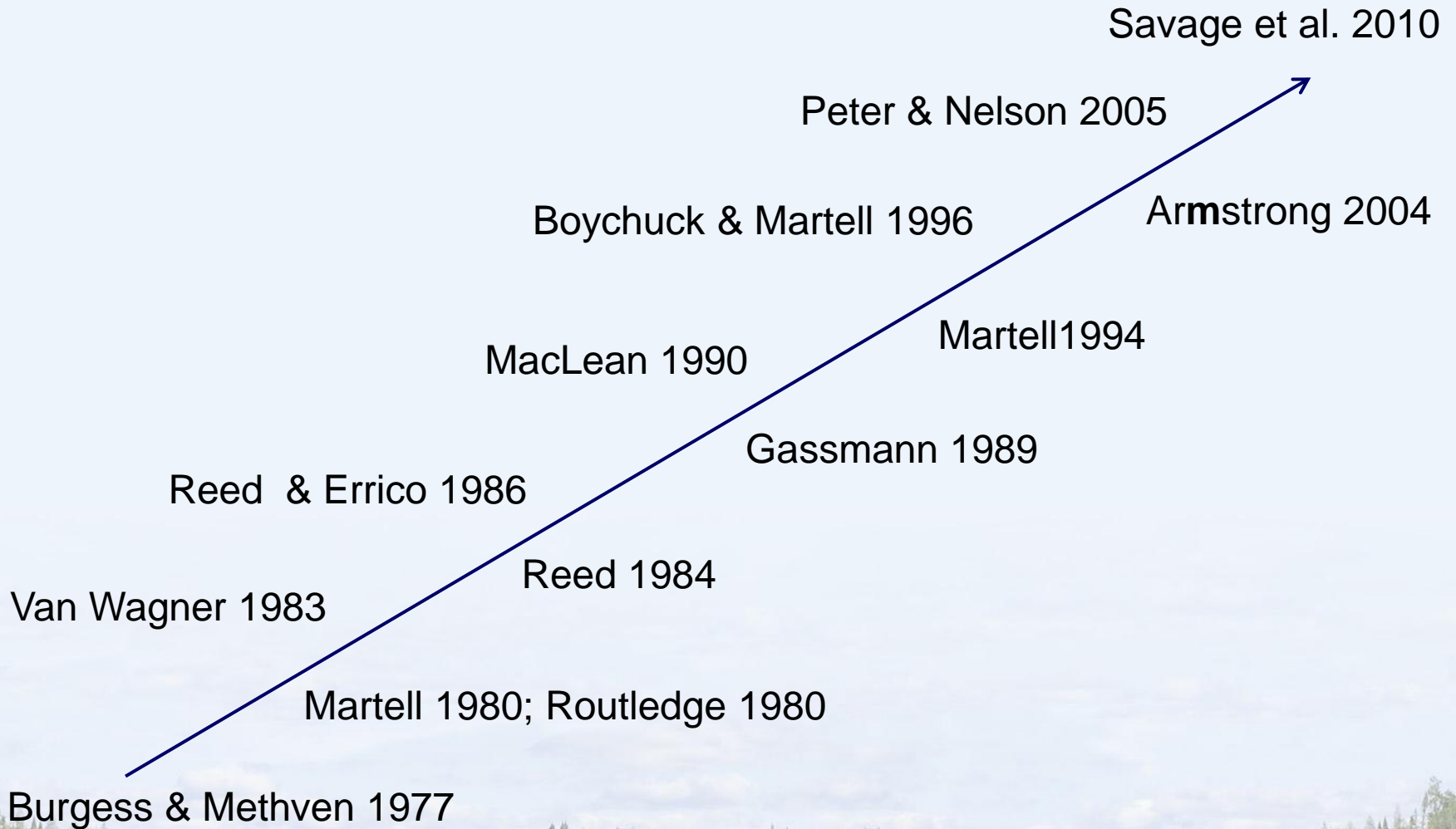


# Considering fire in the AAC:

## For or against a priori reduction?

By Alain Leduc

# A old story...



# Ranges of reduction reported

- Van Wagner (1983) observed 15 to 50% reduction in AAC for burning rates varying from 0.5 to 2% / year.
- Reed & Errico (1986) estimated 40% reduction for average burning rates of 1% / year.
- Martell (1994) obtained a 35% reduction with a burning rate of 1.5% / year.



