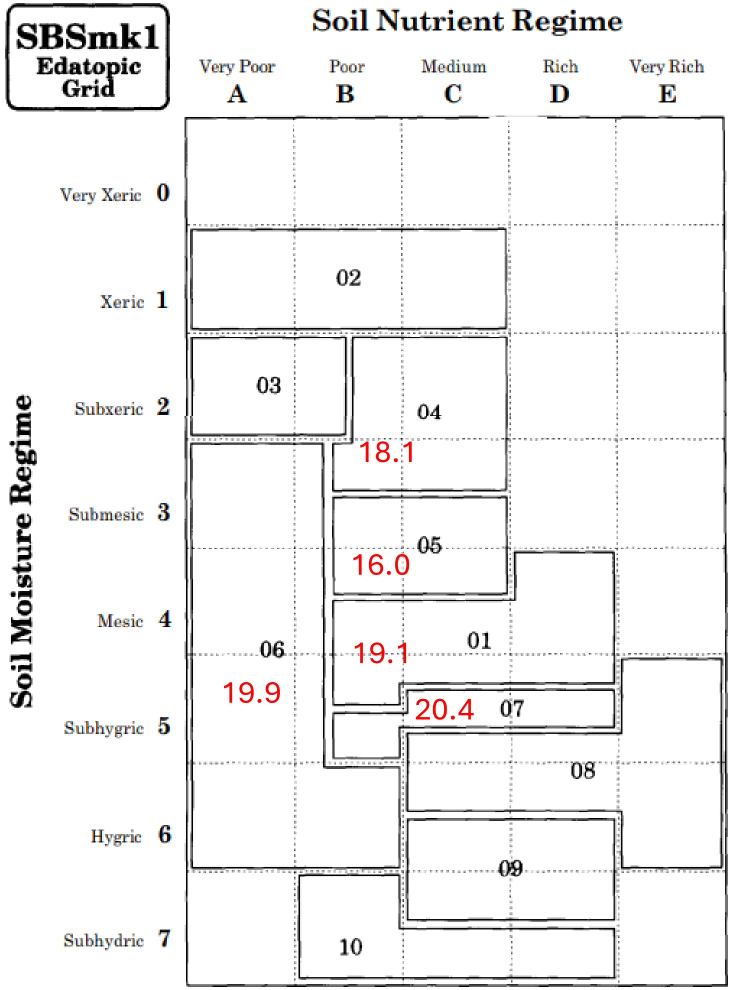


FIGURE 4.13. Vegetation table for all forested zones in the PRFR, north half.

- BWBS and SBS – Aspen occurs and grows well on submesic (3) to subhygric (5) sites . Medium to fine textured soils.
- Which site series do you suggest in the SBSmk1?



01 Sxw - Huckleberry - Highbush cranberry
02 Pl - Cladina - Step moss
03 Pl- Feathermoss - Cladina
04 SxwFd - Knight's plume
05 SxwFd - Toad-flax
06 Sb - Huckleberry - Spirea
07 Sxw - Oak fern
08 Sxw - Devil's club
09 Sxw - Horsetail
10 Sb - Scrub birch - Sedge

FIGURE 19. Edatopic grid displaying site units in the SBSmk1 variant.

