

Katherine Waselkov¹, Reece Riley¹, Maria Peña², Katelin Pearson³, and Jenn Yost³

¹California State University, Fresno, Department of Biology; ²California State University, Fresno, Library Digital Services Division; ³California Polytechnic State University, Biological Sciences Department

Using digital images to investigate phenological change in a biodiversity hotspot

The California Phenology Thematic Collections Network (CAP TCN) is a collaborative project involving 22 herbaria, with the goal of capturing images, transcribing label data, and georeferencing locality descriptions for nearly a million plant specimens. A major additional component of the project is developing new Symbiota-based tools and workflows to enable precise scoring of the phenological status of herbarium specimens, and applying these methods to the imaged specimens from the California Floristic Province biodiversity hotspot. The research involves a multitude of college students and citizen scientists.

The Fresno State Herbarium

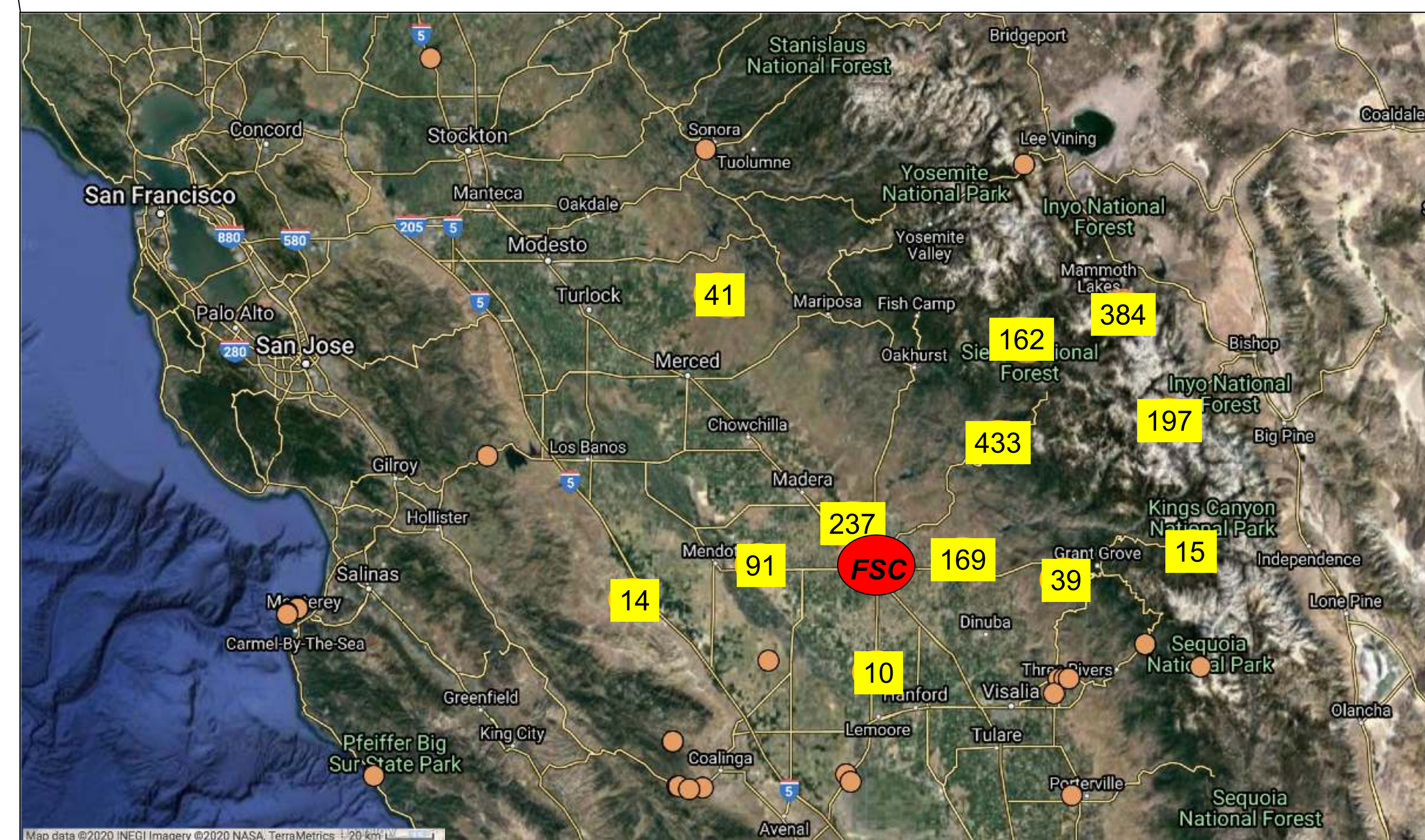
The FSC Herbarium at California State University, Fresno, is contributing ~40,000 specimens to the CAP network. The collection dates from the 1890s to today, with a special concentration on coniferous forests and meadows at elevations above 2500 meters in the Sierra Nevada mountains. These locations were surveyed from the 1920s to the 1960s by the Fresno State Biology professor Dr. Charles H. Quibell.

In addition to the high elevation ecosystems represented in this herbarium, the FSC has substantial collections from other severely threatened Central California habitats, including vernal (ephemeral) pools and alkali scrub communities, riparian corridors along the Kings and San Joaquin Rivers, and foothill chaparral and native grasslands. Fresno County is the most agriculturally productive county in the U.S., and the location of Fresno, the 5th largest city in California, with a total county population of almost a million people and a growth rate of 0.88% per year.



Three FSC specimens from high elevations in the Sierra Nevada Mountains, collected in 1917, 1951, and 1995, from left to right. So far, imaging is complete for ~40% of the collection, and transcription is complete for ~24%.

Many ecosystem functions depend on plant phenology. Phenology affects both the individual fitness of plants, and the fitness of symbiotic organisms that depend on them: temporal mismatches between plants and pollinators, for example, can quickly drive populations extinct and cause rapid evolutionary shifts. Many studies using herbarium specimens have discovered links between phenology and climate: however, no previous studies have focused on the California flora, which has the highest degree of endemism in the U.S. Climate change is heavily impacting precipitation as well as temperature in this Mediterranean climate, which may have synergistic effects on phenology.



Over 1800 georeferenced FSC specimens, showing the concentration of collections from the southern Sierra Nevada Mountains. The location of the FSC physical collection is shown in red. The whole California map shows USDA Forest Service vegetation zones.

The digitization of the FSC specimens in particular will enhance understanding of historical Central California ecosystems, especially those high elevation habitats particularly threatened by climate change, to establish baseline 20th century data at each elevation for species presence and phenology. With the data generated by this project, we will be able to answer questions such as: (1) Which species are in the most danger of phenological mismatches? (2) Which habitats and vegetation types are most phenologically sensitive to changes in winter precipitation and temperature?, (3) Where might mismatches occur between flowering plants and their pollinators, pathogens, and pests?, and many more.