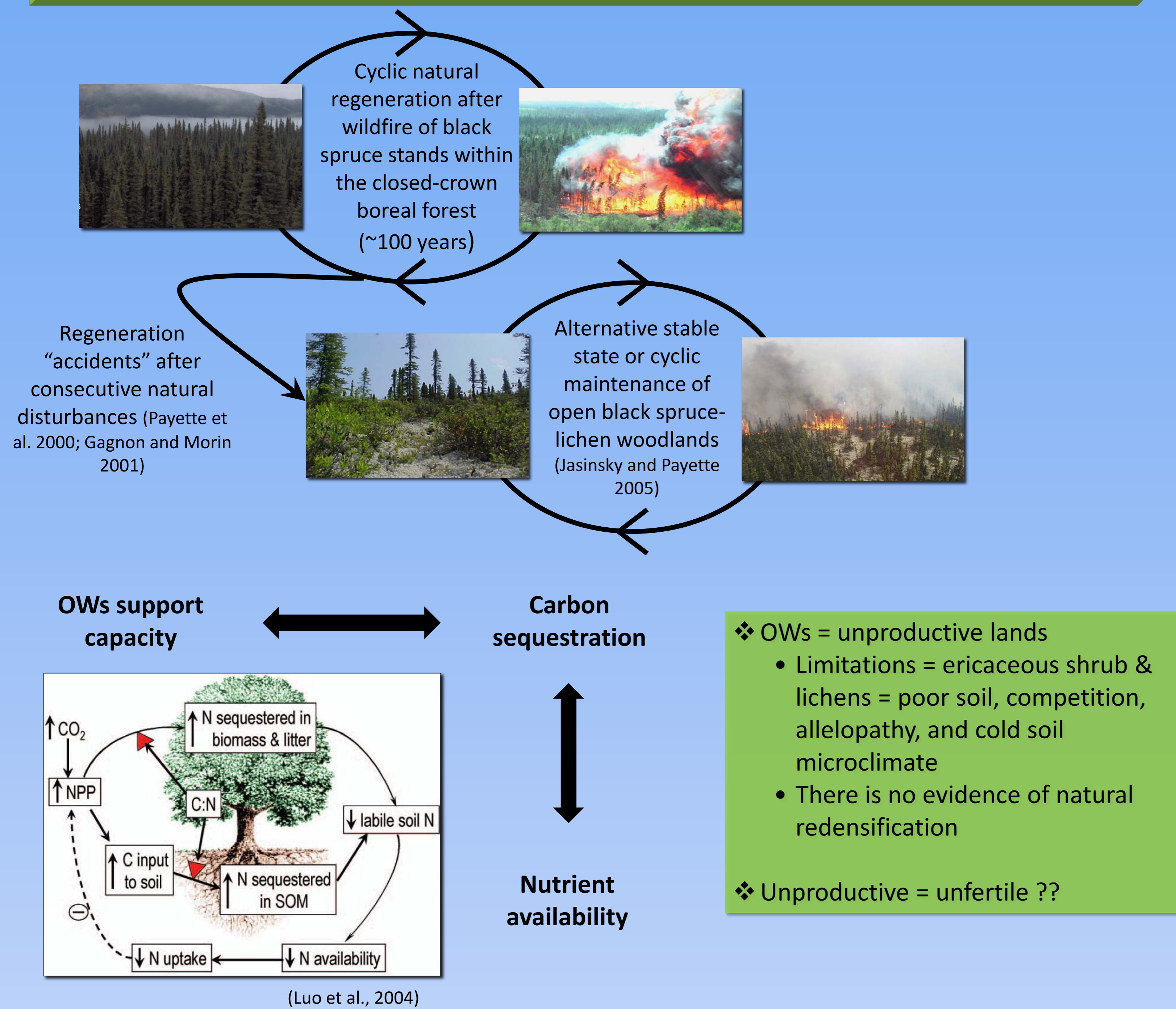


How important is the soil fertility and planted tree nutrition to the carbon sequestration of afforested boreal open woodland

