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Species SI conversion equations for Alberta and Saskatchewan

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Introduction

Site index is used as the primary estimator of potential productivity in the Mixedwood Growth Model (MGM) and in other models. Site index can be readily determined for stands where there are healthy top height trees close to reference age for the species of interest. However, site index is difficult to determine when healthy top height trees are not present, and where estimates of site index are required for species not currently present in the stand. In addition, site index estimates can be unrealiable when trees are less than 7 m tall or are very old.

Estimating site index of one species from that of another species has been proposed as one possible method for estimating site index for species not currently present in a stand or which do not have suitable top height trees for site index determination (eg. when spruce is growing in the understory of aspen) (Hostin and Titus 1996; Wang 1998).

Methods

Data for this study came from field data collected from 347 sample plots for estimation of site index as a function of environmental variables (FRIP Project FFI-14-08) together with data from other similar project previously conducted in Alberta (FRIAA Project WCG-017), and data from permanent sample plots in Alberta and Saskatchewan.

A small number of plots contained more than one species, and provided only a limited number of SI estimates for different species at the same site conditions. Therefore, species SI conversion equations between two species were developed using the approach of ecologically equivalent sites and reduced major axis (RMA) regression as described by (Wang, 1998). First, plot level SI estimates for each species were stratified according to the combinations of SMR and SNR within each NSR. Plots from Saskatchewan were treated as a separate NSR since all plots fall within Mid-Boreal Lowland Natural Ecoregion of Saskatchewan (or in transition zone with neighboring ecoregions) which would be equivalent to a Natural Subregion in Alberta (Mclaughlan et al., 2010). Then, average SI by species and NSR for each combination of SMR and SNR was used in developing species SI conversion equations. The Reduced major axis (RMA) regression approach was applied because two-way predictions are required (two response variables). As most matched species pairs (by combinations of SMRs and SNRs) contained different number of plots for each species, the analysis was weighted by average number of plots for each species pair. Pearson's correlation coefficient was used to test significance and strength of the resulting linear relationships.

Results and discussion

Table 1 shows SI conversion equations for species pairs that had significant correlation. Models for Aw-Pl, Pl-Pj and Sw-Pj were not significant and are not shown. Despite being significant, these equations explain 28.5% (Aw-Sw and Sw-Aw), 47.0% (Aw-Pj and Pj-Aw) and 25.7% (Sw-Pl and Pl-Sw) of the variation in the predicted site index values. These results indicate that care should be exercised in the application of these species conversion equations. In addition, comparison against estimates of site index based on Natural Subregion, soil moisture regime and soil nutrient regime (Figure 1) indicate differences between the two approaches. We recommend careful comparison of values provided by these species conversion equations against other estimates of site index based on ecological variables (see for example Bjelanovic and Comeau 2019). Given that site index estimates based on ecological variables are based on a larger number of samples, they should be used in preference to species conversion equations.

Table 1. Species conversion equations for Site Index (reference age 50, breast height age) developed for Alberta and Saskatchewan using reduced major axis (RMA) regression analysis. Sample size represents number of matched species SI pairs at ecologically equivalent sites (by SMR, SNR and NSR) used to fit the equations, numbers in brackets represent total number of plots used to calculate mean SI for each combination of SMR and SNR. SEE is the standard error of estimates.

Species SI		Equation	Sample size	SEE (m)	Pearson's r	p-value
from	to					
Aw	Sw	SIsw = -7.343189 + 1.311067*SIaw	29 (304)	1.74372	0.5339512	0.002851
Sw	Aw	SIaw = 5.600927 + 0.7627377*SIsw	29 (304)	1.330001	0.5339512	0.002851
Aw	Pj	SIpj = 5.82653 + 0.546366*SIaw	16 (173)	0.9781398	0.6854636	0.003381
Pj	Aw	SIaw = -10.66415 + 1.830275*SIpj	16 (173)	1.790265	0.6854636	0.003381
Sw	Pl	SIpl = -1.588538 + 1.040232*SIsw	21 (197)	2.182897	0.5028511	0.02016
Pl	Sw	SIsw = 1.5271 + 0.9613242*SIpl	21 (197)	2.098472	0.5028511	0.02016

Aw=trembling aspen; Sw=white spruce; Pj=Jack pine; Pl=lodgepole pine.

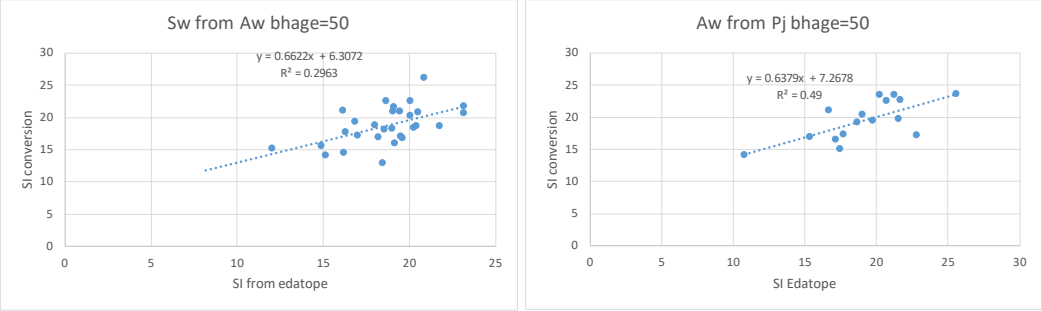

Figure 1. Two examples of relationships between SI predicted using species conversion equations and SI predicted from edatope (Natural Subregion, soil moisture regime and soil nutrient regime) based on tables presented by Bjelanovic and Comeau 2019 for breast height age 50.

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References

Bjelanovic, I., and Comeau, P.G. 2019. Estimating site index using ecosite and edatope in Alberta and Saskatchewan. MGM Research Note #2019-1. University of Alberta, Edmonton, Alberta.

Hostin, P.J., and Titus, S.J. 1996. Indirect site index models for white spruce in Alberta's boreal mixedwood forest. For Chron. 72: 73-79. doi: 10.5558/tfc72073-1

Wang, G.G. 1998. An ecologically based model for site index conversion among species. Can. J. For. Res. 28: 234-238. doi: 10.1139/x97-214

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Table 1a. Species conversion equations for Site Index (reference age 50, total age) developed for Alberta and Saskatchewan using reduced major axis (RMA) regression analysis. Sample size represents number of matched species SI pairs at ecologically equivalent sites (by SMR, SNR and NSR) used to fit the equations, numbers in brackets represent total number of plots used to calculate mean SI for each combination of SMR and SNR. SEE is the standard error of estimates.

Species SI		**Equation**	**Sample size**	**SEE (m)**	**Pearson's r**	**p-value**
from	to					
Aw	Sw	SIsw = -8.931636 + 1.331283*SIaw	29 (304)	1.84067	0.533967	0.002851
Sw	Aw	SIaw = 6.709044 + 0.7511551*SIsw	29 (304)	1.382629	0.533967	0.002851
Aw	Pj	SIpj = 4.832583 + 0.5387083*SIaw	16 (173)	1.003236	0.6858188	0.003357
Pj	Aw	SIaw = -8.970687 + 1.856292*SIpj	16 (173)	1.862299	0.6858188	0.003357
Sw	Pl	SIpl = -0.6141204 + 1.017823*SIsw	21 (197)	2.232458	0.5069554	0.019
Pl	Sw	SIsw = 0.6033667 + 0.9824892*SIpl	21 (197)	2.193366	0.5069554	0.019

Aw=trembling aspen; Sw=white spruce; Pj=Jack pine; Pl=lodgepole pine.