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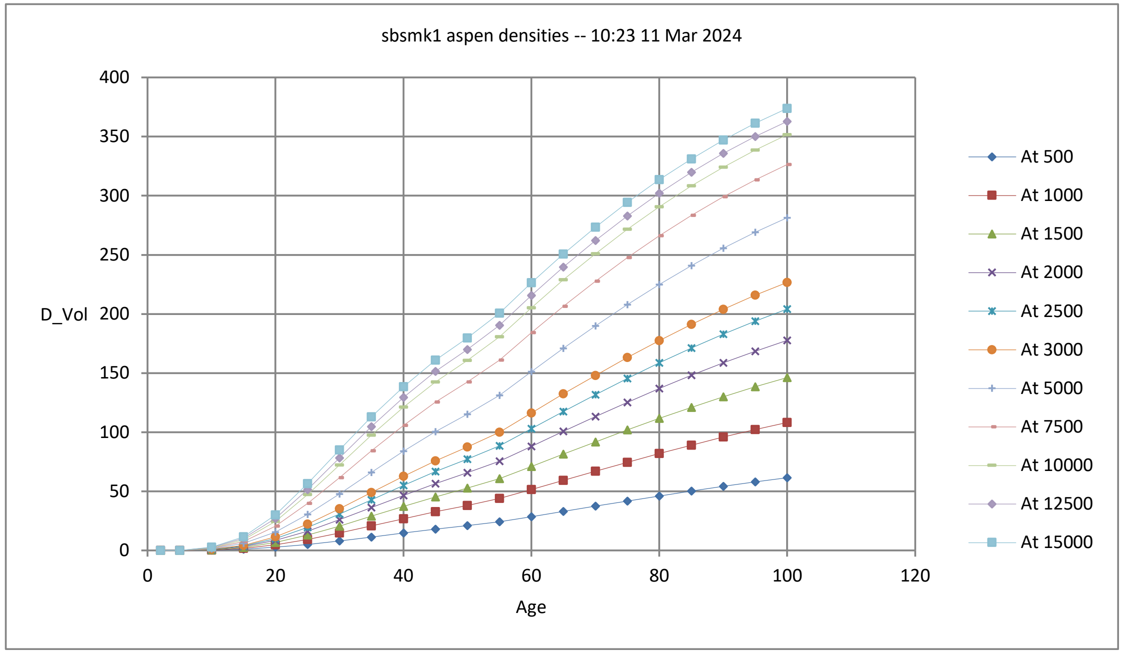
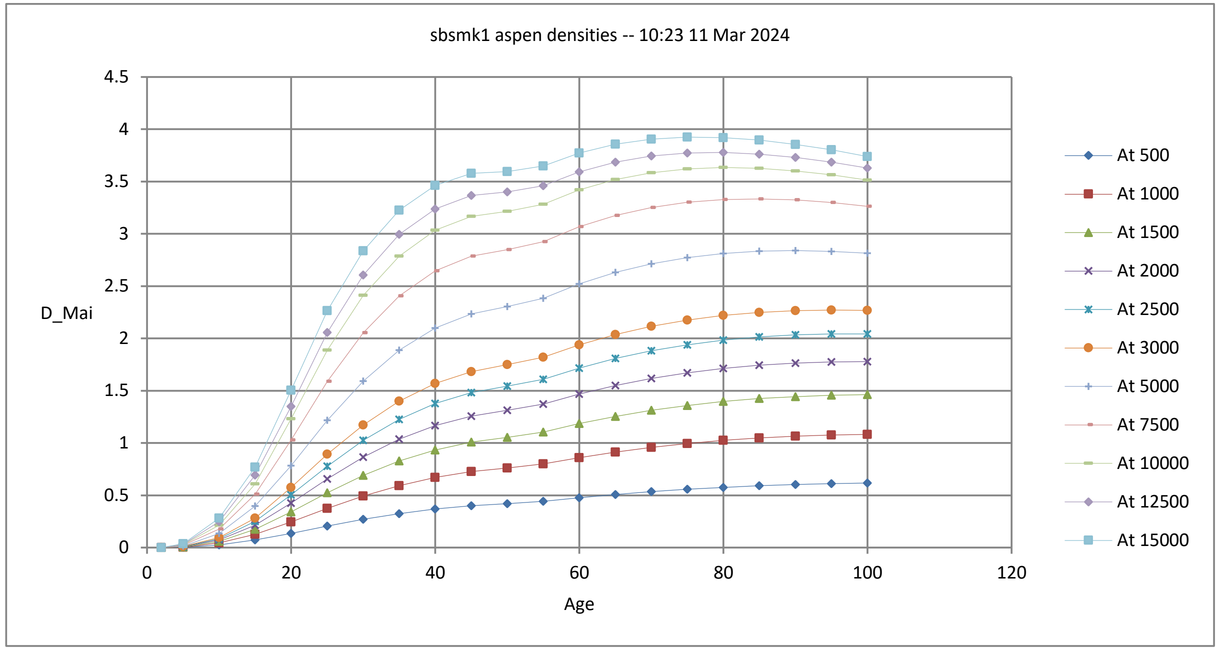
Aspen SI (from SIBEC) shown in red

