The direct and indirect effect of fire on radial growth of *Pinus koraiensis* trees in a northern temperate forest of China

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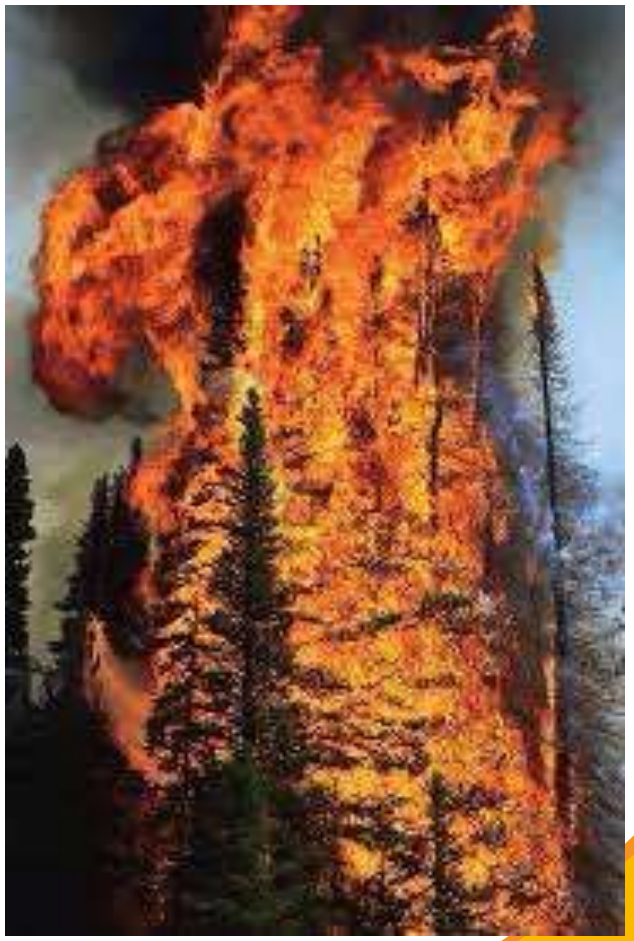
Consequences of Fire

- loss of valuable timber resources
- degradation of catchment areas
- loss of biodiversity and extinction of plants and animals
- loss of wildlife habitat and depletion of wildlife
- loss of natural regeneration and reduction in forest cover
- global warming
- loss of carbon sink resource and increase in percentage of CO_2 in atmosphere
- change in the microclimate of the area with unhealthy living conditions



Consequences of Fire

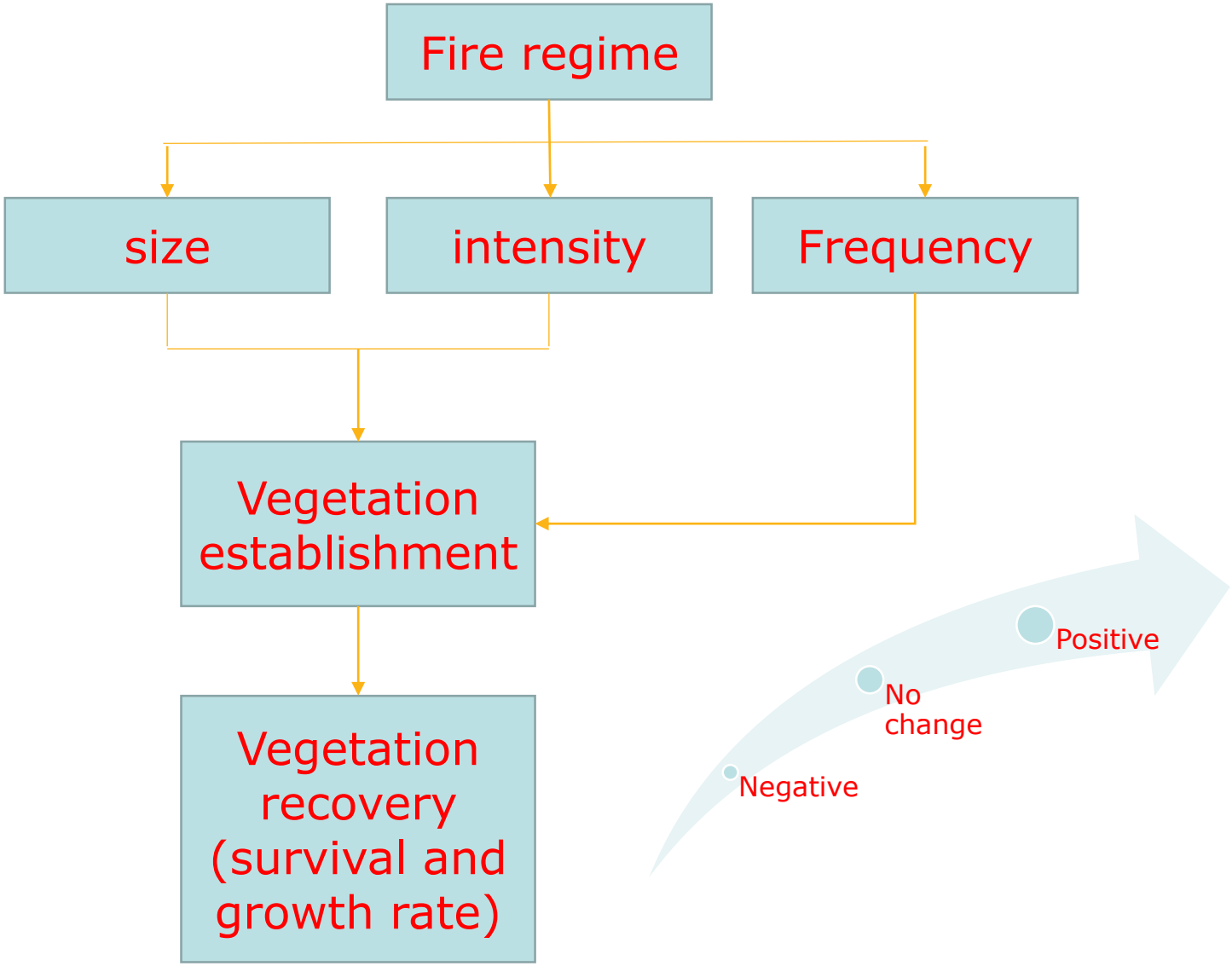
Fire is a natural component of many ecosystems, which include plants and animals that interact with one another and with their physical environment.

