

Using Herbaria to Track Phenology Changes in *Erythronium americanum*



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Using herbarium specimens to study changes in phenology

Climate change is altering environmental conditions for many organisms and ecological communities, potentially leading to changes in the natural history of many species.¹ Many phenological shifts have been documented in response to changing seasonal patterns, including shifts to earlier flowering time in many plant species.² Spring ephemeral plant species such as the yellow trout lily are of particular interest in studying flowering time phenology as they are some of the first plants to arise in the spring and their entire life cycle is completed not long after flowering.



Erythronium americanum in flower

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“*Erythronium americanum*, Roosevelt Island, 3/30/13”
flickr.com/photos/fritzflohrreynolds/8604399540

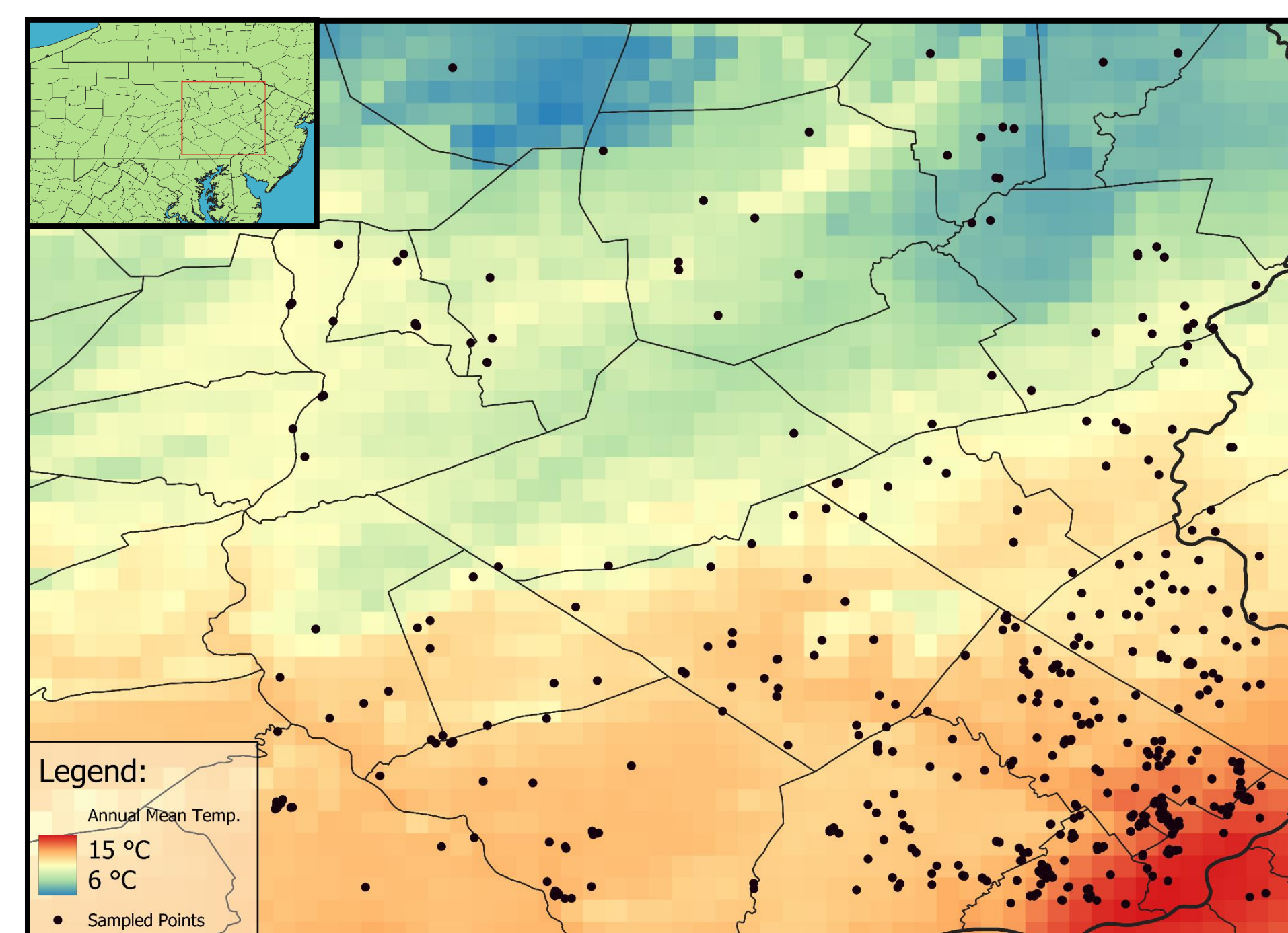
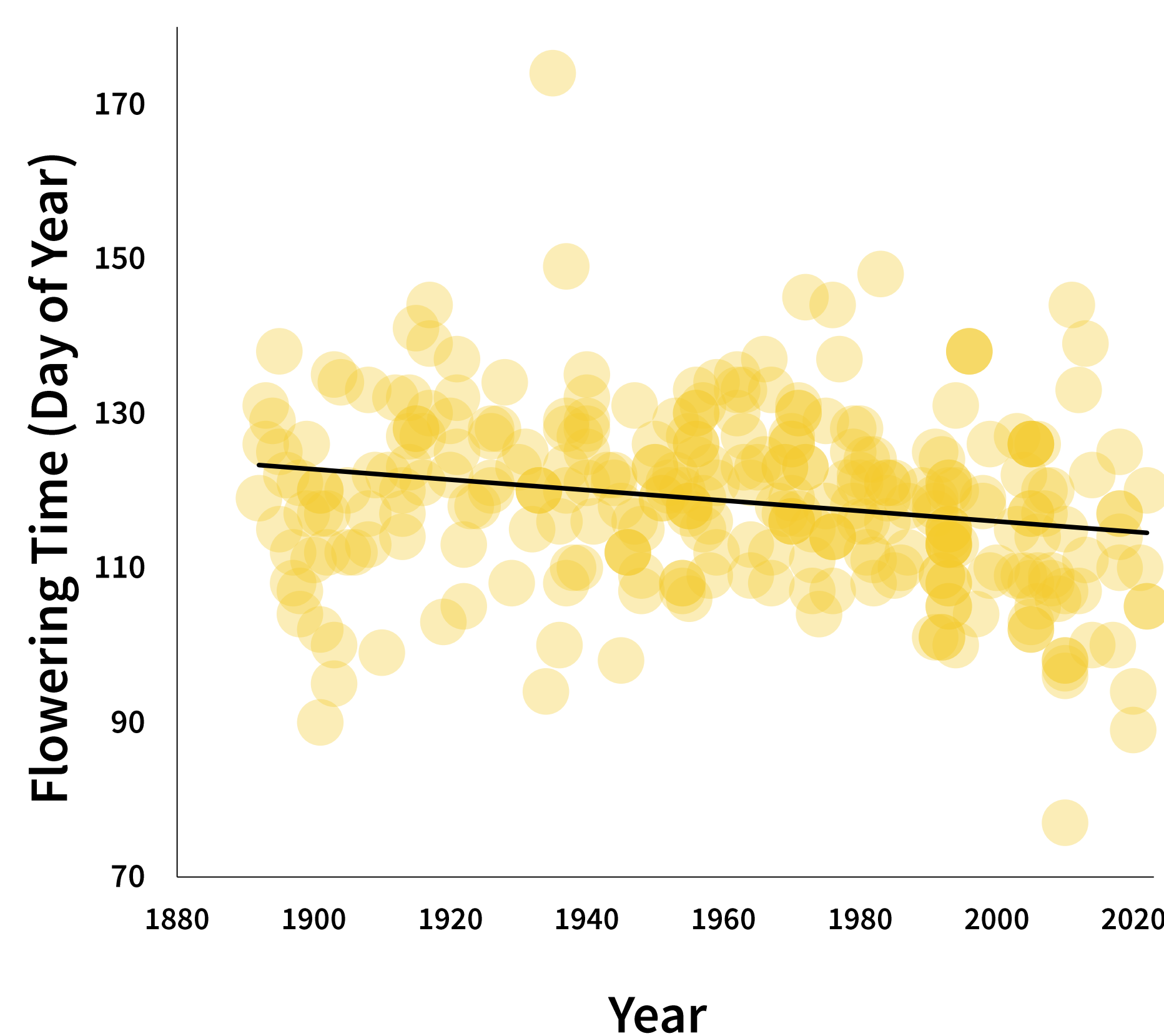
Flowering specimen (May 1972) of *Erythronium americanum*; ESU Franklin B. Buser Herbarium