Effect of early (age 2) aspen densities – on stand volume and MAI trends

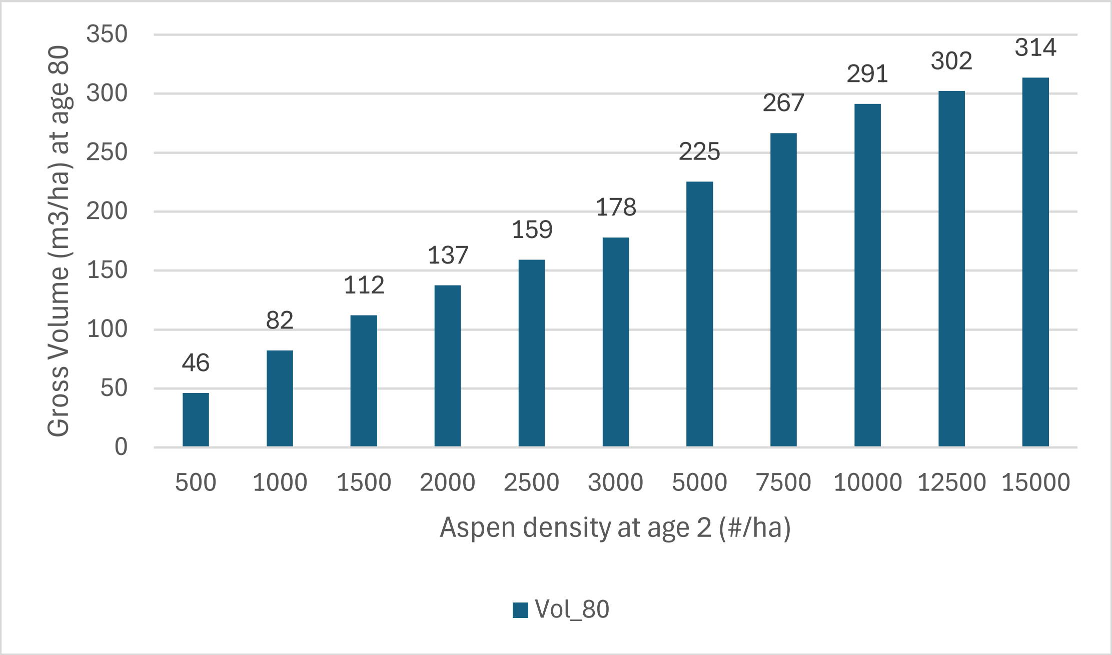
MGM simulations for SBSmk1_01 (SI=19.1, At height=0.8m at age 2)





Early aspen densities and aspen yield

- Total aspen volume increases with increasing initial aspen density, but hits an inflection point at about 10,000 sph
- Densities above about 5,000 sph yield over 200 m3/ha at age 80 (MAI>2.82)
- Densities below 1500 sph yield <112 m3/ha (MAI<1.4)
  - Low natural regeneration densities may have lower yields than this as low densities may be symptomatic of site issues



Aspen stocking/regeneration surveys

Alberta Reforestation Survey (2022)