Consequences of Fire

Depending on their intensity, fires can benefit or harm forests

-Burn away flammable ground material

-Release valuable mineral nutrients


Fire regime
size
intensity
Frequency
Vegetation establishment
Vegetation recovery (survival and growth rate)
Positive
No change
Negative

No change:

short -term negative effect of fire on radial growth may be offset by a positive effect

Positive:

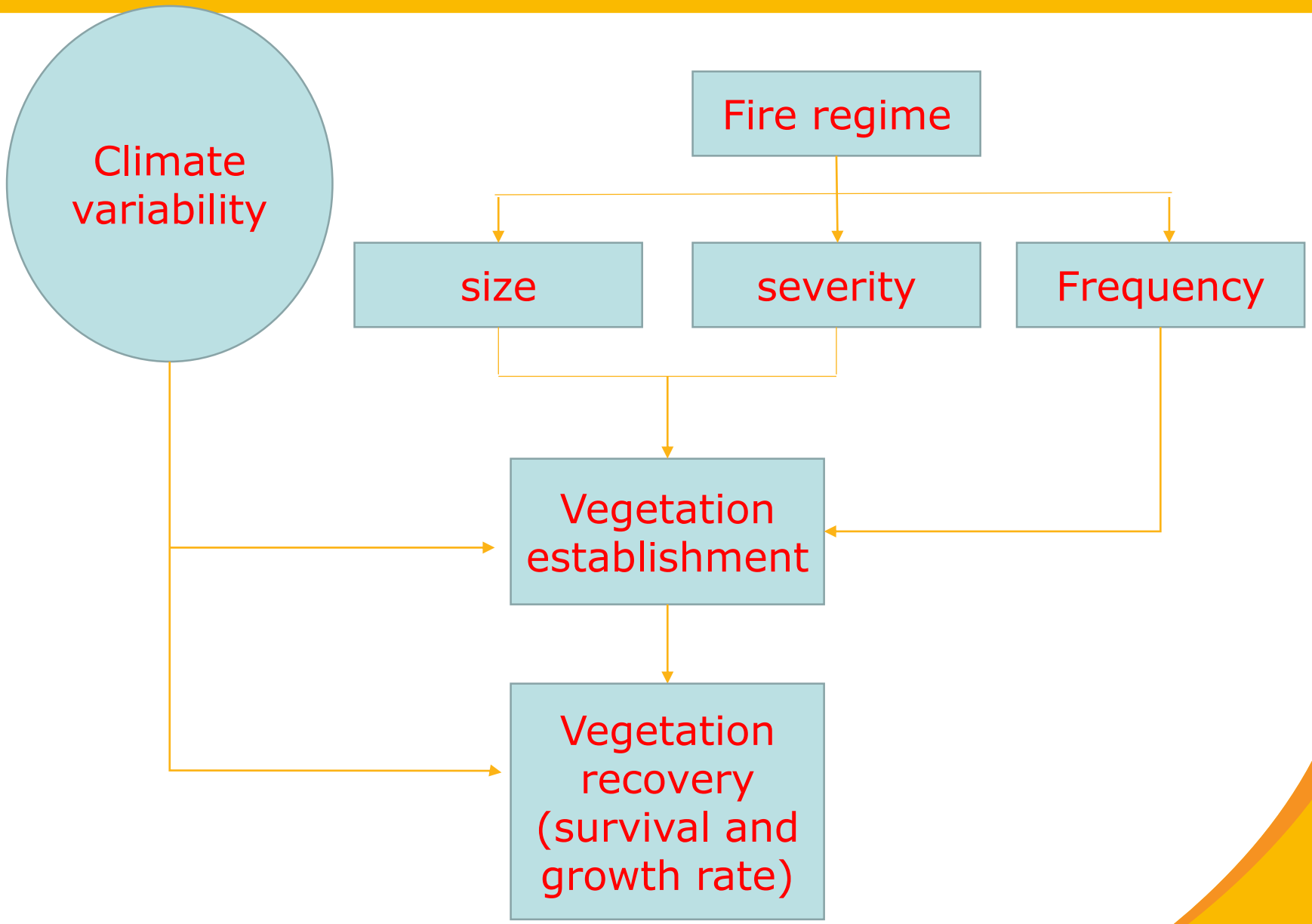
release from competition imposed by neighboring vegetation

