Does Warming Temperature Delay or Advance Cherry Blossoms in Washington D.C., USA?

Arthur Hsin-Wu Hsu, Kyungdahm Yun, and Soo-Hyung Kim
School of Environmental and Forest Sciences, University of Washington

Introduction

- Spring phenology has been reported to occur earlier in response to warming.
- For vegetation at high altitudes and latitudes, spring phases have in fact occurred later in recent years, in spite of clear warming trends.
- Why do some studies state spring events are advanced and some argue they are delayed?
- Several studies have pointed out that the divergence not only comes from different species but also the different warming periods.

Materials and Methods

- Phenology data: flowering cherry cultivar, “Yoshino”, blossoms dataset for Tidal Basin, Washington D.C. provided by National Park Service (NPS) from 1938 to 2017. Average blossom date: April 4 (Julian day: 94).
- Climate data was collected from Reagan National Airport, the same period above. Data are missing in 1946 and 1970~1973.
- Winter and spring temperature combinations: cold-cold, cold-warm, warm-cold and warm-warm
- Winter (11, 12, 1): cold and warm based on average 5.3°C.
- Spring (2, 3, 4): cold and warm base on average 8.5°C.

Results

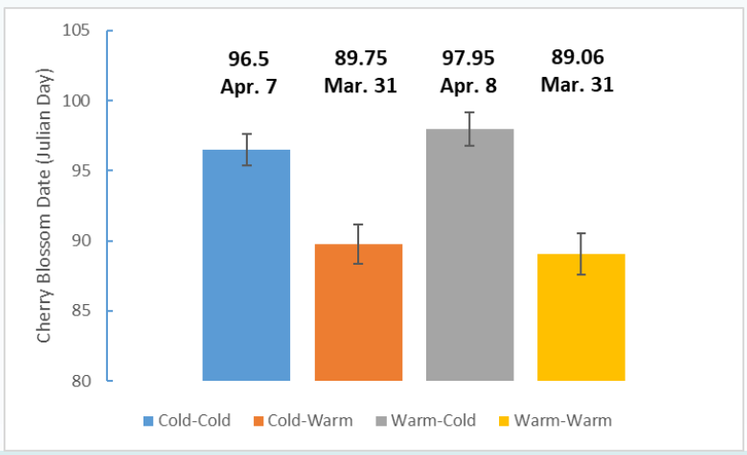

Fig. 1 Cherry blossom dates based on different winter and spring temperature combinations.

Table 1 The analysis of variance (ANOVA) of cherry blossom dates if we consider temperature as a single factor.

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Groups	1192.96	3	397.65	12.57	<0.0001**
Error	2278.14	72	31.64		
Total	3471.11	75			

Table 2 Least significant difference (LSD) of cherry blossom dates if we consider temperature as a single factor.

Groups	*Count*	*Sum*	*Average*	*Variance*	*Std. Dev.*	*Std. Err.*
Cold-Cold	18	1737	96.5[a]	21.55882	4.6431	1.0944
Cold-Warm	20	1795	89.75[b]	38.72368	6.2228	1.3915
Warm-Cold	20	1959	97.95[a]	28.15526	5.3062	1.1865
Warm-Warm	18	1603	89.06[b]	37.70261	6.1402	1.4473

Table 3 Two-way ANOVA of cherry blossom dates if we consider winter and spring temperature as two factors.

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Spring_CW	1058	1	1058	41.747	<0.0001**
Winter_CW	0.888888889	1	0.888888889	0.035074	0.851998
Interaction	26.88888889	1	26.88888889	1.060993	0.306639
Error	1723.333333	68	25.34313725		
Total	2809.111111	71			

Conclusion

- Different warming periods influence cherry blossom dates.
- Cold or warm winter do not influence cherry blossom dates, but cold or warm spring influence cherry blossom dates.
- No interaction between cold or warm winter and spring, which means no compensatory effect between winter and spring.
- To sum up, warming in winter doesn’t affect cherry blossom dates, but warming in spring advance cherry blossom dates.

~~~Thank you!!!~~~
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