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RATIONALE



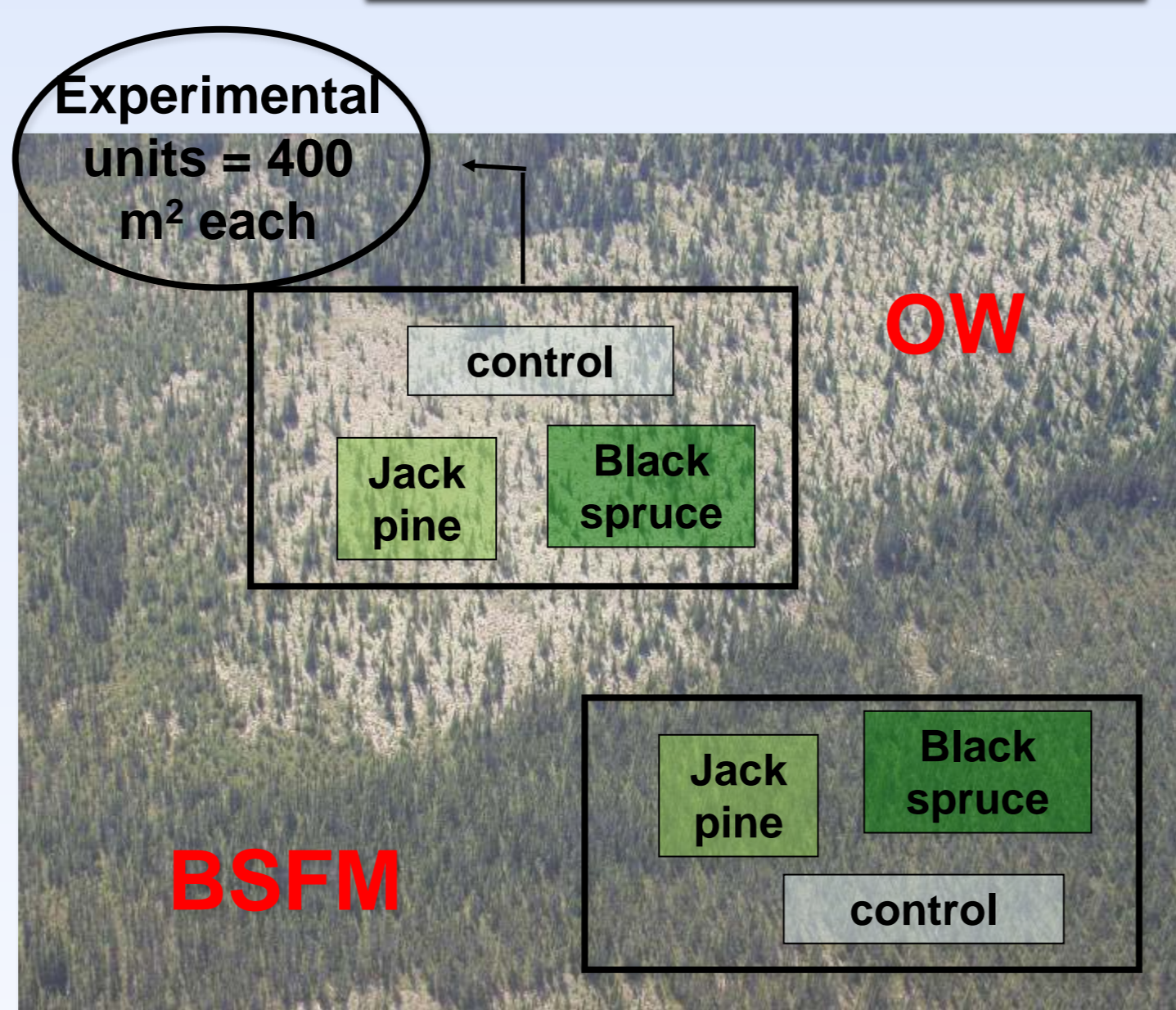
THE STUDY

HYPOTHESES

- ❖ 10 years after afforestation, soil fertility is equivalent in OWs and BSFM stands.
- ❖ Planted species used in afforested OWs could have a greater impact on their environment than in black spruce-feathermoss (BSFM) adjacent stands, whose fertility have already been demonstrated.
- ❖ A functional connection exists between planted tree (black spruce and jack pine) traits and soil fertility (results not shown).