Negative:

damage to foliage

cambium

fine roots


Climate variability
Fire regime
size
severity
Frequency
Vegetation establishment
Vegetation recovery (survival and growth rate)

Two specific hypotheses:

(1) The direct negative effects of fire on radial growth of trees are offset by indirect positive effects.

(2) The indirect effects of fire on radial growth over the long term was mainly caused by modifications to climatic responses instead of trees being released from or under increasing competition.

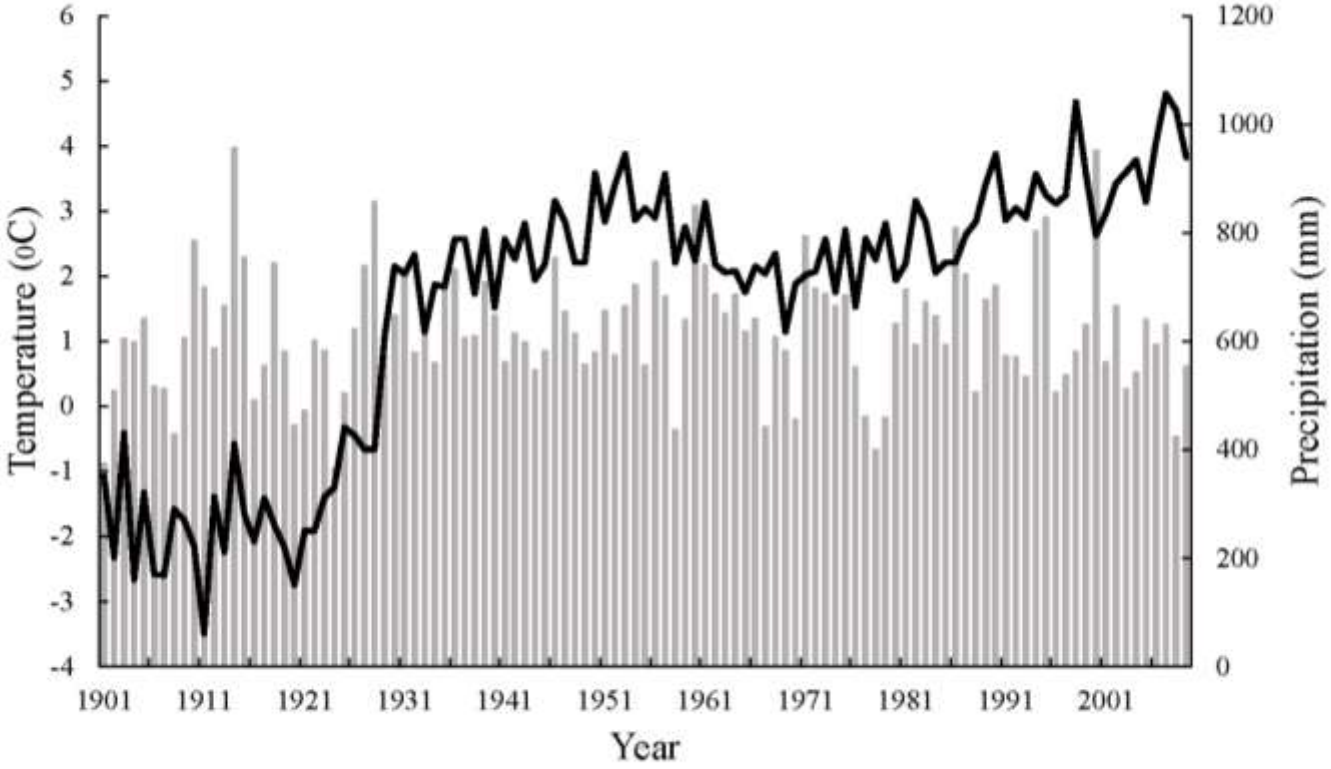
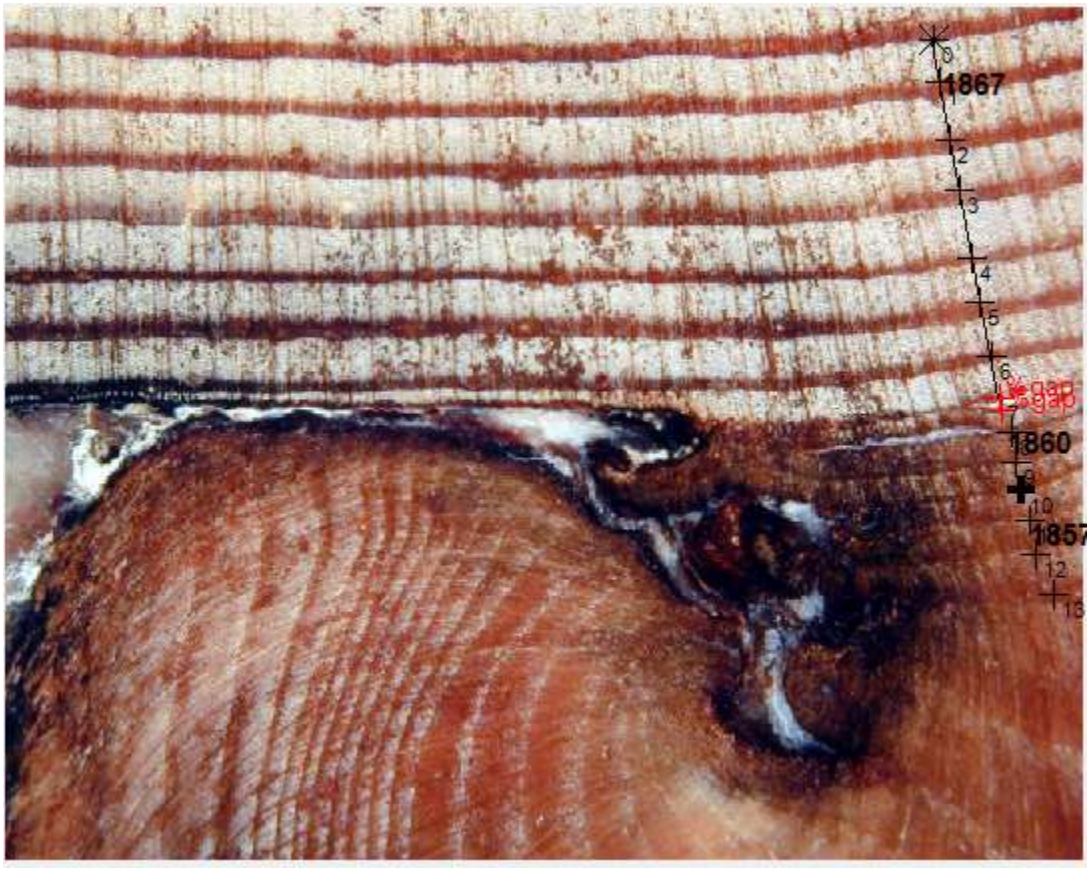


Fig. 1 Annual mean temperature (—) and annual total precipitation (■) at the study site from 1901 to 2009


122° E
124° E
126° E
122° E
124° E

Table 1. Summary statistics of burn and control Korean pine samples and their standardized chronologies

Statistics	Burn	Control
Number of trees (cores)	21(40)	30(54)
Mean diameter at breast height(cm)	46.7±9 cm	47.6±6 cm
Length of chronology	AD1859~2009	AD 1858~2011
Mean sensitivity (MS)	0.19	0.18
Signal to noise ratio (SNR)	17.10	13.10
Express population signal (EPS)	0.94	0.93
Mean correlation between trees (RBAR)	0.62	0.42



Fire occurred in the year of 1857 !

