Models for simulating the temporal development of Siberian larch (*Larix sibirica* Ledeb.) plantations in Hallormsstaður Iceland

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Lárus Heiðarsson[1] and Timo Pukkala[2]

[1] Icelandic Forest State Service

[2] University of Eastern Finland

Siberian Larch in eastern Iceland

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- Is one of the main tree species used in afforestation in the northern and north-eastern parts of Iceland
- It grows well on infertile and dry sites and has therefore been the most planted tree species in Iceland during 1945–2000
- Will be a species of increasing commercial value in the coming years

Growth modelling in Iceland

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- Pioneering work was done by Annukka Pesonen 2009 in modelling the growth of Siberian larch in Hallormsstaður and by Mervi Juntunen 2010 in modelling the growth of lodgepole pine (Pinus contorta Dougl.) for the whole country.

Dataset diameter growth modelling

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- Two datasets were used for diameter growth modelling:
  - Data collected in temporary plots (149 observations)
  - Data collected in permanent sample plots (6 permanent sample plots). The measurement period was from 1952-2008.

Dataset height and survival modelling

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- Only the PSP data were used for dominant height and survival modelling since the temporary plots data did not include information on dominant height increment and tree survival

Characteristics of the two data sets used

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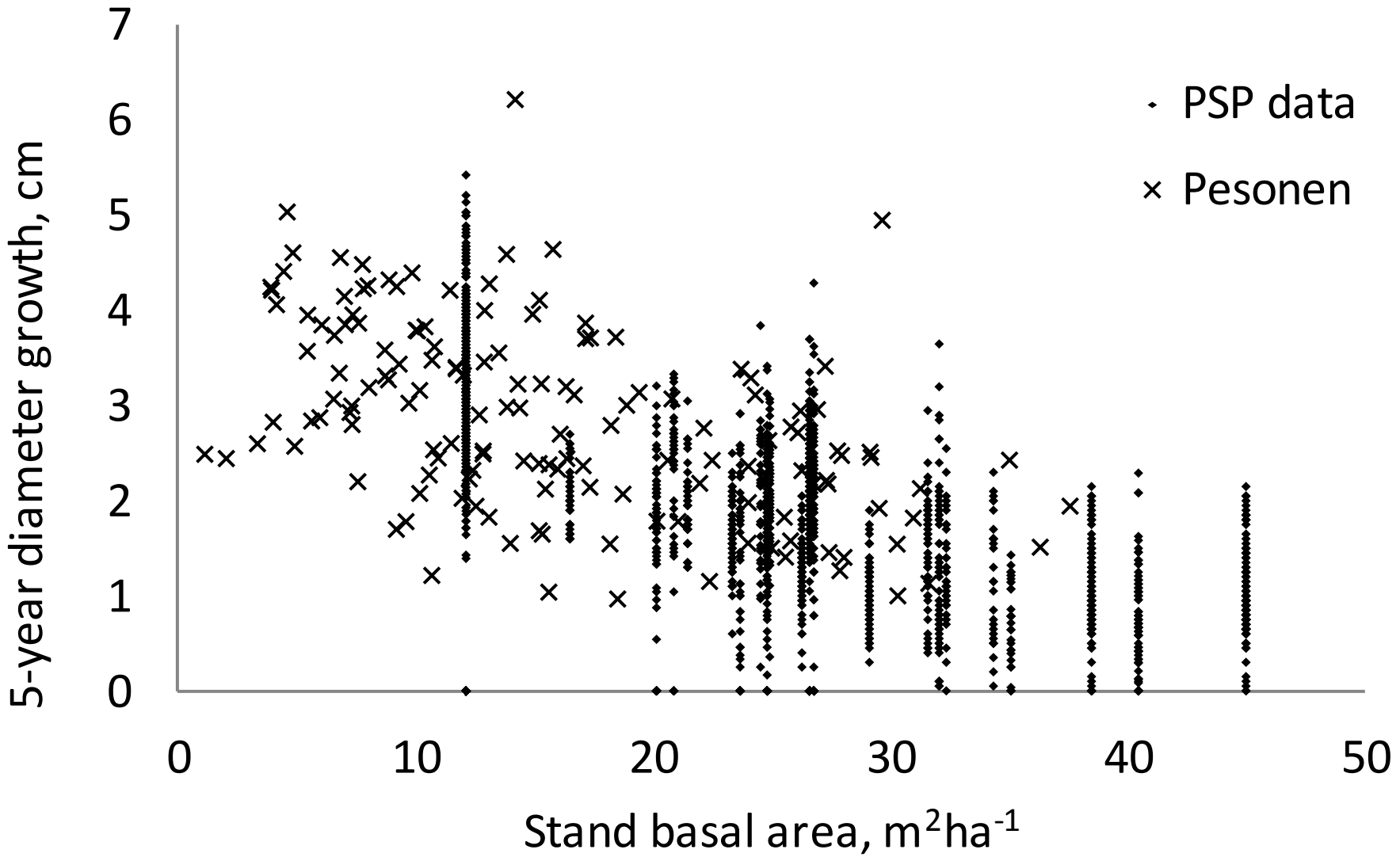
	Temporary plots (n=149)			PSP (n=1681)		
Variable	**Mean**	**S.D.**	**Range**	**Mean**	**S.D.**	**Range**
Diameter, cm	13.1	6.4	2.7–38.3	14.6	6.4	2.8–36.3
Dominant height, m	8.9	3.0	3.6–15.7	10.7	3.3	5.5–18.3
Age, years	31.7	11.7	14.0–64.0	31.0	12.4	14.0–61.0
Basal area, m^2ha^{-1}	15.8	8.4	1.0–37.6	26.5	9.4	12.1–45.0
No. of stems per ha^{-1}	1538	813	400–3900	1700	1007	540–4980
Site index, m	15.6	1.7	10.0–21.5	19.6	1.27	16.8–22.0
Increment, cm/5 yrs	2.89	0.99	0.98–6.24	1.88	0.98	0–5.43