# Raisons to justify a posteriori approach

- Current cost is too high
- We can control for fire risk
- We can operate salvage logging to limit losses
- We can revise our cutting plan each 5 yrs
- We cannot really predict what will be future fire risks



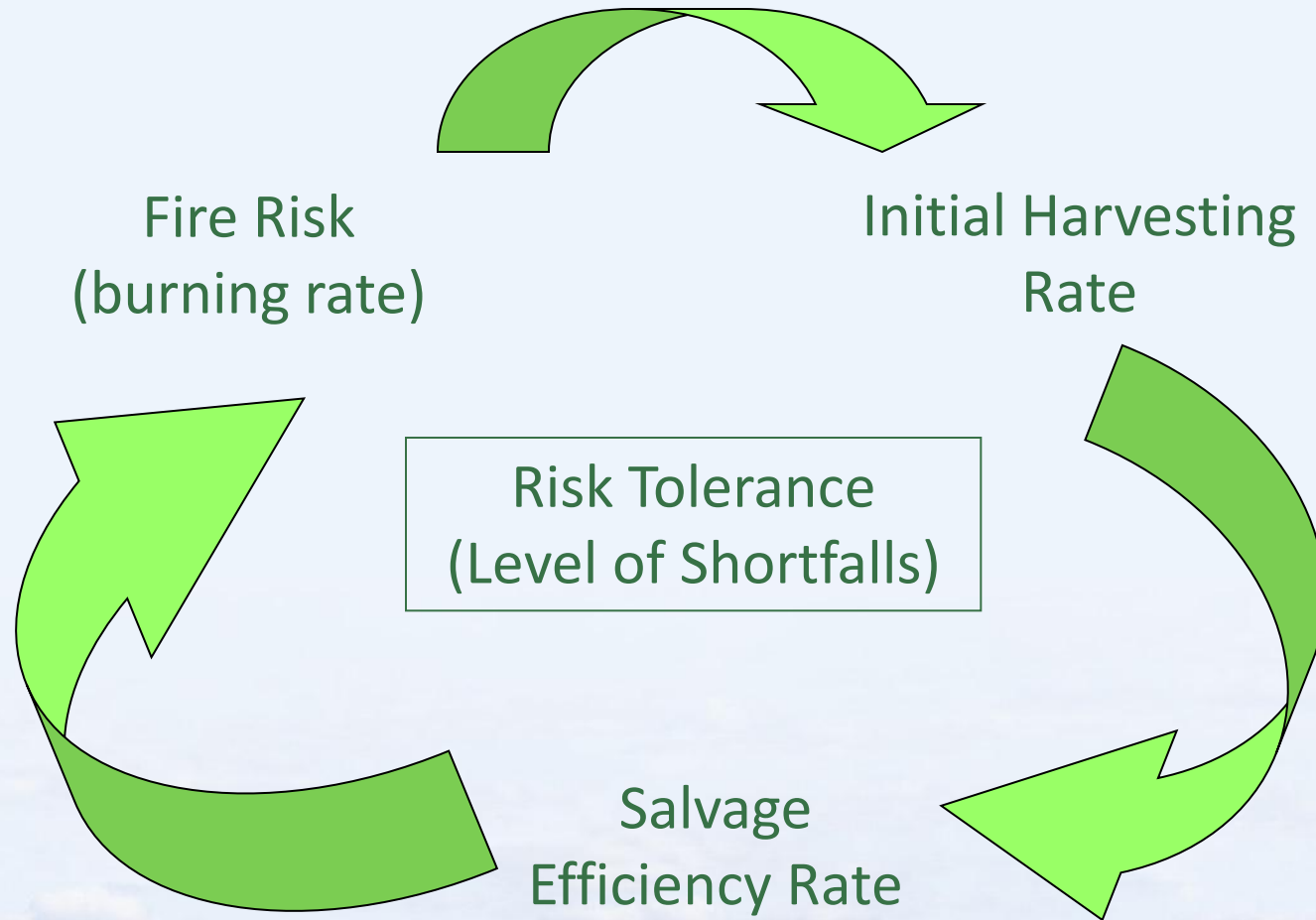
# Questions

To evaluate the AAC reductions for more realist fire risk levels, considering:

- Forest vulnerability (Age structure *in situ*)