Growth pattern

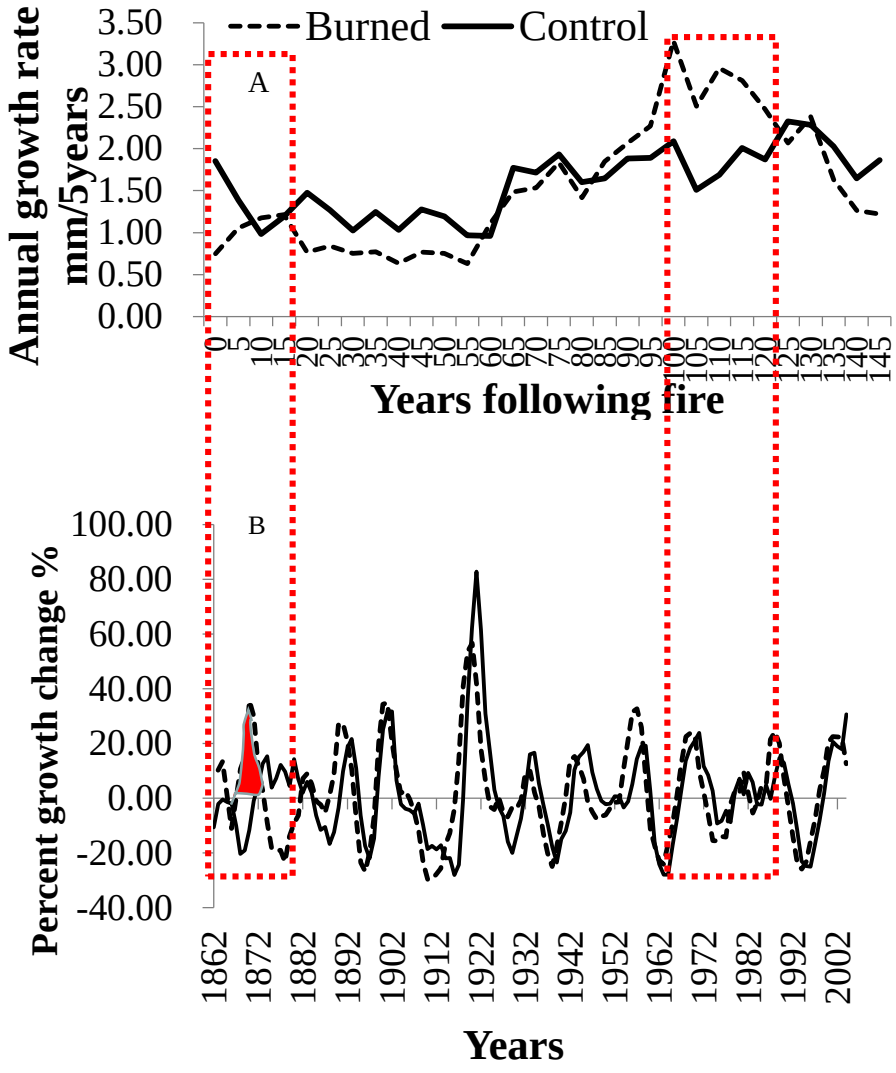
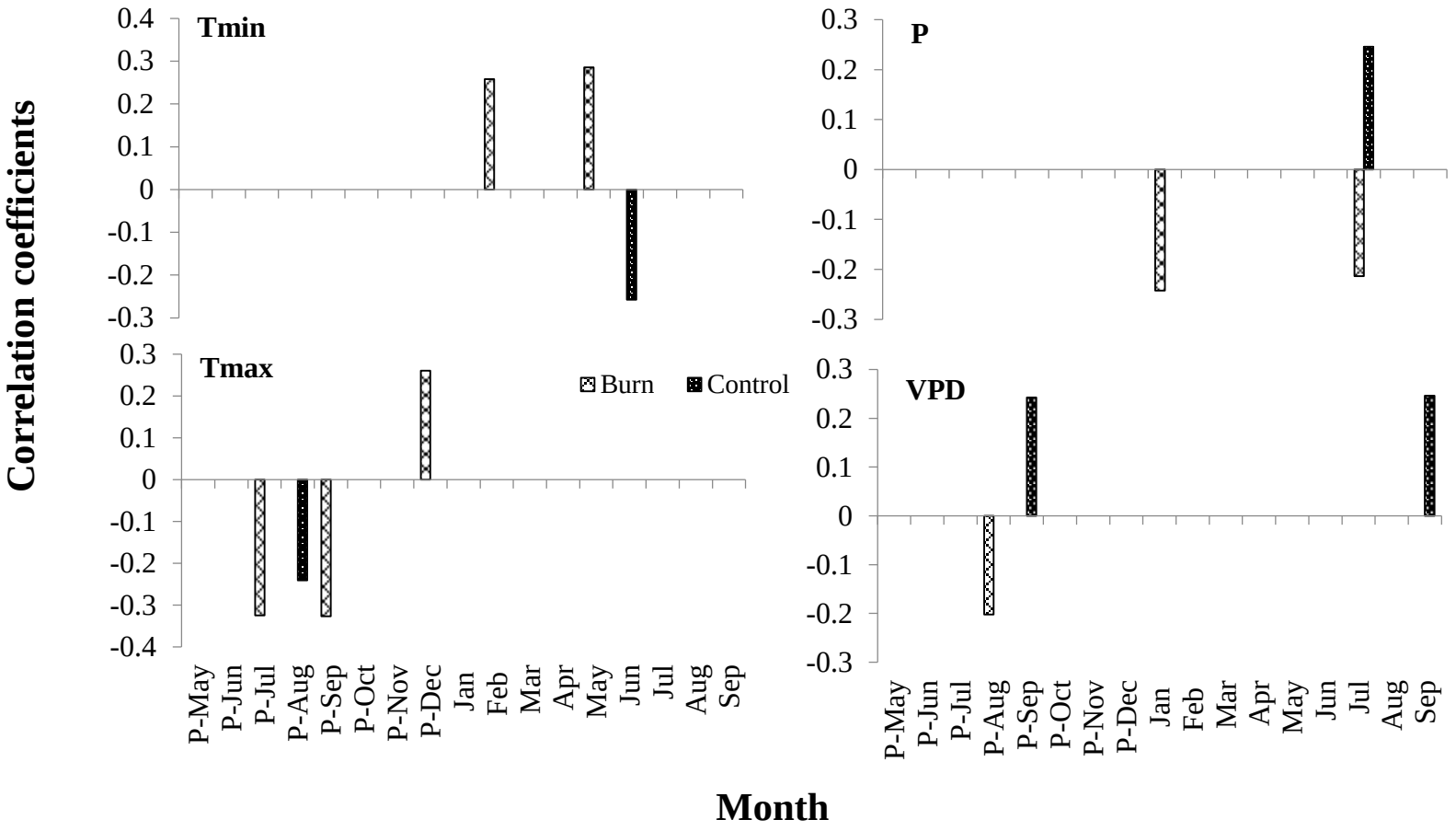