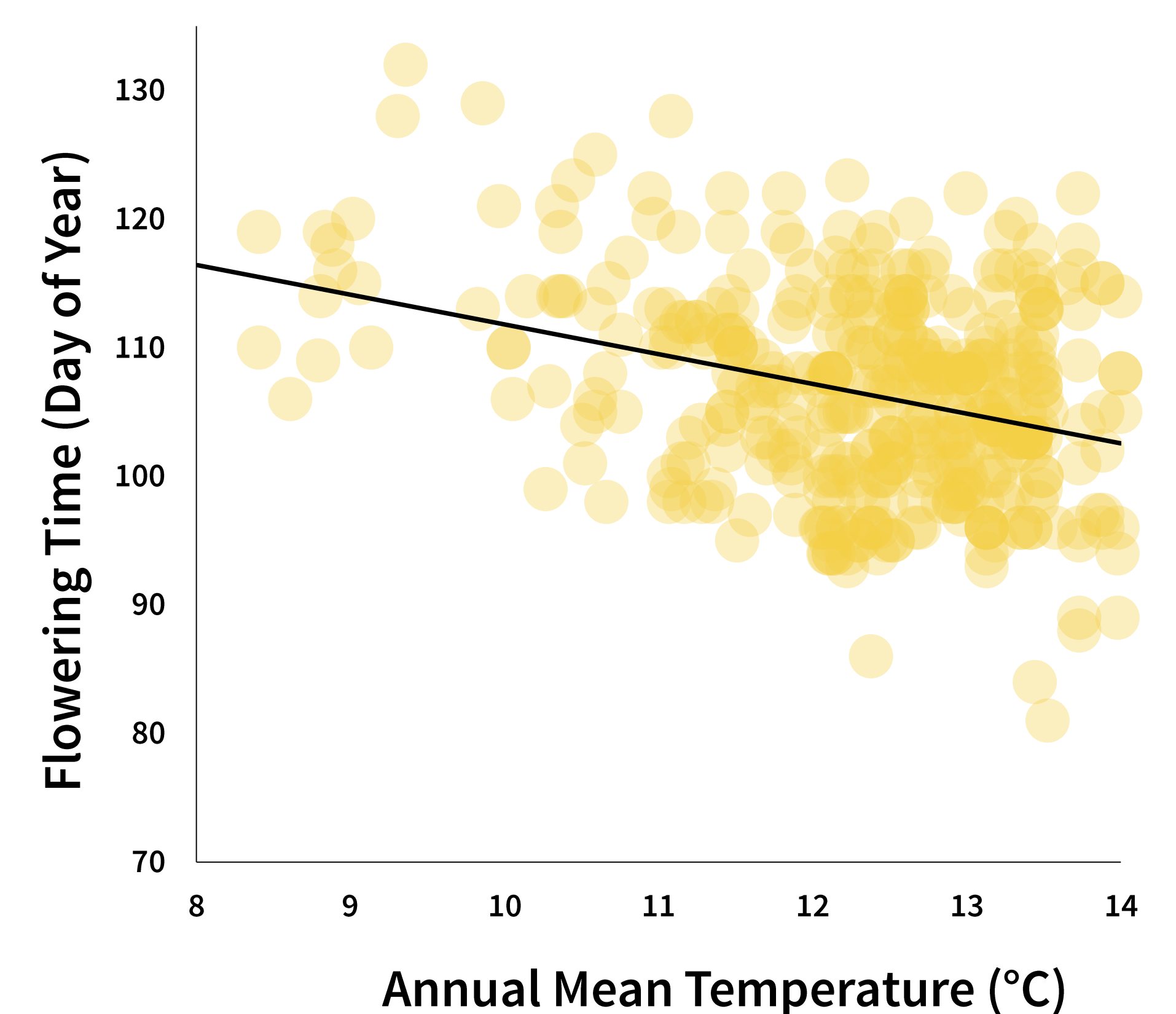
We assess phenological change in yellow trout lilies by examining herbarium specimens from 1890 to present from the ESU Buser Herbarium and 26 additional herbaria, accessed via The Global Biodiversity Information Facility (GBIF)^{3,4,5}.