- Establishment – years 4 to 8
    - determine the level of success of early reforestation activities in relation to site occupancy (degree to which trees utilize available growing space).
    - Assess composition and distribution of regen, identify unstocked/poorly stocked strata
    - If Stocking (number of plots with acceptable regeneration) is >= 80% then opening is sufficiently regenerated. In aspen blocks need minimum 70% deciduous (At and Ac) and can have up to 10% other acceptable species (spruce, pine, fir)
    - Reconnaissance (walk-through or aerial) surveys done first and only ground surveys required if stocking is between 70% and 84%.
    - 2.77 plots/ha for blocks >24 ha, systematically laid out
    - Plot size=1.78 m radius (10 m^2) basic plot (1 tree=1000 sph)
    - Plot is stocked if it has at least one acceptable tree
    - Minimum Acceptable Deciduous height=1.3 m in Central Mixedwood (=BWBS) and Lower Foothills (=SBS)

BC Stocking Standards (2022)

- Regeneration Delay - about age 4
    - used to prove that the regeneration requirements have been met
- Stocking (not-mandatory) – age 5 - ??
    - to reassess the stocking status, need for treatments (replant, brushing, spacing), and monitor the progress of the young stand
- Plot sizes: large enough so that plot has >=4 well–spaced crop trees – 3.99 m radius commonly used

Aspen stocking/regeneration surveys

Alberta Reforestation Survey (2022)

- Performance Survey
  - gather data needed to calculate regeneration metrics (tree and stand characteristics, stand type and MAI)
  - Only sample a selection of openings
  - year 11 – 14, at least 2 growing seasons after any tending.
  - For Deciduous blocks – if results from the Establishment Survey show block is sufficiently restocked (>=80% stocking) then a performance survey is not required
- Aerial stratification
- Field Sampling
  - (next page)

BC Stocking Standards (2022)

- Free-Growing
  - To determine if the stand meets free growing requirements
  - BWBSmk1: At $\geq$2.0 m tall (?age 5-6?) , before age 20
  - Well spaced: TSS=3500, MinPA=2000
- Plot sizes: large enough so that plot has >=4 well –spaced crop trees – 3.99 m radius commonly used

Aspen stocking/regeneration surveys

Alberta Reforestation Survey (2022)

- Performance Survey
  - Field Sampling
    - Intensity – plots established at 25 m intervals (16 plots/ha)
    - Plot Size
      - Basic –
        - 1.78 m radius (10 m^2) – tally acceptable trees by species (conifer >0.3 m and deciduous>1.3 m)
      - Detailed (25% of the basic plots, every 4th plot)
        - 5.64 m radius (100 m^2)
        - For each species group largest dbh tree (top height tree) in the plot
        - Measure DBH, height, total age since germination
        - Option to measure DBH of all trees in the central 1.78 m basic plot area
  - Compilation
    - Compile survey data to determine opening level MAI
    - RSA compiler used - (based on GYPSY)
      - inputs: stand age, densities, total age by species groupl, Site Index (BH age), % stocking by species group
    - After calculations for each sampled opening – results are rolled up to estimates of MAI for each stratum (cover type) in each area of interest (FMU)
- For more details see the 252 page Reforestation Standard of Alberta (Alberta Agriculture, Forestry, and Rural Economic Development 2022)