Fig. 2 Growth pattern of burned and control Korean pine trees

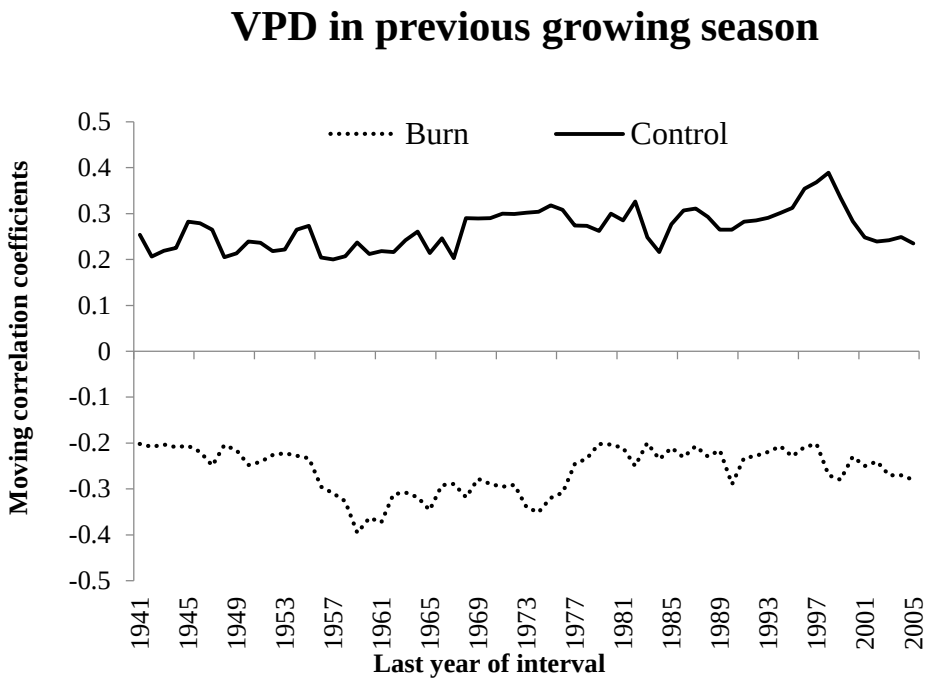
Greater variability in growth patterns was observed within the first 25 years following fire (i.e., 1858-82) and during the period from 1960 to 1980.