- Salvage logging
- Tolerance to risk



# Optimization – Linear Programming



# Methodology – Transition Matrix (Markhov)

Initial State

$X_0$

$X_1$

$X_2$

·

·

·

$X_k$

Fire Harvesting

$X_0 - f^t$

$X_1$

$X_2$

·

·

·

$X_k$

Salvage Logging

$X_0$

$X_1$

$X_2$

·

·

·

$X_k$

Industrial  
Harvesting

$X_0$

$X_1$

$X_2$

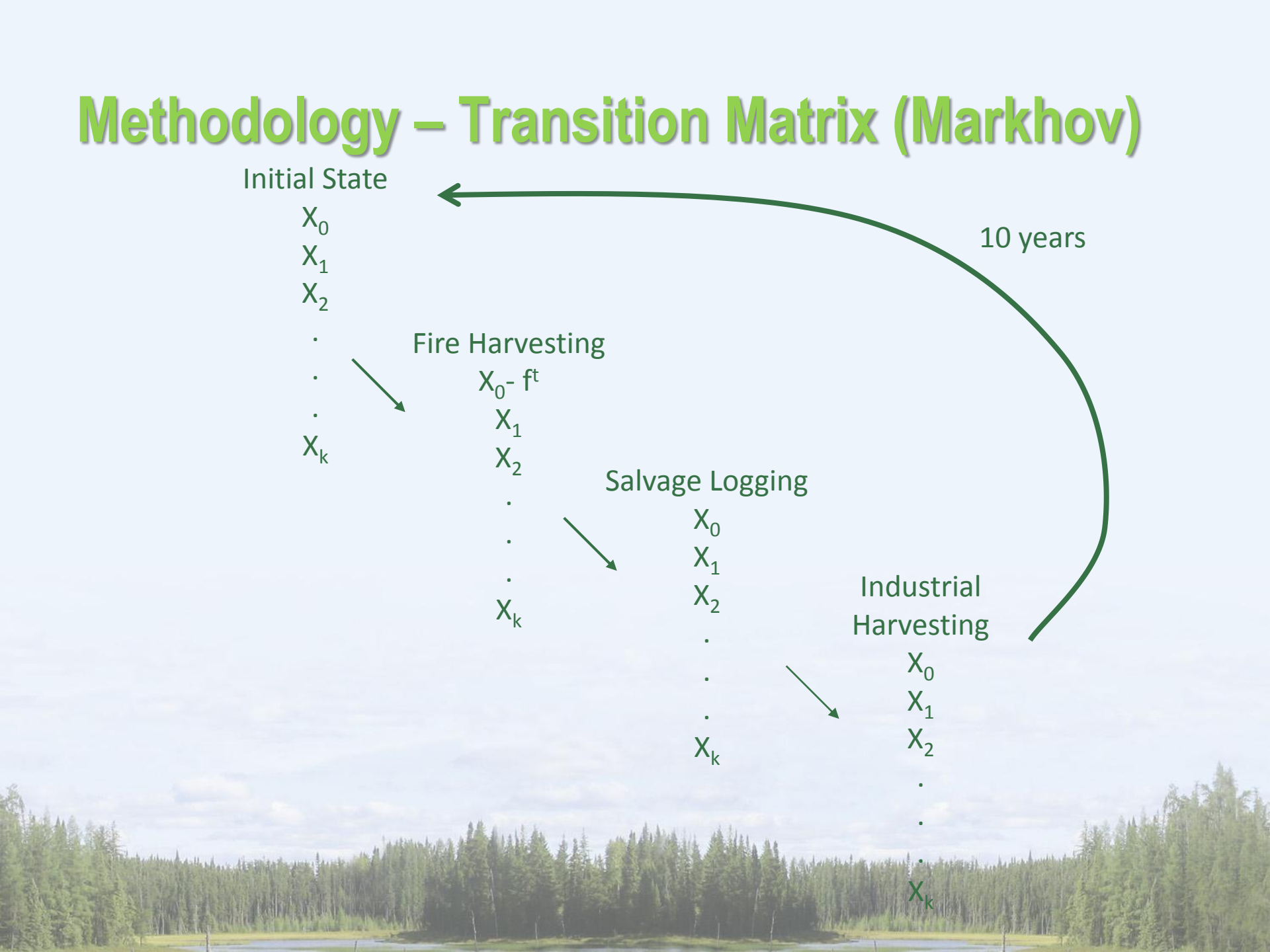
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$X_k$

