# THE EFFECTS OF FALSE SPRING EVENTS ON FOLIATE PHENOPHASES AND THE DURATION OF VEGETATIVE RISK

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## ABSTRACT


- Trees and shrubs growing in temperate environments are at risk of being exposed to late spring freezes, or false springs, which can be detrimental to growth.
- Individuals at certain phenophases (i.e. between budburst and full leafout) are more likely to incur damage from a freezing event.
- The rate of budburst, and the length of time between budburst and leafout, is a crucial indicator for predicting level of damage from a false spring event.
- We will refer to the timing of these collective phenophases as the duration of vegetative risk.
- We exposed 7 native deciduous tree species to a freezing event.
- In one treatment, drought conditions were applied prior to budburst and then individuals were put in a growth chamber for 24 hours at -3℃, the second treatment drought conditions were not applied prior to budburst but individuals were put in the same chamber after budburst was initiated. Both were compared to a control group.
- Our results indicate that freezing events occurring between budburst and leafout cause the duration of vegetative risk to increase. This increase could potentially expose leaf buds to more freezing events and subsequently increase the level of damage incurred.


## BACKGROUND

Plants are most susceptible to frost damage between budburst and leafout [2,4,1]. Frost tolerance, however, steadily decreases after budburst begins until the leaf is fully unfolded, with leafout being the most susceptible to frost damage [2].

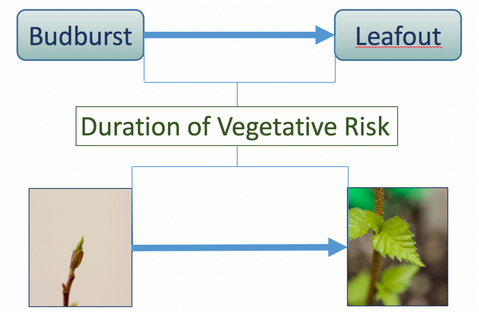



Figure 1: Schematic of duration of vegetative risk, the timing between budburst and leafout

## OBJECTIVES

- Determine how spring freezing events affect the duration of vegetative risk.
- Determine how spring droughts prior to freezing events affect budburst and the duration of vegetative risk.
- Assess the level of damage incurred from late spring freezing events on temperate forest seedlings and saplings.

*Viburnum cassinoides* after freezing treatment

## METHODS

TREATMENTS – Recorded BBCH stage every ~3 days

Treatment A: Control Group – No late spring freezing event prior to leafout nor any drought conditions prior to budburst

Treatment B: Experimental Group 1 – Plants put in growth chamber at -3℃ [3] for 24 hours between budburst and leafout

Treatment C: Experimental Group 2 - Plants had drought conditions applied prior to budburst and then were put in growth chamber at -3℃ for 24 hours between budburst and leafout phenophases

Greenhouse: 12 hr photoperiod, ~58℃

Growth Chamber: 12 hr photoperiod, -3℃

Table 1: Number of individuals per species for each treatment group

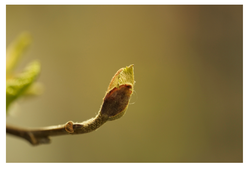
| | A | B | C |
|---|---|---|---|
| ACEPEN | 7 | 7 | 1 |
| ALNINC | 12 | 12 | 12 |
| BETALL | 6 | 6 | 6 |
| BETPOP | 8 | 8 | 8 |
| CORCOR | 1 | 1 | 1 |
| PRUPEN | 7 | 6 | 1 |
| VIBCAS | 16 | 15 | 2 |

## RESULTS

Table 2: The average duration of vegetation and standard deviation for each treatment group

| TREATMENT | MEAN RISK | STAND DEV |
|---|---|---|
| A | 17.157 | 6.559 |
| B | 23.436 | 7.044 |
| C | 25.318 | 7.549 |

- The duration of vegetative risk was extended by nearly a week if a freezing treatment was applied.
- Freezing treatments had more of an effect on individuals with budburst occurring later in the season. As day of budburst increased, the duration of vegetative risk increased. Whereas, in the control group, individuals with later days of budburst had faster durations of vegetative risk.
- Not all species were affected in the same way.



*Alnus incana* budburst without freezing treatment

*Alnus incana* budburst after freezing treatment

## RESULTS

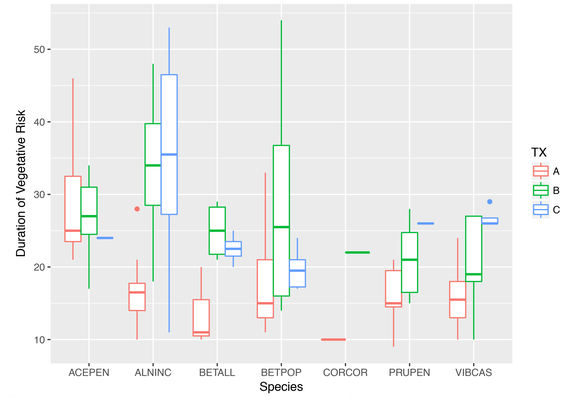



Figure 2: Boxplot comparing the duration of vegetative risk by species for each treatment

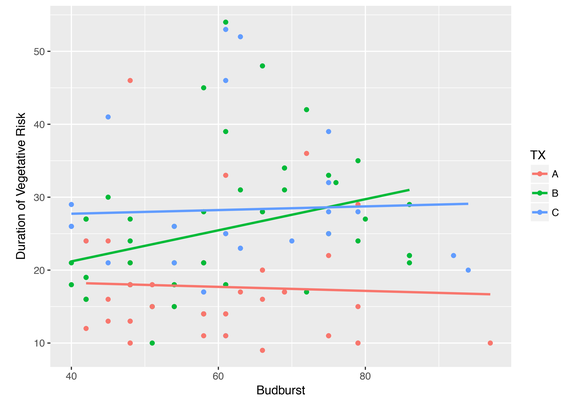



Figure 3: Scatterplot comparing the duration of vegetative risk by day of budburst across treatments, with all species pooled.

## CONCLUSIONS

Our results indicate that spring freezing events extend the time until leafout for most native temperate forest tree species. Therefore, damaging frosts prolong the duration of risk for tree species and put them at risk to multiple late spring freezing events in one year. Spring drought conditions prior to a freezing events also heighten the risk of multiple damaging spring freezing events.

Individuals that initiate budburst later in the season appear to be more sensitive to late spring freezing events. As the day of budburst increased, the duration of vegetative risk increased.

Further studies are necessary to assess how much damage each species incurs from late spring freezing events and if the damage has long-term detrimental effects. The interplay of spring droughts and freezing event should also be analyzed more thoroughly.

## REFERENCES


[1] Augspurger, C.K. (2009). Spring 2007 warmth and frost: Phenology, damage and refoliation in a temperate deciduous forest. *Functional Ecology* **24**, 1031-1039

[2] Lenz, A., Hoch, G., Korner, C., & Vitasse, Y. (2016). Convergence of leaf-out towards minimum risk of freezing damage in temperate trees. *Functional Ecology*, 1-11.

[3] Schwartz, M.D. (1993). Assessing the onset of spring: A climatological perspective. *Physical Geography*, **14**, 536-550.

[4] Vitasse, Y., Lenz, A., Hoch, G. & Korner, C. (2014). Earlier leaf-out rather than difference in freezing resistance puts juvenile trees at greater risk of damage than adult trees. *Journal of Ecology,* **102,** 981-988.