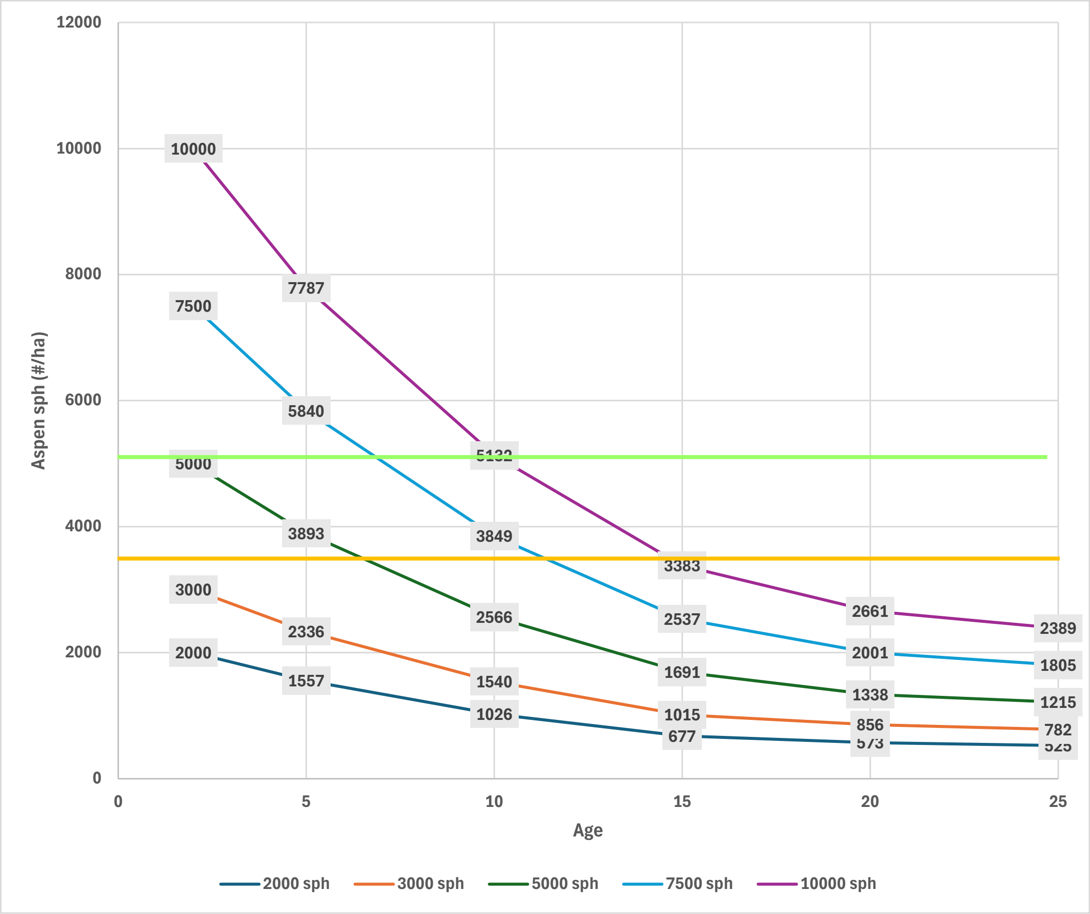
BC: BWBSmk standard

A15 — LMH65-BWBS (2012)