Stand basal area and diameter growth



Climate

- The mean annual temperature (1961–1990) at a synoptic station at Hallormsstaður was 3.4°C and the mean annual precipitation was 738 mm. For the same period, the mean maximum daytime temperatures were 12.4, 14.1 and 13.4°C in June, July and August, respectively.

Models developed

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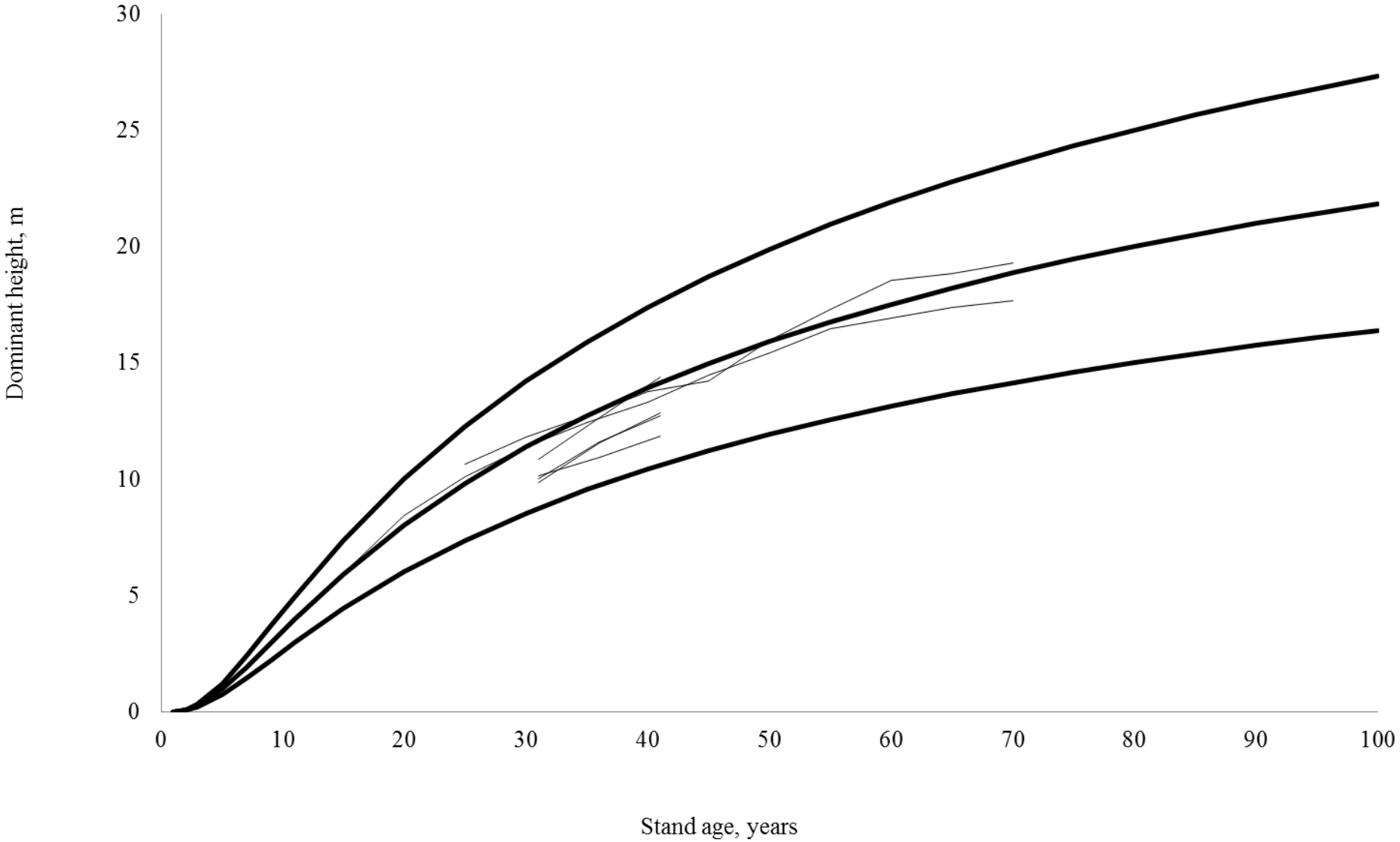
- Site index and dominant height model

