Results

Variation in First Flowering Day (FFD)

1. We identified 24 flowering plant species in the Stevens Data set that met the criteria for analysis described in the methods. The first flowering day (FFD) varies extensively both among years within a species and among species. Median FFD varied across the species from a low of X to a high of Y and included early, mid and late spring flowering species (Fig. X) .

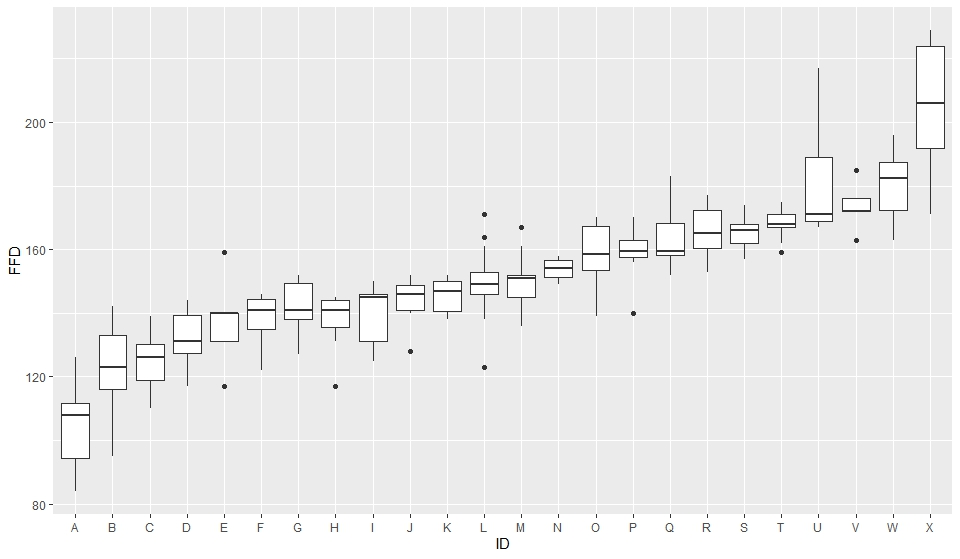


Figure X. Box plots of the first flowering day of 24 plant species from the Bluestem Prairie reserve in Clay county, MN. Observations were made between 1942-1961 and 2012-2020. Box plots indicate distribution quartiles and standard error bars. The species codes are as follows:A=Anemo paten;B=Ranun rhomb;C=Calth palus;D=Ceras arven;E=Ranun abort;F=Oxali viola;G=Sisyr angus;H=Litho canes;I=Trill cernu;J=Litho incis;K=Pedic canad;L=Zizia aurea;M=Vicia ameri;N=Cypri candi;O=Achil mille;P=Anemo canad;Q=Oxytr lambe;R=Rosa arkan;S=Penst grand;T=Penst graci;U=Campa rotun;V=Zigad elega;W=Amorp canes;X=Oenot nutta.

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Figure 2. Correlations of FFD and SPDX for each species. R2 and p-values reported for each.

1. Snow pack correlation – There were variable relationships between FFD and SPDX among species. R2 values ranged from 0.033 to 0.86 indicating a lot of variation in the explanatory power of SPDX of FFD. Three of 21 species were statistically significant (*Cerastium arvense*, *Amorpha canescens*, and *Zigandenus elegans*).

Table 1. Summary of indirect effects for TSNOW and AGDU on FFD. Estimates of indirect effects and p-values based on sample data reported.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Species | TSNOW | p-value | AGDU | p-value |
| *Anemone patens* | 0.626 | 0.147 | 0.921 | <0.01 |
| *Ranunculus rhomboides* | 1.139 | <0.01 | 1.053 | <0.01 |
| *Caltha palustris* | 1.221 | <0.01 | 1.049 | <0.01 |
| *Cerastium arvense* | 1.098 | <0.01 | 1.023 | <0.01 |
| *Ranunculus abortivus* |  |  |  |  |
| *Oxalis violacea* | 1.059 | <0.01 | 1.020 | <0.01 |
| *Sisyrinchium angustifolium* | 1.114 | <0.01 | 1.027 | <0.01 |
| *Lithospermum canescens* | 1.013 | <0.01 | 1.003 | <0.01 |
| *Trillium cernuum* | 1.712 | 0.143 | 1.861 | <0.01 |
| *Lithospermum incisum* | 0.967 | <0.01 | 0.997 | <0.01 |
| *Pedicularis canadensis* | 1.205 | <0.01 | 1.113 | <0.01 |
| *Zizia aurea* | 1.131 | <0.01 | 1.031 | <0.01 |
| *Vicia americana* | 0.940 | <0.01 | 0.963 | <0.01 |
| *Cypripedium candidum* | 0.826 | <0.01 | 0.968 | <0.01 |
| *Achillea millefolium* | 1.011 | <0.01 | 1.002 | <0.01 |
| *Anemone canadensis* | 0.963 | <0.01 | 0.993 | <0.01 |
| *Oxytre lambe* | 1.059 | <0.01 | 1.020 | <0.01 |
| *Rosa arkansana* | 1.279 | <0.01 | 1.052 | <0.01 |
| *Penstemon grandifloras* | 1.167 | <0.01 | 1.037 | <0.01 |
| *Penstemon gracilis* | 1.031 | <0.01 | 1.007 | <0.01 |
| *Campanula rotundifolia* | 0.695 | <0.01 | 0.939 | <0.01 |
| *Zigadenus elegans* | 1.067 | <0.01 | 1.043 | <0.01 |
| *Amorpha canescens* | 0.430 | 0.096 | 0.897 | <0.01 |
| *Oenothera nuttallii* | 1.421 | 0.024 | 1.220 | <0.01 |

Table

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Figure 3. Path diagrams with indirect effect estimates labeled. Number of asterisks indicate level of significance for p-value: \*p ≤ 0.05, \*\*p ≤ 0.01, \*\*\*p ≤ 0.001.

1. Model selection –
   1. The model excluding DOBG was selected based on the AIC. This model had the lowest AIC in all species.
2. Path analysis – All models had statistical support for goodness of fit. Statistics!!
   1. Temperature- Many species had a significant regression coefficient for the relationship between AGDU and FFD. X were positive, indicating and X were negative. The first four flowering species had stronger and significant relationships than later flowering species.
   2. Temperature and SPDX- The relationships between AGDU and SPDX were positive in all species and the coefficients ranged from 0.01 to 0.18 but, only four were significant.
   3. Snow – The relationship between TSNOW and SPDX had a positive and significant regression coefficient in all species. TSNOW related to SPDX because both describe
   4. SPDX and FFD – Four out of the 21 species had a significant relationship between SPDX and FFD, two were negative and two were positive.