10 years



# Simulation Characteristics

Forest management unit is a spatially composed of:

- One single forest stand
- Unique commercial minimal age
- No establishment delay, nor growth delay
- No stand age susceptibility to fire (random event)
- Simulation runs on 250 years with 10 year steps
- Age structure is described by 10 year classes (up to 250 years)





# Parameters

Rotation age of 100 years = initial harvesting rate of 1% / year  
Compare 7 initial age structures (5 reals + 2 theoreticals)

Variables:

- Fire risk: burning rate of 0.1 to 0.67%/year (Fire cycle 150-1000 years)
- **Salvage logging efficiency varying from 50 – 100%**

**Response variable = Shortfall (%) = Risk Tolerance**



# Different Modes

Deterministic mode: Burning rate is constant

- Sensibility Analysis

Stochastic mode: Burning rate varies through time

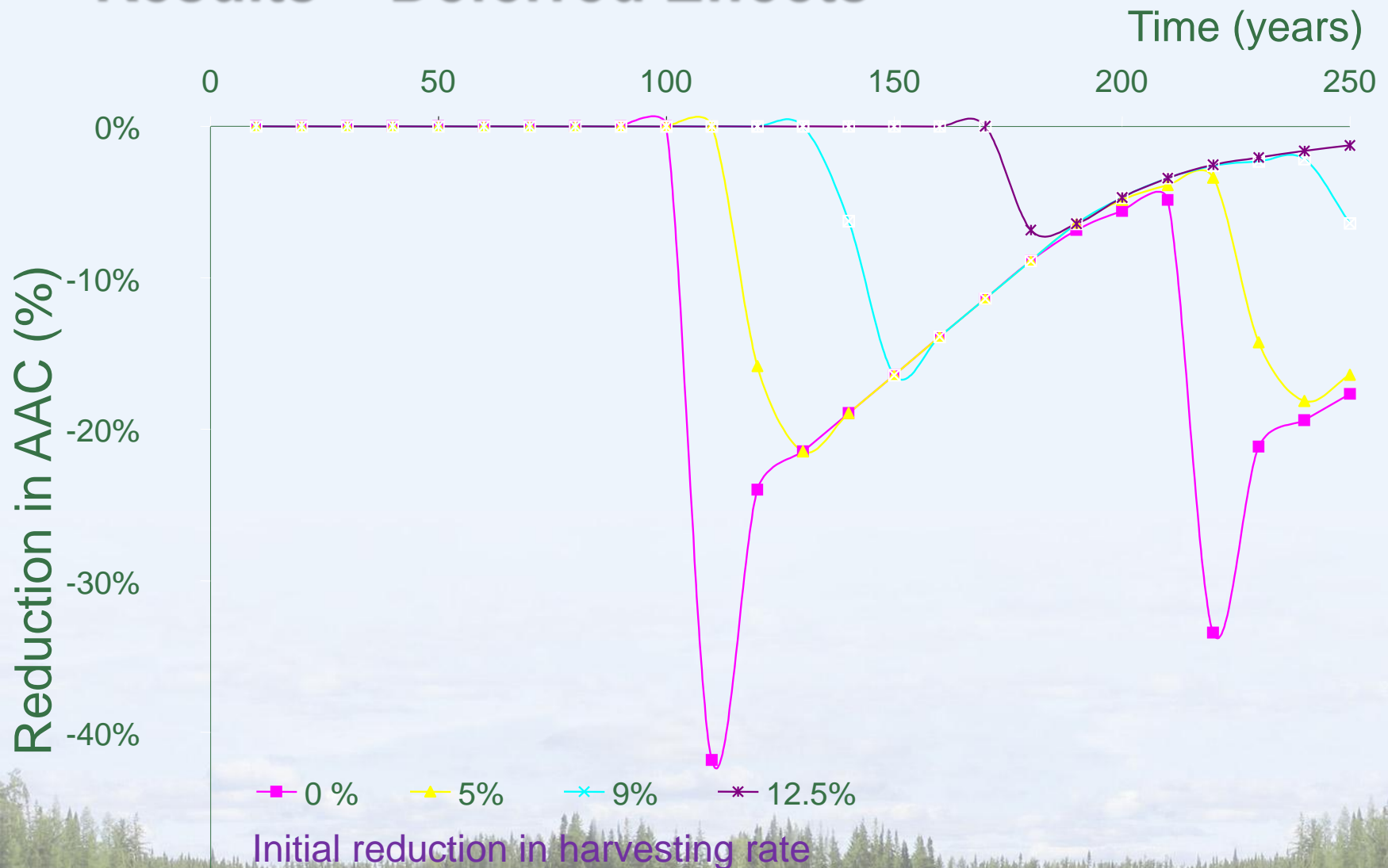
- Includes large fire years effect

Beta Version (on Excel)

Final Version (in R)