Growth-climate relationship



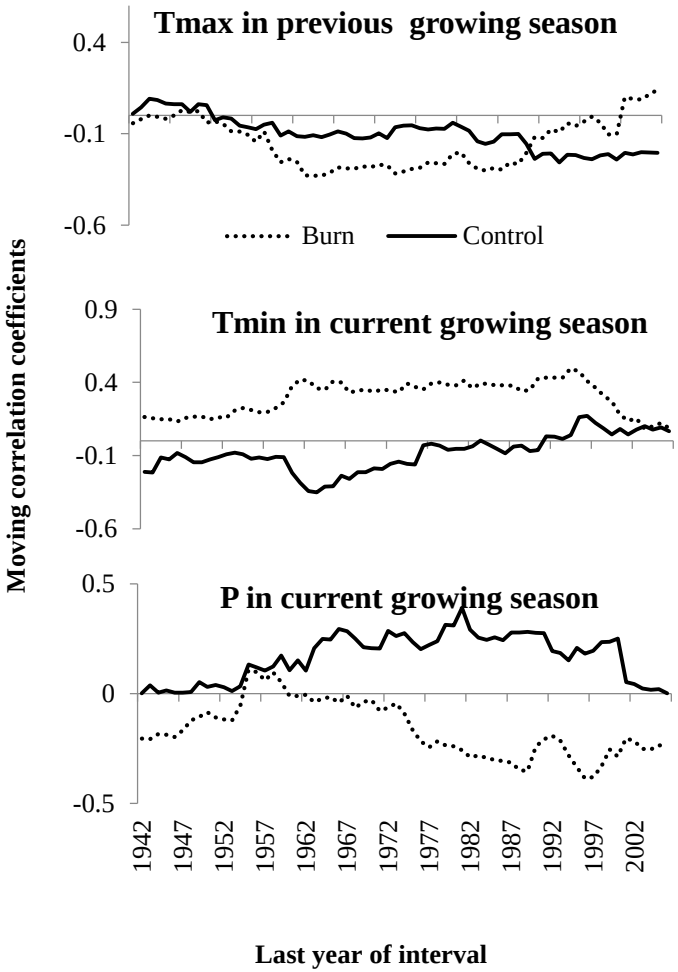
Burned trees had a significantly negative response to precipitation in the current growing season (CG-P) and VPD in the previous growing season (PG-VPD). On the contrary, the responses of control trees to CG-P and PG-VPD were both significantly positive. In contrast with the negative correlation between the monthly minimum temperature in the current growing season (CG-Tmin) and growth of control trees, a significantly positive relationship was observed among burned trees.

Growth-climate relationship



Unchanged effect of PG-VPD on radial growth of trees from the two sites!

Growth-climate relationship



The negative effect of PG-Tmax on radial growth was observed during the period from 1960 to 1990 for burned trees, but from 1990 to 2006 for control trees. The differential responses to CG-Tmin and CG-P of burned and control trees were only found in the short term from 1960 to 1970 and from 1978 to 1990, respectively.

Effect of recent competition

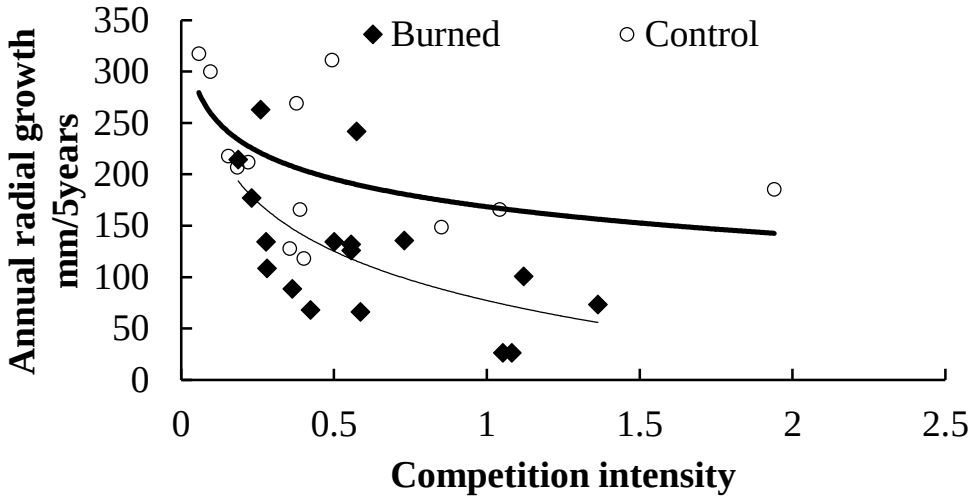


Table 2. Summary statistics of neighboring trees of burn and control Korean pine samples

Statistics	Burn	Control
average distances between the target and neighboring trees(m)	2.73 m (0.5 m~4.7 m)	2.5 m (0.8m~4.7 m)
average age at dbh of the nearest neighboring trees(cm)	20±4 cm	14±2 cm
average age at breast height of the nearest neighboring trees	87(25~150)	56(10~148)
Mean competition intensity	0.86	0.66
correlation between competition and annual radial growth rate	-0.5857 p=0.013*	-0.3496 p=0.242