Row	Area of Use	Regime Name	BGC Classification: Zone/SZ	Site Series	Ecological Suitability for a Timber Objective: Conifer Species – Primary	Conifer Species – Secondary	Conifer Species – Tertiary	Broadleaf Species	Regeneration and Free Growing Stocking Standard: RESULTS Stocking Standards ID	Preferred (p) Species	Acceptable (a) Species	Density (well-spaced/ha): Target	MIN pa	MIN p	Regen. Delay (max yrs)	Free Growing Assessment Period Latest (yrs)	Minimum Height at Free Growing Species-Height (m)
10	(2012)																
11	LMH65-BWBS (2012)	Reference	BWBSdk	112					1043880	Ac^{ab}	Sw^{1,32}	2500	2000	1700	4	20	Ac-2.0, Others-0.6
12	LMH65-BWBS (2012)	Reference	BWBSmk	101	Pl Sw^{32}		Sb	Acb^{a} At^{a} Ep^{a}	1043881	Pl Sw^{32}	Sb	1200	700	600	4	20	Pl-2.0, Others-1.0
13	LMH65-BWBS (2012)	Reference-Conifer/Decid	BWBSmk	101	Pl Sw^{32}		Sb	Acb^{a} At^{a} Ep^{a}	1043882	Pl Sw^{32}	At^{a,59} Ac^{ab,59}	1200	700	600	4	20	Sw-2.5, Others-2.0
14	LMH65-BWBS (2012)	Reference-Mixedwood	BWBSmk	101	Pl Sw^{32}		Sb	Acb^{a} At^{a} Ep^{a}	1043883	At^{a} Ac^{ab} Sw^{32}	Pl	2500 (1200 con.)	1200 (700 con.)	1000 (600 con.)	4	20	All-2.0
15	LMH65-BWBS (2012)	Reference-Decid/Conifer	BWBSmk	101	Pl Sw^{32}		Sb	Acb^{a} At^{a} Ep^{a}	1043884	At^{a} Ac^{ab}	Sw^{32} Pl	3500	2000	1700	4	20	All-2.0
16	LMH65-BWBS (2012)	Reference	BWBSmk	102	Pl		Sb Sw	At^{b}	1043885	Pl	Sb Sw	1000	500	400	7	20	Pl-1.2, Others-0.6
17	LMH65-BWBS (2012)	Reference	BWBSmk	103	Pl Sw^{32}			At^{a} Ep^{a}	1043886	Pl Sw^{32}		1200	700	600	7	20	Pl-1.6, Others-0.8
18	LMH65-BWBS (2012)	Reference	BWBSmk	104	Pl Sb Sw	Lt		Atb	1043887	Pl Sb Sw	Lt	1200	500	400	4	20	Pl-1.2, Others-0.6
19	LMH65-BWBS (2012)	Reference	BWBSmk	110	Sw^{1,32}	Pl^{1}	Sb	Acb^{a} At^{b} Ep^{b}	1043888	Sw^{1,32} Pl^{1}	Sb	1000	500	400	4	20	Pl-1.2, Others-0.6
20	LMH65-BWBS (2012)	Reference	BWBSmk	111	Sw^{1,32}	Pl^{1}	Sb	Acb^{a} At^{b} Ep^{b}	1043889	Sw^{1,32} Pl^{1}	Sb	1000	500	400	4	20	Pl-1.2, Others-0.6
21	LMH65-BWBS (2012)	Reference	BWBSmk	112					1043890	Ac^{ab}	Sw^{1,32}	2500	2000	1700	4	20	Ac-2.0, Sw-1.0
22	LMH65-BWBS (2012)	Reference	BWBSmw	101	Pl Sw^{32}		Sb	Acb^{a} At^{a} Ep^{a}	1043891	Pl Sw^{32}	Sb	1200	700	600	4	20	Pl-2.0, Others-1.0
23	LMH65-BWBS (2012)	Reference-Conifer/Decid	BWBSmw	101	Pl Sw^{32}		Sb	Acb^{a} At^{a} Ep^{a}	1043892	Pl Sw^{32}	At^{a,59} Ac^{ab,59}	1200	700	600	4	20	Sw-2.5, Others-2.0
24	LMH65-BWBS (2012)	Reference-Mixedwood	BWBSmw	101	Pl Sw^{32}		Sb	Acb^{a} At^{a} Ep^{a}	1043893	At^{a} Ac^{ab} Sw^{32}	Pl	2500 (1200 con.)	1200 (700 con.)	1000 (600 con.)	4	20	All-2.0
25	LMH65-BWBS (2012)	Reference-Decid/Conifer	BWBSmw	101	Pl Sw^{32}		Sb	Acb^{a} At^{a} Ep^{a}	1043894	At^{a} Ac^{ab}	Sw^{32} Pl	3500	2000	1700	4	20	All-2.0
26	LMH65-BWBS	Reference	BWBSmw	102	Pl		Sw	At^{b}	1043895	Pl	Sw	1200	700	600	7	20	Pl-1.4, Sw-1.0

Early trends in aspen density for “low” density stands in BC – and FG survey age

- For a pure aspen stand, initial (age 2) sph required to reach a minimum 3500 sph TSS will vary with assessment age. For example:
  - Assessment age 5 = 4500 sph at age 2
  - Assessment age 10 = 7000 sph at age 2
  - Assessment age 15 = 11000 sph at age 2



5000 total

3500 sph (well-spaced)


Questions?
Discussion?

Key references

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