To explain current-day variation in flowering time among yellow trout lilies in eastern Pennsylvania, we also examined the relationship between flowering time and local temperatures, using iNaturalist observations⁶ (2020 – 2022) and PRISM climate models⁷.

Is *Erythronium americanum* flowering earlier?



Occurrences of flowering *Erythronium americanum* individuals, 2020-2022, obtained from iNaturalist



Average flowering time in herbarium specimens from recent years is about **one week earlier** than the average flowering time observed in specimens a century prior.

However, there is substantial variation in flowering time within a given year, likely because these specimens are drawn from a wide range of latitudes consisting of localities ranging from Pennsylvania to Maine. Naturally, we would expect the southern-most plants to flower earlier.

We used iNaturalist records from the years 2020-2022 to examine spatial variation in *E. americanum* flowering time, exploring how much of this variation could be explained by differing environmental conditions.

We reviewed 677 iNaturalist observations of *E. americanum* from eastern Pennsylvania and western New Jersey, of which 430 were flowering. We used QGIS 3.30.0 to sample these observation points along PRISM annual mean temperature data for the years in which the samples occurred.

Temperature variation explains only ~10% of variation in flowering time in the iNaturalist observations. It is worth noting that the temperatures given in this data set are from a model and may not accurately represent the temperature experienced by an individual plant at a given locality. Also, spatial variation in mean annual temperature may not accurately reflect variation in temperature at flowering time.

Overall, it seems that *E. americanum* is flowering earlier. Further research is needed to explain spatial variation in flowering time.

1. Parmesan, C., Yohe, G. (2003). A globally coherent fingerprint of climate change impacts across natural systems. *Nature* 421, 37–42
2. Franks, S. J., Sim, S., & Weis, A. E. (2007). Rapid evolution of flowering time by an annual plant in response to a climate fluctuation. *Proceedings of the National Academy of Sciences*, 104(4), 1278-1282
3. GBIF.org (27 March 2023) GBIF Occurrence Download <https://doi.org/10.15468/dl.t3w39g>
4. GBIF.org (01 March 2023) GBIF Occurrence Download <https://doi.org/10.15468/dl.22nutz>
5. Herbarium records obtained from the ESU Franklin B. Buser Herbarium and the following collections (Index Herbariorum codes): TENN, ASU, NY, AUA, GREE, DSRC, USF, FLAS, YU, LOB, CAN, ACAD, CM, CHRB, TRT, UNAM, CHSC, ANSP, USCH, CONN, SFV, VT, UTEP, MVSC, SIM
6. iNaturalist. available from <https://www.inaturalist.org>. accessed 27 March 2023.
7. PRISM Climate Group, Oregon State University, <https://prism.oregonstate.edu>, data created 29 Nov 2022, accessed 7 Apr 2023.

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