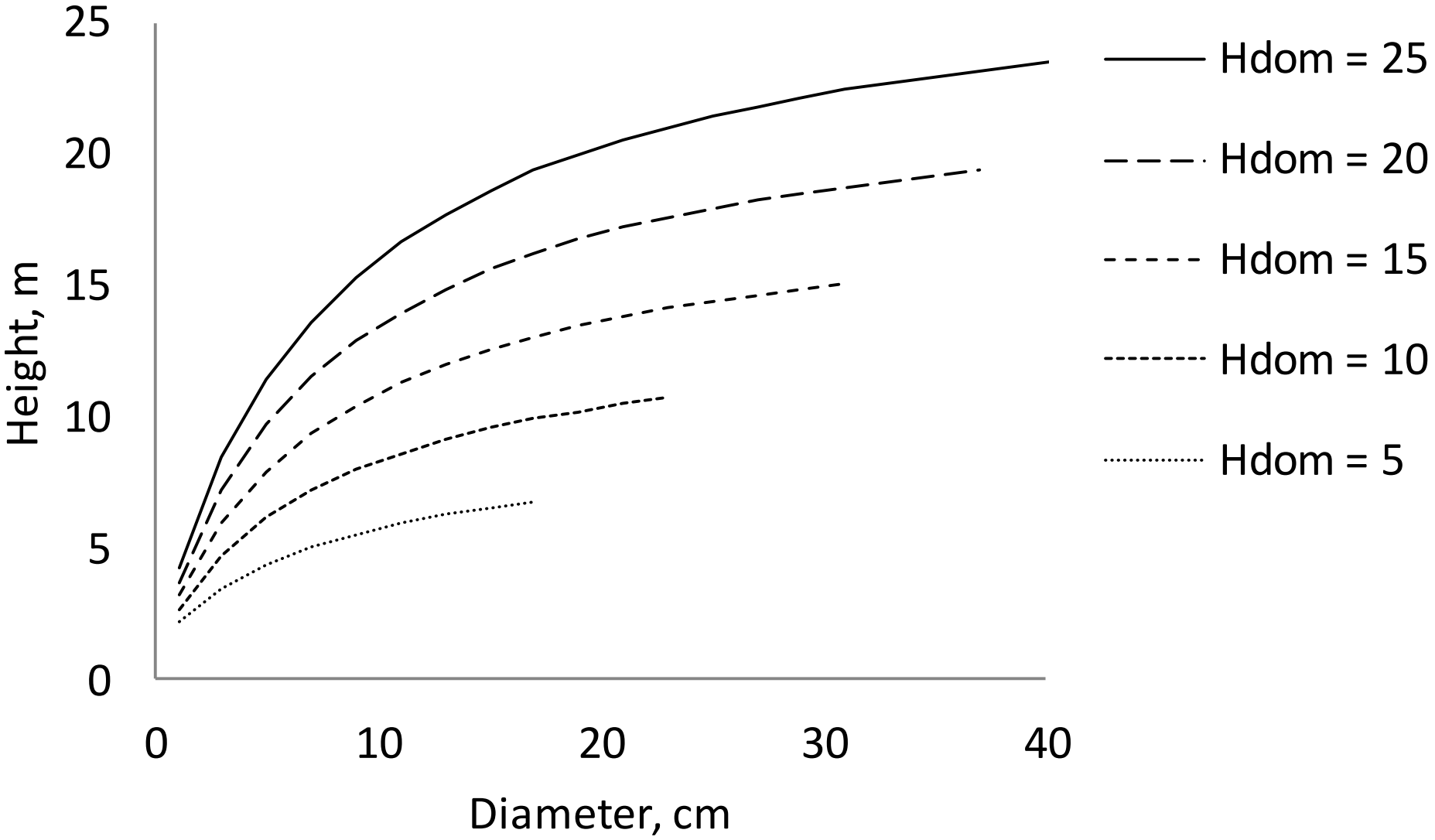
  $H_2 = f(T_1, H_1, T_2)$

- Single tree height model
- Diameter increment model
- Survival model

Results dominant height, site index



Single tree height model