EXPERIMENTAL DESIGN

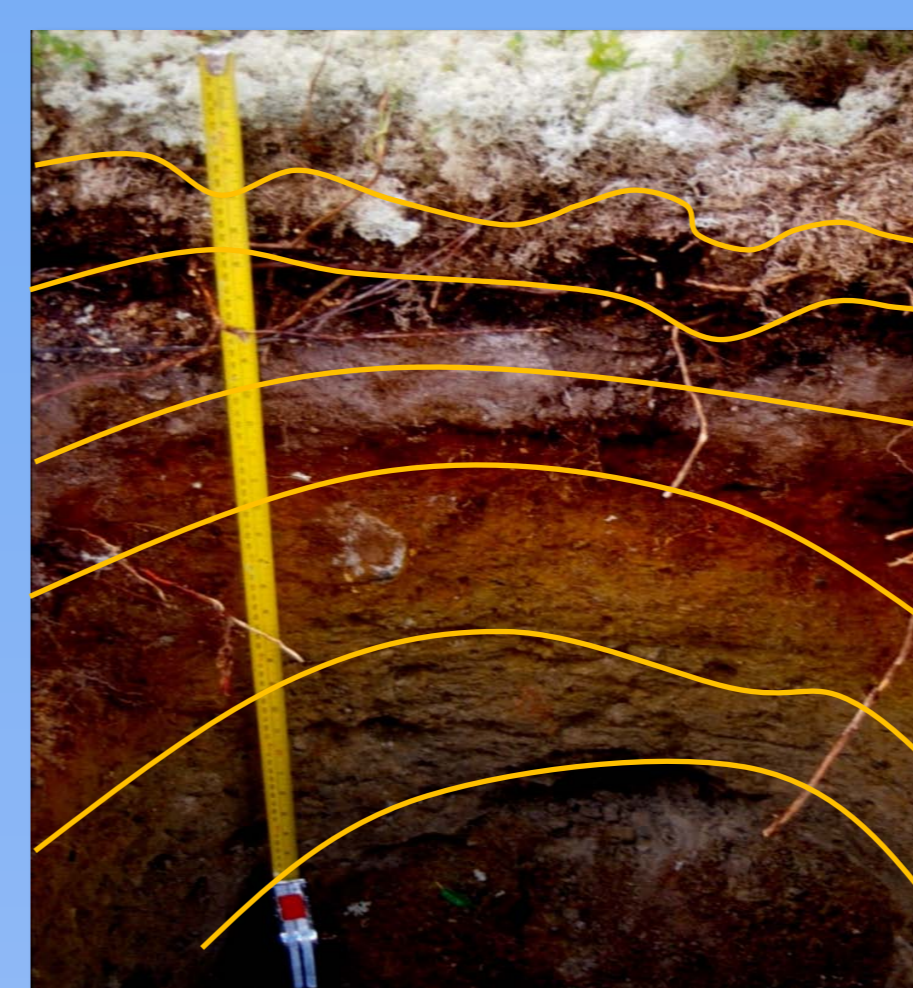
- ❖ 7 experimental blocks among 3 study sites in Québec's closed-crown boreal forest
- ❖ 2x3 split-plot design
- ❖ 2 different stand types (OW, BSFM)
- ❖ 3 different silvicultural approaches (scarification with planted black spruces, scarification with jack pines, control)



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RESULTS



❖ Podzolic soils and their horizons:

Organic horizon : The major organic horizons are L, F, and H, which are mainly forest litter at various stages of decomposition and humus.

Mineral horizons:

- Contain 17% or less organic C
- Usually composed of three different types of horizon
 - A : formed at or near the surface in the zone of leaching or eluviation of materials in solution or suspension, or of maximum in situ accumulation of organic matter or both.
 - B : characterized by enrichment in organic matter, sesquioxides, or clay, or by the development of soil structure; or by a change of color denoting hydrolysis, reduction, or oxidation.
 - C : comparatively unaffected by the pedogenic processes operative in A and B (The Canadian system of soil classification 1998)

Table 1. P values from the ANOVA for nutrient stocks in the mineral B soil horizon

ELEMENTS	MINERAL SOIL STOCKS (B HORIZON)		
	STANDS (OW, BSFM)	PLANTATION (BS, JP, none)	STANDS * PLANTATION
C Tot	0.1469	0.3622	0.9190
N tot	0.1846	0.2515	0.8174
K	0.5734	0.2518	0.2812
Ca	0.0434*	0.6866	0.3473
Mg	0.0148*	0.8661	0.4657
Mn	0.2856	0.6090	0.7073
Al	0.0347*	0.5409	0.7992
Fe	0.0263*	0.3583	0.8717
Na	0.2266	0.4162	0.4273
S	0.2512	0.3329	0.5363
C.E.C.	0.1084	0.8747	0.4500
S.B.	0.7631	0.8137	0.4083
pH	0.0300	0.8890	0.9440

*The data were cube root transformed

❖ Each plot was sampled with an Auger soil sampler in 10 year-old afforested OWs and planted BSFM stands (in between the scarification furrows in the planted plots). Only the first B horizon was sampled.

