

Dirca occidentalis, a Proxy for the Diminishing Arcto-Tertiary Geoflora in California?

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BACKGROUND

Western leatherwood, *Dirca occidentalis*, also called simply dirca, is a rare plant endemic to the San Francisco Bay Area. It is rated by the California Native Plant Society as 1B.2 (rare, threatened or endangered in California and elsewhere). It is unique in being the only member in California of the family Thymelaeaceae. The species has been extensively studied by William Graves of Iowa State University (Graves 2004, Graves 2005, Graves and Schrader 2008, Norris and Graves 2012).

Dirca is also distinguished by being one of the earliest winter-flowering shrubs. Because dirca is conspicuous at the time of its early winter flowering, it has been the tradition of the Santa Clara Valley Chapter of the California Native Plant Society to have, as one of its first field trips of the year, a trip to observe dirca in bloom. A field trip was led to the Rancho San Antonio Open Space Preserve in Los Altos in the year 2000, and a gps unit was employed to record 14 different locations with dirca in bloom. On a return field trip in 2020, dirca was found in only 2 locations, one comprised of a single plant and another with about a dozen plants (Figure 1).

The 2020 observations alerted us to the possibility that dirca may be declining in parts of its range in the San Francisco Bay Area. However, we are lacking in the baseline data that would provide a quantitative measure of the observed change in its abundance.

For rare plants, and especially for relict plants, such as *Dirca occidentalis*, which may be especially vulnerable to the effects of climate change, a more comprehensive and systematic approach is needed to detect changes in abundance and distribution over time. This project is an attempt at developing such an approach for dirca on the San Francisco Peninsula.



Figure 1. The decline in dirca gps occurrence locations in Ranch San Antonio Open Space Preserve between the year 2000 (circles) and the year 2020 (rectangles).



Figure 2. Baseline dirca occurrence locations for Palo Alto Foothills Preserve recorded in the Calflora database in February 2021 (blue dots).

Summary: The rare endemic relict plant *Dirca occidentalis* is in decline in parts of its range in the San Francisco Bay Area. A monitoring program is being developed and implemented to track climate change and other negative impacts to this species.

PRELIMINARY RESULTS

Location-based Monitoring:

Hidden Valley/Waterdog Lake - Calflora Observer Pro location points were collected in February 2021 and again in December 2021 along trail segments that cover almost all of the Hidden Valley/Waterdog Lake trail network. These comprise a total of 19 data points that can be used for ongoing monitoring.

Palo Alto Foothills Preserve - In February, 2021 15 point locations for dirca were reported in Calflora by Claire Grist of Grassroots Ecology, and these were selected as the baseline for ongoing monitoring. The Palo Alto Foot Hills colony will be surveyed again in January 2022. Figure 2 displays the base map of recorded point locations in Calflora for the Palo Alto Foothills site.

Plant tagging

Stevens Creek County Park/Fremont Older Open Space Preserve - In December 2021 the dirca colony was surveyed for plants in flower or with expanding flower buds. Of the 50 plants originally tagged in 2016, 29 were sampled for health status. Of these 8 had failed to produce any sign of flowering or growth and were presumed dead.

Swiss Park – In December 2021 a total of 64 plants were tagged with metal tags (Figure 3), comprising most of the plants in the colony. These can be used for future monitoring of plant status.

CONCLUSIONS

This project was an attempt to establish baseline measures of dirca abundance in a few colonies for the purpose of detecting declines in plant numbers. On the basis of preliminary surveys, it was found that *Dirca occidentalis* is disappearing from sites where it was abundant until recently. This decline had coincided with a period of extreme heat and drought. The drought of the period 2012-2016 was at least the second driest in the last 1,200 years. This was followed by the exceptional drought of 2019-2021, which was the driest period ever recorded for the Peninsula, with the possible exception of that of 1976-1977. Given its requirement of a temperate, moist microclimate, it is reasonable to attribute the die-off to this historically abnormal weather.

The Rancho San Antonio Open Space Preserve was revisited in December, 2021 to re-evaluate the status of dirca plants at the two remaining locations where they were observed in 2020. It was discovered that the single plant found at one location had failed to flower or leaf out this year and was apparently dead (Figure 3). This conclusion was also supported by observations of plant mortality at the Stevens Creek/Fremont Older dirca colony site. These are the two southernmost known dirca colonies and the ones expected to experience the greatest effects of climate change.

Dirca occidentalis has adapted to California's moderate coastal Mediterranean climate by advancing its flowering and growth phenology into the winter when there are favorable soil moisture conditions, and when competition from nearby winter-dormant plants is at a minimum. It suspends growth and enters summer dormancy with the onset of drought stress. However, recently the Peninsula colonies have endured periods of historically extremely low levels of precipitation. Climate models project even more extreme weather in the future.

The ancestral dirca species was a component of the Arcto-Tertiary Geoflora (Raven and Axelrod 1998) or, according to an alternative interpretation of fossil evidence, the Mixed-Mesophytic Geoflora (Baskin and Baskin 2016). This was a period of moderate temperatures and abundant year-around precipitation. *Dirca occidentalis* is a relict of this Geoflora. In the novel climate of the Anthropocene is *Dirca occidentalis* a sentinel or a proxy for other paleoendemic species in California, such as *Torreya californica*, *Calycanthus occidentalis*, *Viburnum ellipticum*, *Euonymus occidentalis* and *Aralia californica*?

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METHODS

Two general approaches are being taken to document the locations of occurrences of *Dirca occidentalis* and to establish a baseline for ongoing monitoring: collection of gps point locations and physical tagging of reference plants.

Monitoring of Point Locations in Calflora and iNaturalist

The Calflora Observer Pro mobile app is being used as the gps point location collection application. (The iNaturalist mobile app can also be used, and once the data is verified, the data can be transferred to Calflora). Two locations on the San Francisco Peninsula have been selected so far for use for this monitoring because of the sufficiency of recent (2020-2021) gps locations in the Calflora database (<https://www.calflora.org/app/taxon?cm=2739>):

- Hidden Canyon Park/Waterdog Lake Open Space in Belmont in San Mateo County
- Foothills Natural Reserve in Palo Alto in Santa Clara County

Tagging of Dirca Plants for Later Monitoring

Aluminum tags were attached to individual dirca plants with aluminum wire for monitoring of health and viability. Two sites were selected for this purpose:

- Stevens Creek County Park/Fremont Older Open Space (50 dirca plants previously tagged in 2016) at the southern distribution limit of *Dirca occidentalis*.
- Swiss Park Tract of the San Francisco Public Utilities Commission Peninsula Watershed (64 dirca plants tagged in December 2021), a representative mid-Peninsula site.



Figure 3. Left Photo: Example of a dirca plant at Swiss Park identified by a numbered aluminum tag. Right Photo: The individual dirca plant remaining at one location at Ranch San Antonio in 2020 but apparently dead in 2021.