Diameter increment model

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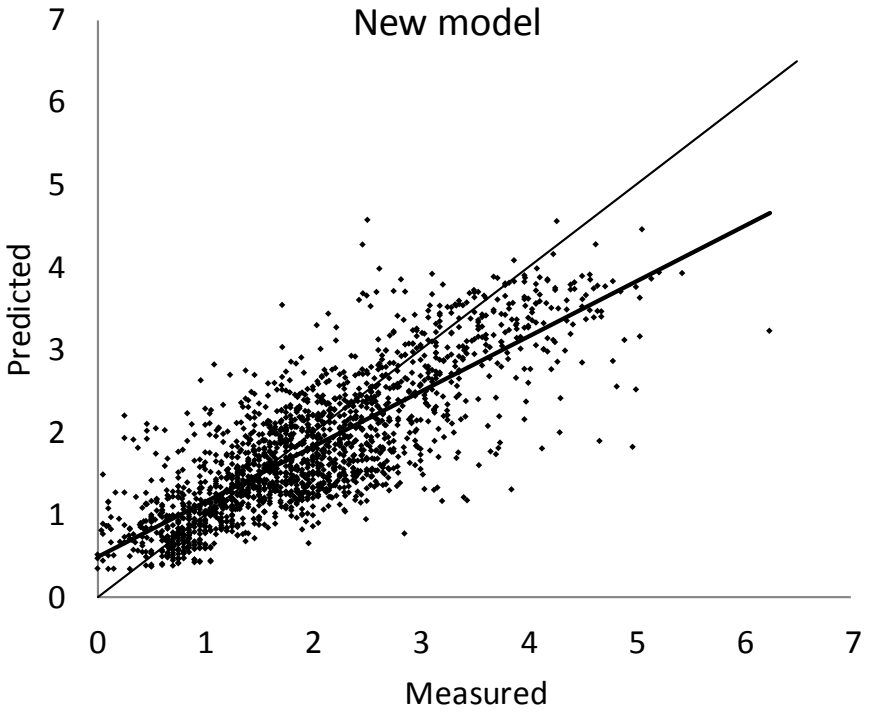
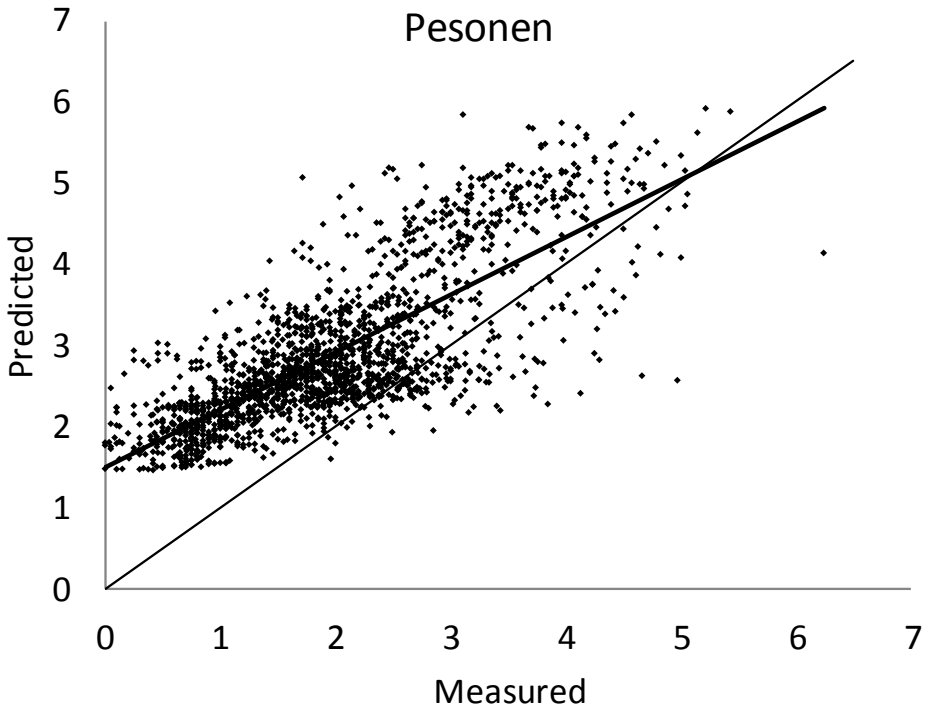
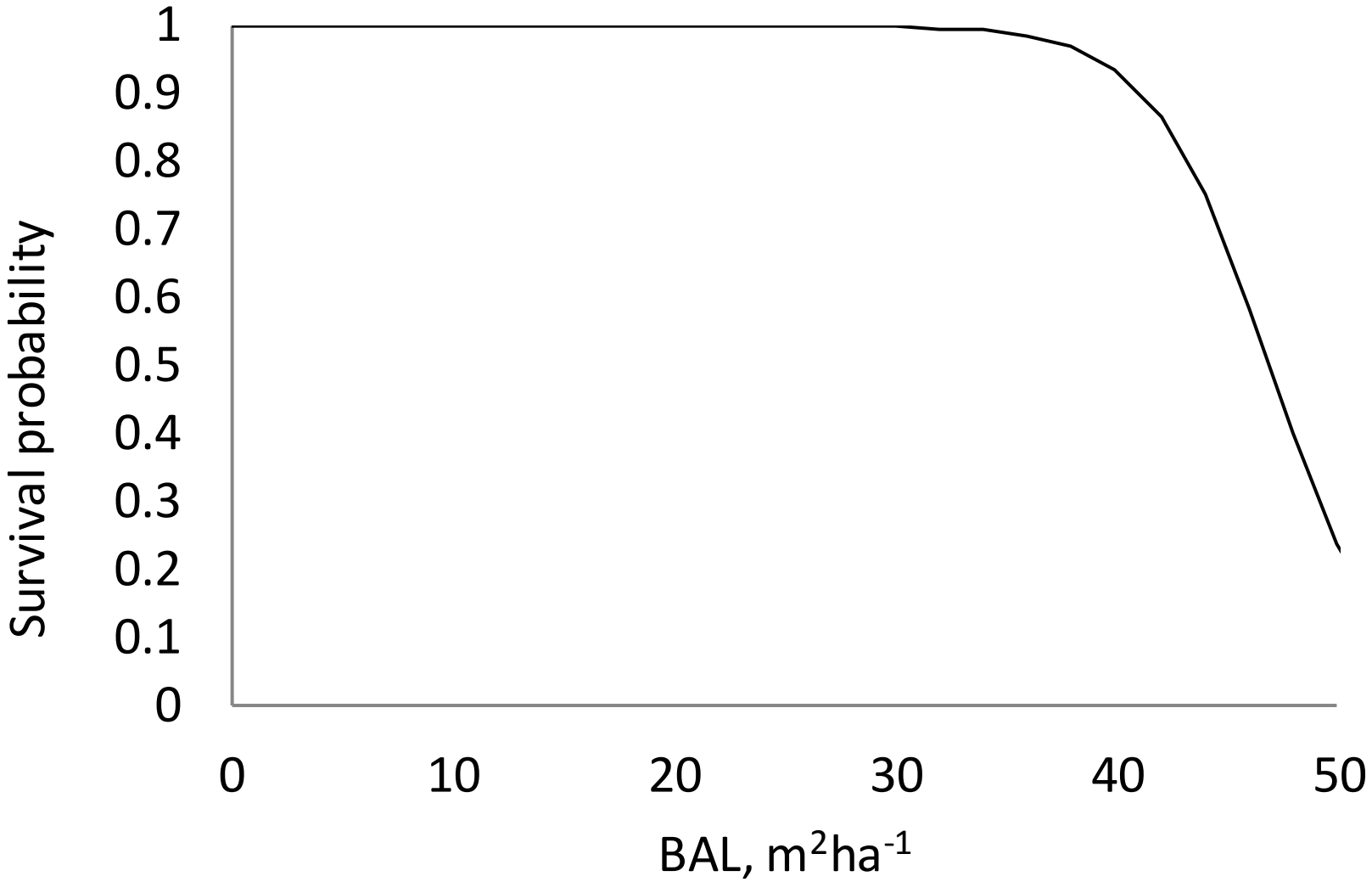