❖ There was a significant effect of stand types (OWs, BSFM) only on major cations (Ca, Mg, Al, Fe) in the first B horizon.

❖ There was no significant effect on any nutrient stocks of the plantation approach (JP, BS, no plantation or control) and of the interaction between stand types and the plantation approach.

❖ The mean carbon stocks: OWs = 40.96 t ha⁻¹ BSFM = 55.68 t ha⁻¹

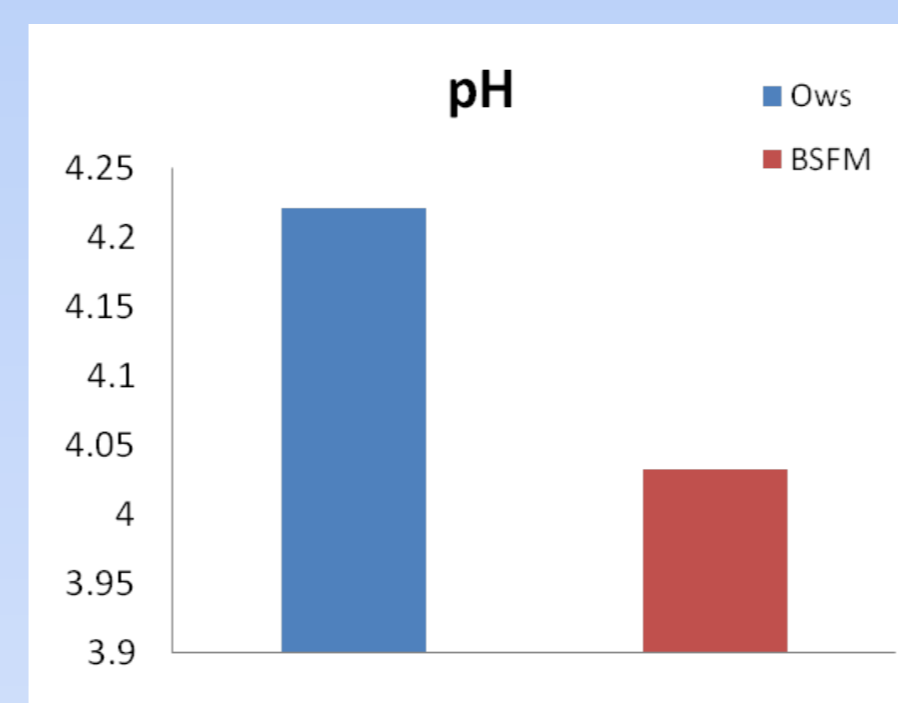


Figure 1. Mineral B horizon pH in OWs and BSFM stands

❖ There was a significant effect of stand types (OWs, BSFM) on soil pH, independently of planted species (JP, BS, none).

❖ The mineral B horizon soil in OWs was significantly less acidic than that in BSFM stands.