* indicate the significantly at level 0.05

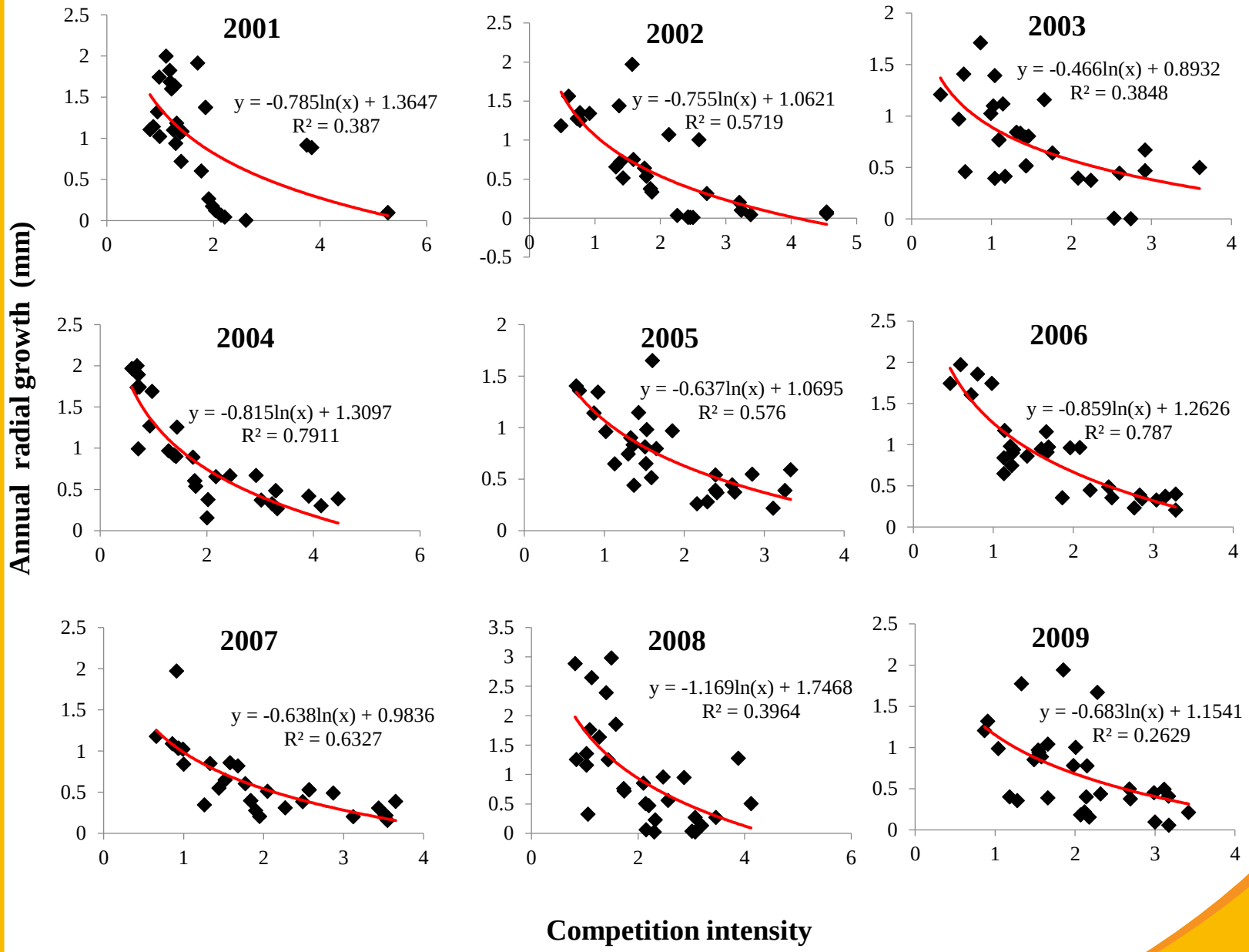


Fig. 7 Historical correlation between the competition intensity and annual growth rate of burn trees during the last 10 years

Two specific hypotheses:

(1) The direct negative effects of fire on radial growth of trees are offset by indirect positive effects.

Q:This study demonstrated that the radial growth of Korean pine trees was negatively influenced by the direct effect of fire in the short term, specifically the first 5 years following fire. The indirect positive effect of fire outweighed the direct negative effects in the short period when trees recovered and were released from competition.

Two specific hypotheses:

(2) The indirect effects of fire on radial growth over the long term was mainly caused by modifications to climatic responses instead of trees being released from or under increasing competition.

Q:Our data suggested the indirect effect of fire makes Korean pine tree traits more sensitive to soil moisture over the long-term.

Unstable:

short -term negative di
on radial growth was off
indirective effect

Positive:

release from competition i
neighboring vegetation

Negative:

damage to foliage

cambium

fine roots

For more information:

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Thank you!