Survival model



Simulation process

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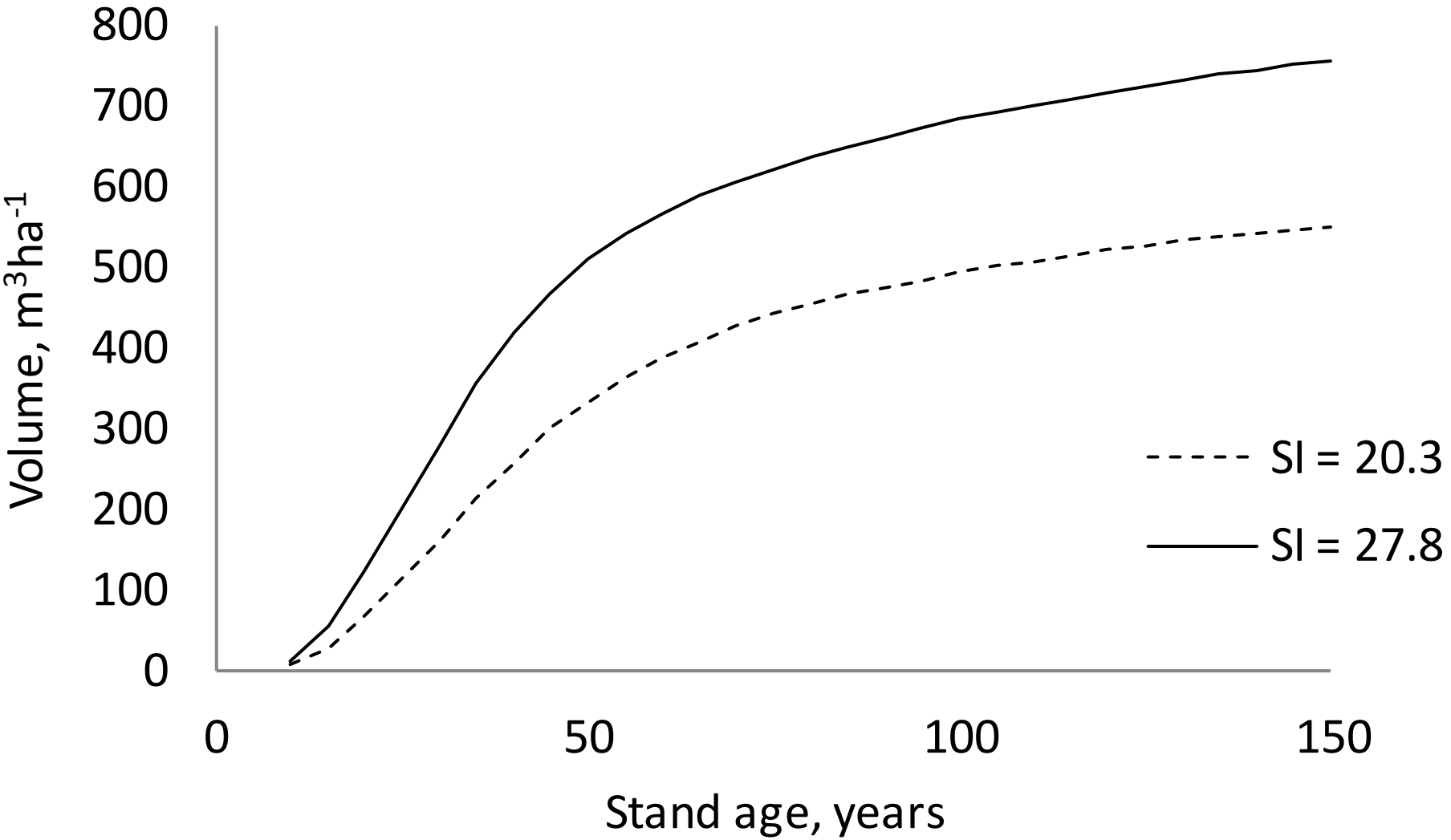
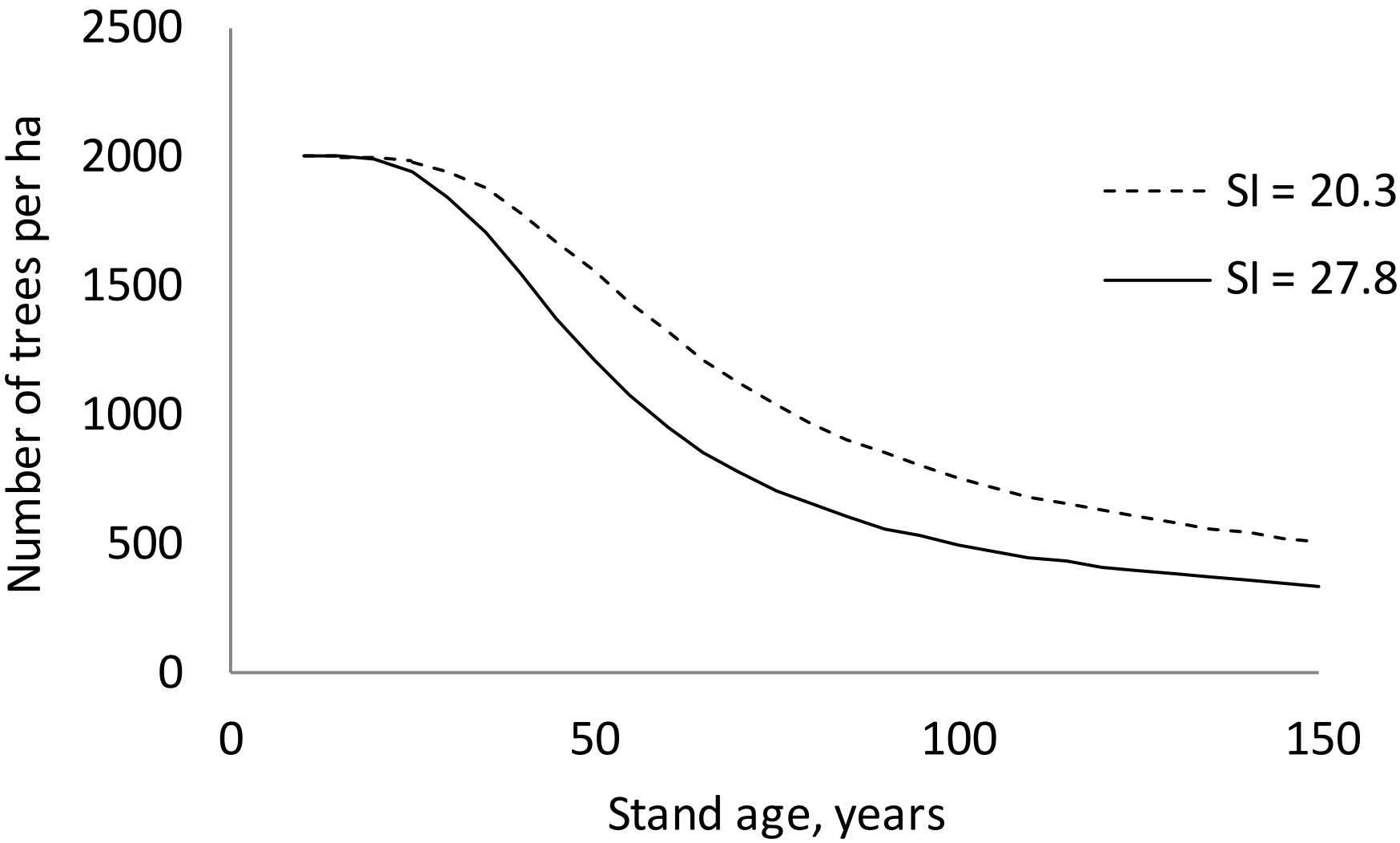
1. Stand age and dominant height are used to calculate site index
2. Calculate tree height for different trees that represent the stand in simulation and then Calculate stem and assortment volumes of the trees with the taper model, using predefined minimum top diameters and piece lengths
3. Calculate the total stand volume, total assortment volumes and any other stand characteristics of interest (e.g., mean and median diameter), using tree volumes, tree diameters, tree heights, and numbers of trees in different diameter classes
4. Calculate dominant height after 5 years
5. Calculate 5-year diameter increments of trees and add them to the current diameters.
6. Calculate the new frequencies of diameter classes by multiplying the current frequency with the 5-year survival probability of a tree in the diameter class