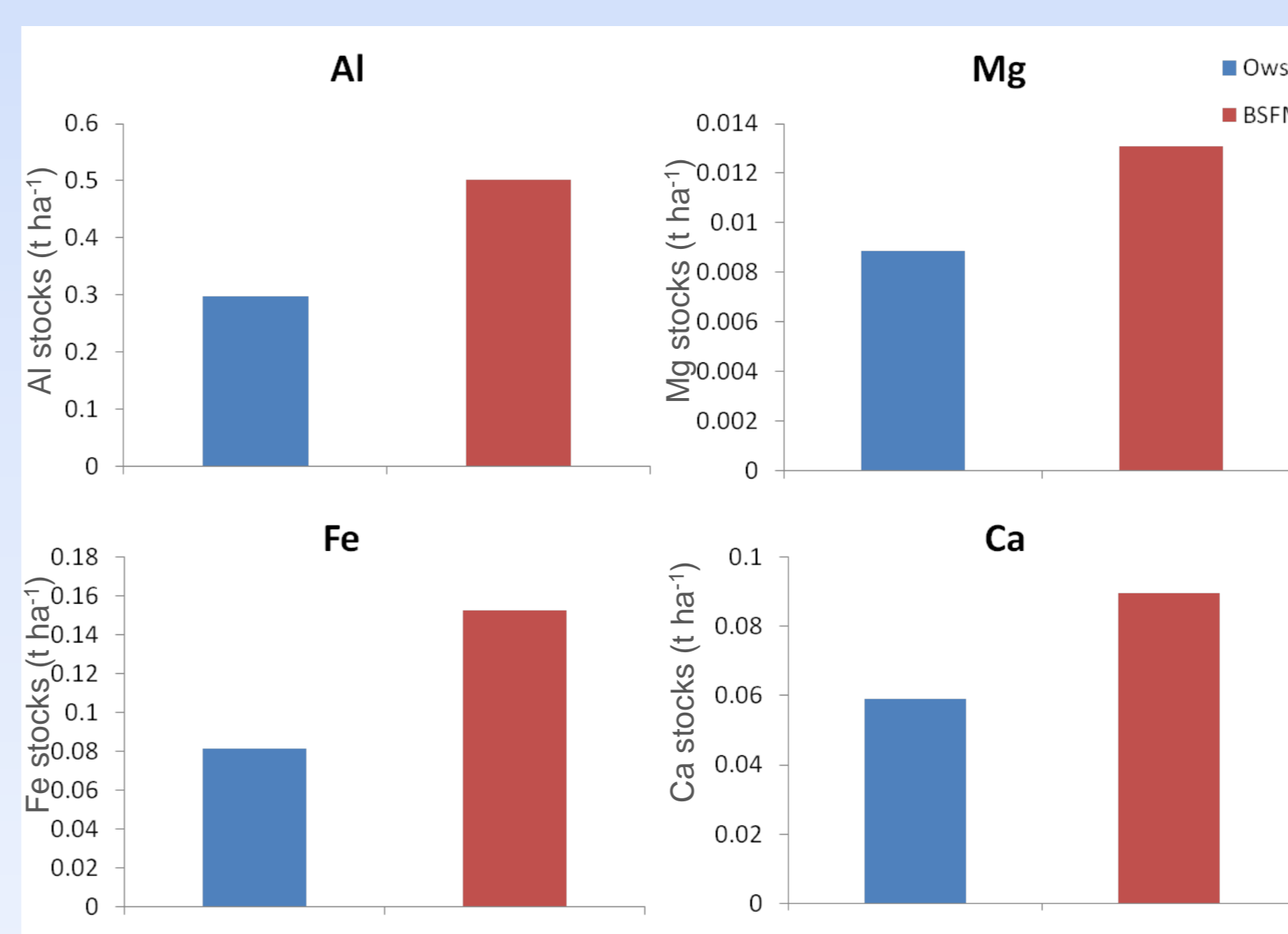


Figure 2. Mineral B horizon nutrient stocks in OWs and BSFM stands

❖ The mineral B horizon nutrient stocks in major cations (Al, Mg, Fe, and Ca) were higher in BSFM stands than in OWs (Fig. 2), despite their higher acidity (see Fig. 1).

❖ This difference in major cations between OWs and BSFM stands has been also observed in younger plantations (results not shown) → 10 years of plantation growth does not mitigate the initial lower soil fertility in afforested OWs?

CONCLUSION

- ❖ Initial lower mineral soil stocks in major cations (Al, Mg, Fe, and Ca) in afforested open woodlands (OWs) is still existing after ten years of plantation growth.
- ❖ Even with contrasting differences in initial stand structure, 10 year-old afforested OWs have equivalent mineral soil carbon stocks to 10 year-old comparable black-spruce feathermoss (BSFM) planted stands.
- ❖ Some unanswered questions:
 - Are lower stocks in major cations limiting to planted tree growth?
 - Are there also differences in the humus layer nutrient stocks after 10 years of plantation growth?
 - What would be the soil fertility in or near the scarification furrows, where planted trees grow?
 - Are there going to be longer term positive impacts of plantation growth on soil fertility in afforested OWs?