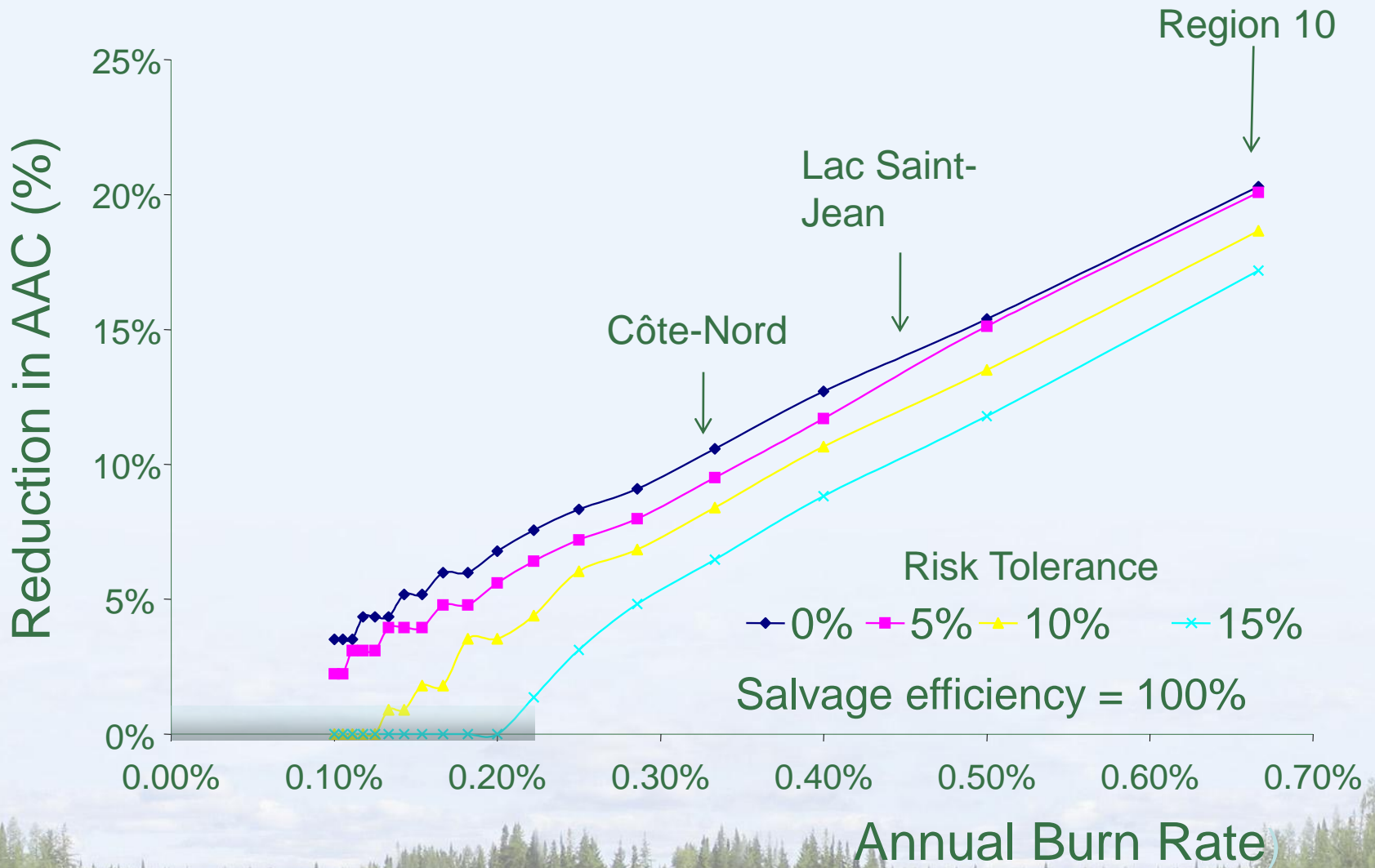


# Results – Deferred Effects

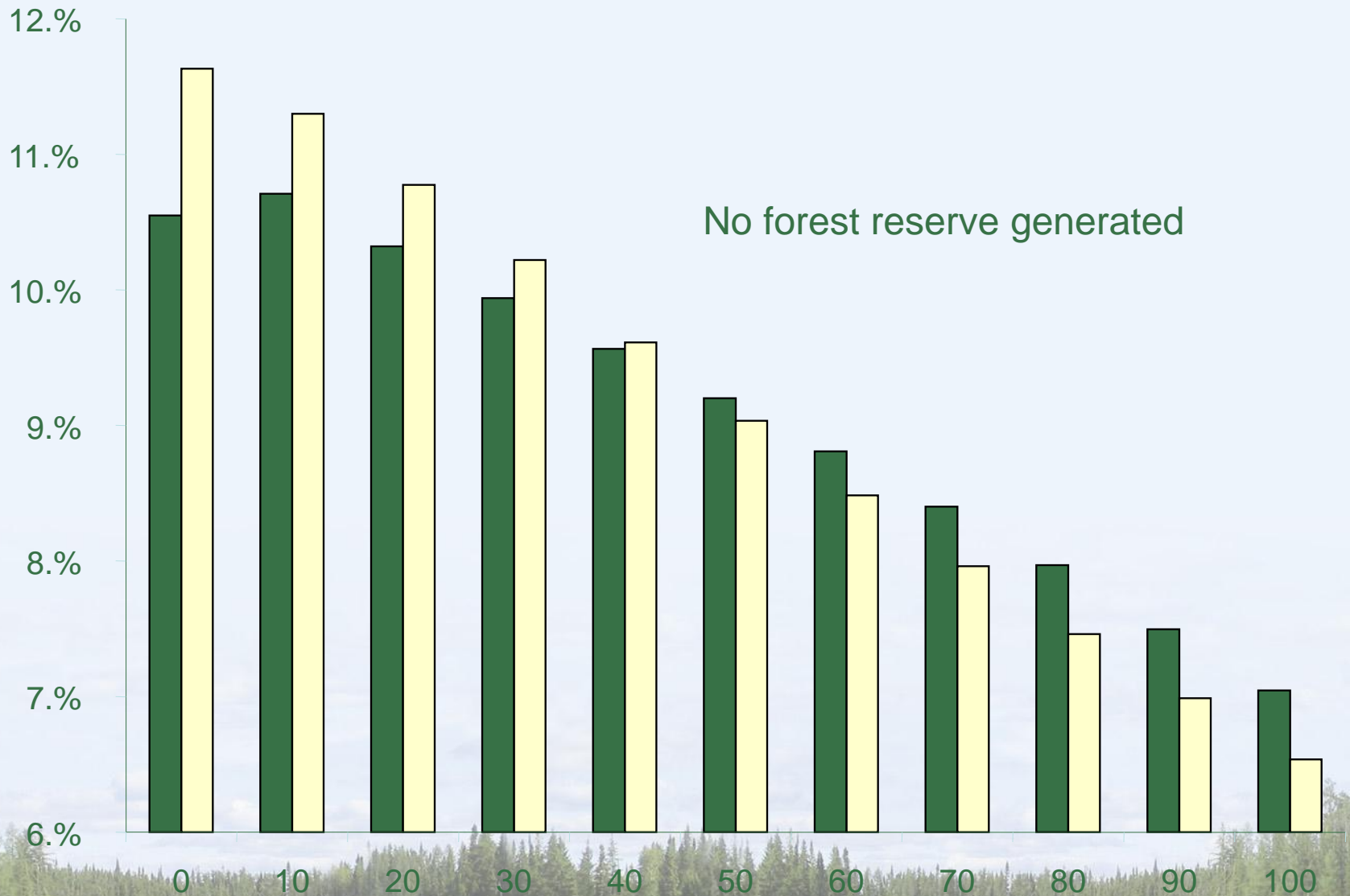




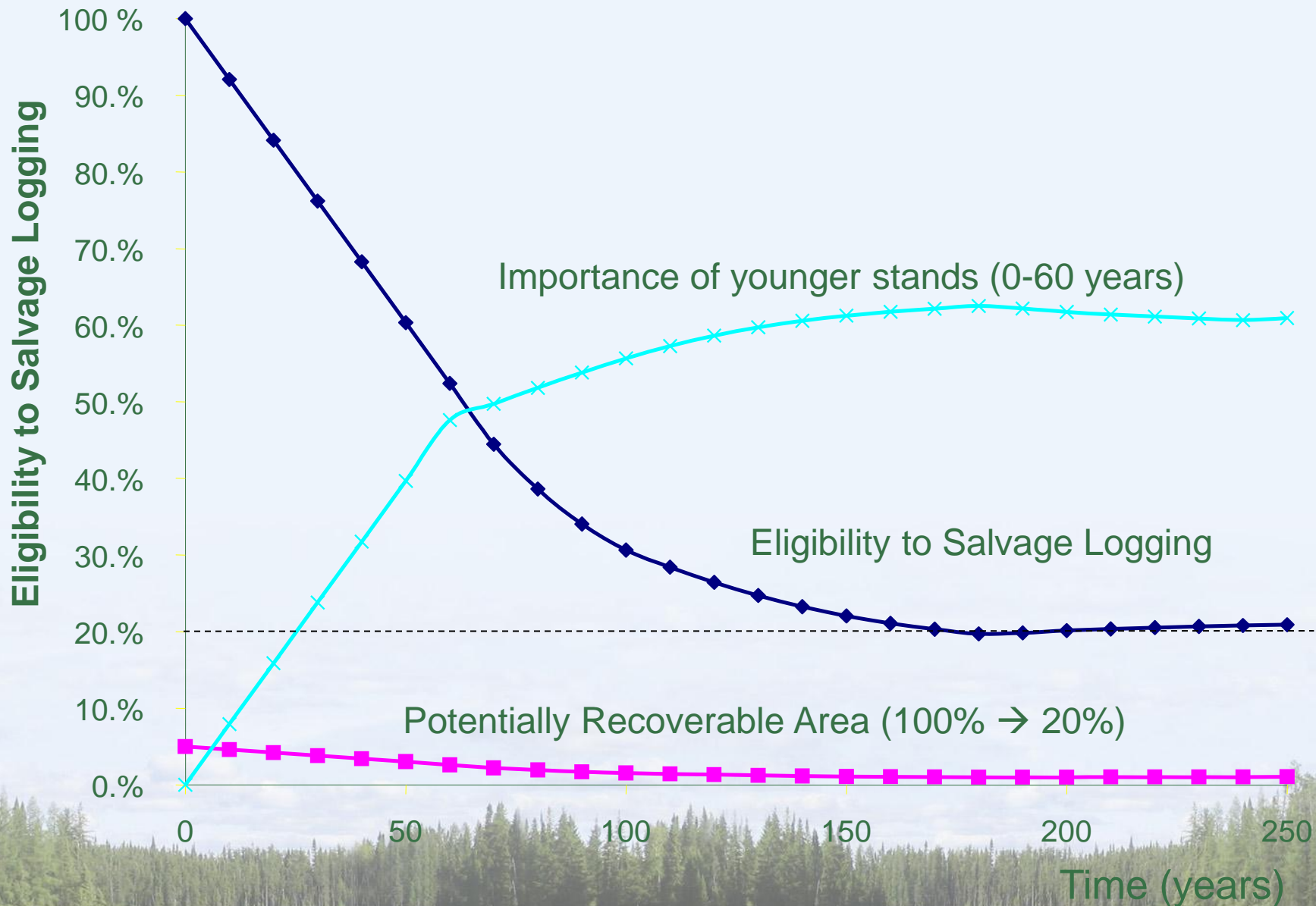
# Results – Risk Tolerance



# Resulting Age Structure after one cycle



# Eligibility to Salvage Logging



# Adding Temporal Variability

Spatial scale	Quebec	Ecological	FMU
Reduction in AAC	territory	Region	
0%	5	2	1
10%	29	12	2
25%	557	102	4





# Adding Temporal Variability

With 10% reduction additional to initial harvesting rate

Spatial scale	Quebec	Ecological	FMU
Reduction in AAC	territory	Region	
0%	1000	747	38
10%	1000	823	58
25%	1000	914	106



# Observations

- The relative drop in AAC follow a linear trend in relation with the increase of fire risk.
- A 1% provision give some protection against low fire risks (fire cycle of 500 to 1000 years)
- Reduction in AAC don't create (at long term) a Forest Reserve with an age above exploitation age.
- Salvage logging option decreases through time in reason of increase of young stands
- Temporal variability of large fire years increases the risk.



# Take home message

It is possible to better evaluate the current cost (reduction of AAC) according to the risk a region presents and our tolerance to risk (variations in future AAC).



## Now what... ?

- Better quantify forest vulnerability (i.e. actual FMU age structure)
- Better quantify the risk under Climate Change
- Better integrate the notion of uncertainty