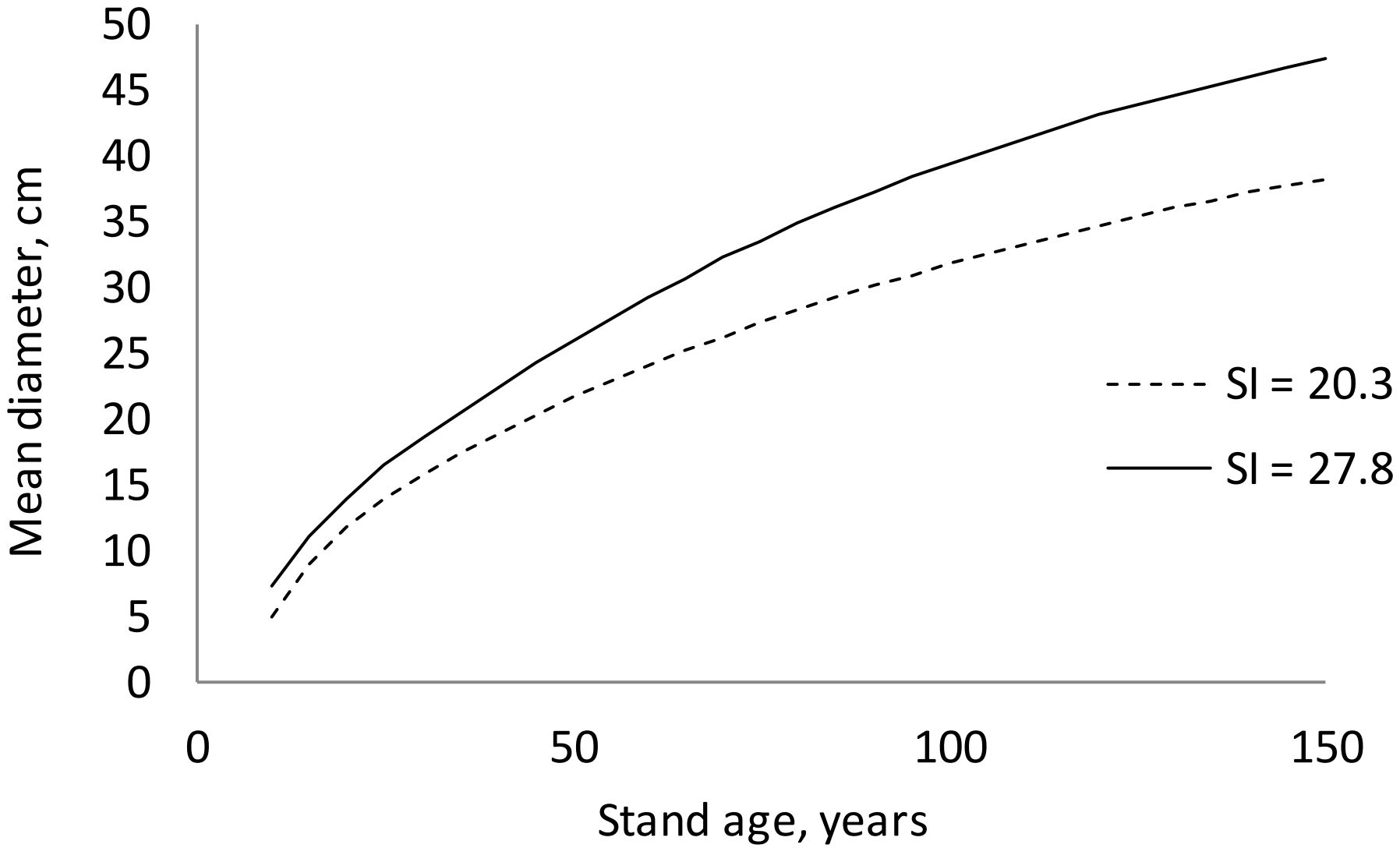
Simulation examples volume production



Simulation examples Survival model



Simulation examples diameter growth



Mean and Current annual volume increment site index 20.3

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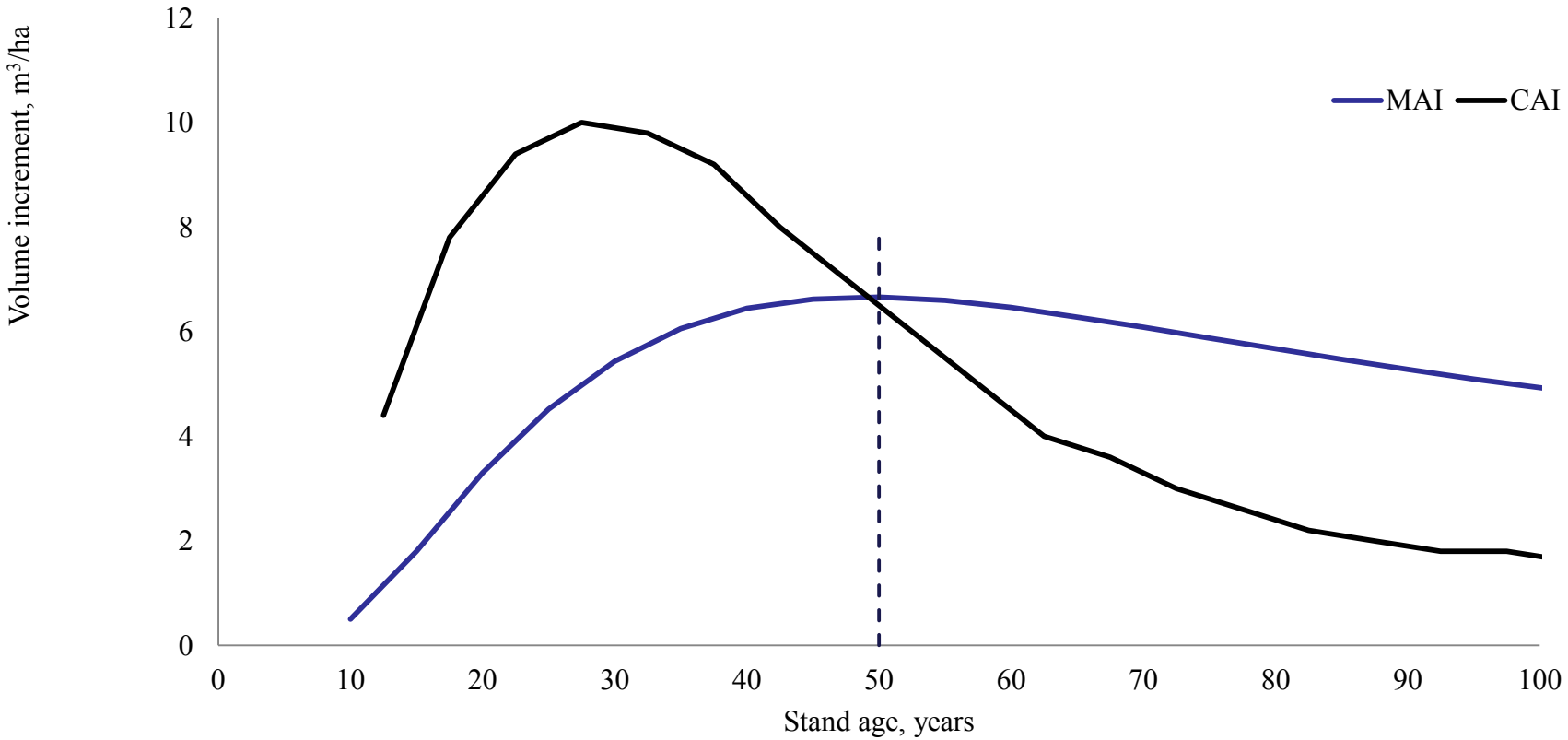
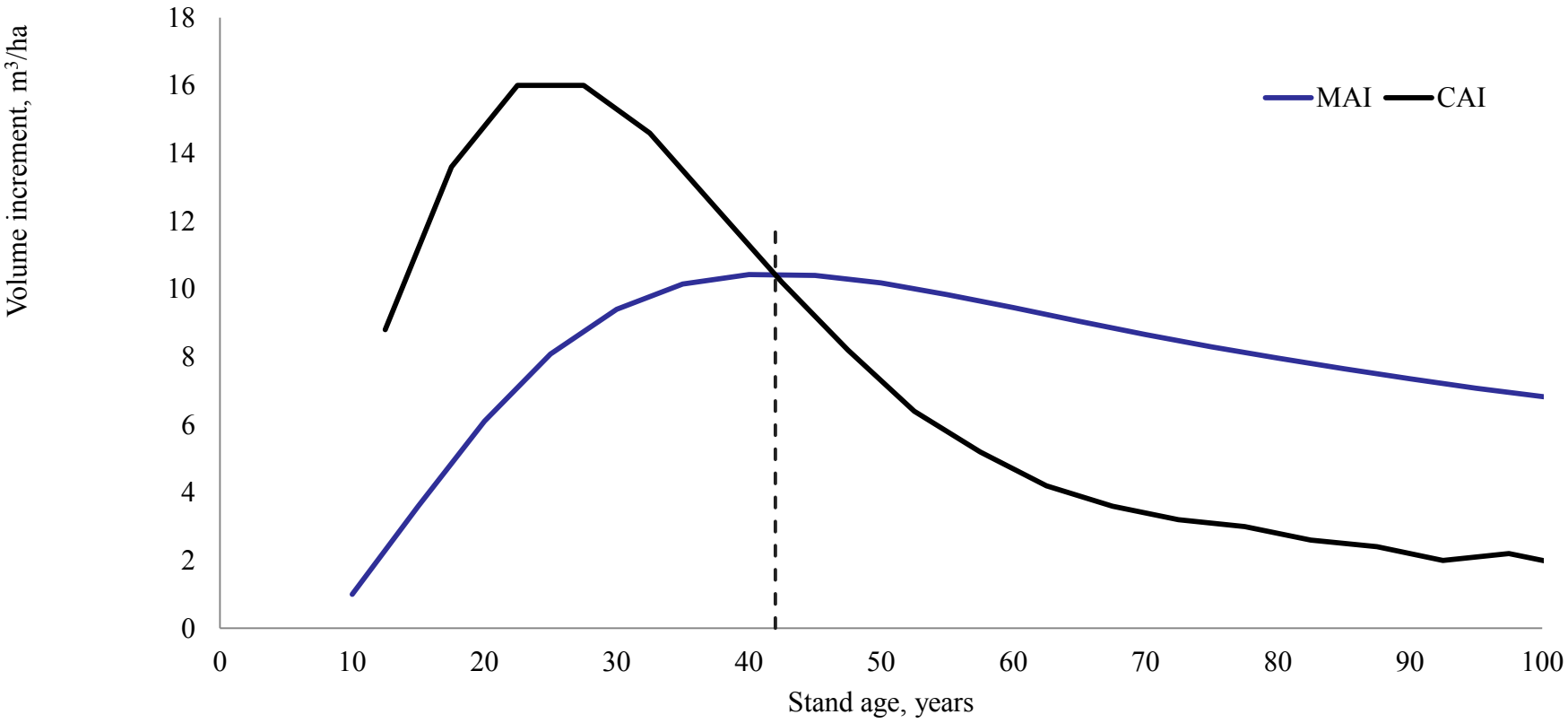
Site index 20.3



Mean and Current annual volume increment site index 27.8

Site index 27.8



At the end

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- The models developed are simple but behave logically in simulations
- Siberian larch is an important species in North and East Iceland and further development of the growth models is needed
- Additional data should be collected from different site indices for a better modelling of site influences