# Captive Propagation and Reintroduction of Large-flowered Fiddleneck (*Amsinckia grandiflora*) in Contra Costa, Alameda, and San Joaquin Counties, California

## PROJECT GOAL

Introduce self-sustaining populations of this critically endangered species into its historical range. For this project a "self-sustaining population" is defined as a population of 2,000 to 3,000 individual plants that require no long-term active management.

## PROJECT TIMEFRAME

2012 to 2021


## PROJECT CONTACT

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## PROJECT TEAM

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## PROJECT FUNDING SOURCE

United States Bureau of Reclamation
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## SPECIES PROFILE

- Taxonomic nomenclature: *Amsinckia grandiflora* (A. Gray) - Kleeb. ex Greene. Family Boraginaceae.
- Habit: annual forb.
- Habitat preference: medium-elevation (~245 - 550 meters) grasslands at transition to scrub and/or oak/juniper savanna.
- Presumed historical range (based on collections): northeastern Contra Costa County to southwestern San Joaquin County.
- Key species characteristics: heterostylus (distinctive pin and thrum morphs, with either style/stigma or stamens more prominent - see inset photos), large corolla (14 - 20mm), calyx lobes unequal in width, 2 to 4 in number (from fusion below middle).
- Listing status: federal and California Endangered.
- Population status: one population of 80 to 6,000 plants, with an average 2,500 over past eight years. Primary threat is competition from exotic annual grasses.

## PROJECT METHODS

### Develop Habitat Model Based on Known Occurrences

- Used GIS to extract remote habitat parameters from occurrences for which precise locations are known (extant and recently extant, weighted toward lone extant occurrence).
- Data extracted include: slope, aspect, elevation, mean precipitation and temperatures, geology and soil types, and solar radiation values. Excluded areas of unsuitable habitat such as dense woodland and chaparral. See **FIGURE 1**.
- Extrapolated using values from known occurrences to identify potentially suitable habitat. See **FIGURE 2**.

### Conduct Field Surveys of Known Occurrences and Modeled Habitat Areas

- Gained access to survey tens of thousands of acres of public and private land with documented occurrences and modeled habitat. See **FIGURE 3**.
- Collected data at precisely mapped known occurrences and previous reintroduction sites.
- Data collected include the following parameters:
  - Geologic features (e.g., presence, abundance, and type of rock outcroppings)
  - Soil texture, color, moisture, pH, and nutrients (many parameters tested at soil lab)
  - Dominant plant species and their cover values
  - Site accessibility
  - Potential problems, such as severe erosion, excessive weeds, and abundance of granivores or signs of granivores (i.e., seed-eating birds and small mammals)

### Rank All Reintroduction Sites and Select Final 10 Sites

- The parameters from each of the ~100 surveyed sites were ranked according to similarity with known occurrence sites, especially the lone extant site.
- Each parameter was assigned a value of 1, 2, or 3, with three being most optimal/similar to natural occurrence sites.
- Scores from remote GIS modeling and field surveys were tallied to identify sites with the highest scores as potential reintroduction sites.
- The 25 highest scoring sites were pursued as reintroduction sites, with the understanding that some properties may not be available.
- The 10 highest scoring sites for which permission was granted to reintroduce were chosen as reintroduction sites. See **FIGURE 3**.

### Propagate Thousands of Seeds and Seedlings

- In 2014 approximately 2,000 seedlings and 40,000 seeds were propagated from stored seed at the University of California Botanical Garden at Berkeley.
- Seedlings and plants for seed production were grown in weed and pathogen-free soil containing American Soil mix, perlite, pumice, and coarse sand.
- The plants were grown outdoors under 50% shade, then moved to full sun when true leaves were produced. Soil moisture was monitored twice a day to ensure ideal amount.
- Protective netting was used to prevent birds from consuming seeds and cotyledons.

### Prepare and Plant Reintroduction Sites

- Seeds and seedlings were planted in clusters of square-shaped plots to concentrate the plants (to attract pollinators) and facilitate monitoring. See **FIGURE 4**.
- Seeds and seedlings were planted in separate plots to examine the benefits and drawbacks of each type of planting.
- Small areas were cleared of vegetation prior to planting in order to reduce competition, particularly from invasive plants.
- Seedlings were planted 12 to 15 cm deep, and seeds were planted 1 to 1.5 cm deep, then soil was firmed around the planted material.
- All plants were watered in unless rain was forecasted within the next few days following planting.
- One half of each reintroduction site was fenced to analyze the benefits and drawbacks of livestock grazing.
- Bird netting and bird flashing ribbon were used to deter birds from consuming the cotyledons and seeds. These were abandoned due to animals becoming entangled in the netting, and the ribbons resulting in excessive garbage.
- An average of 200 seedlings and 4,000 seeds were initially planted at each of the 10 sites during the 2014-2015 growing season.
- A similar number of additional seeds and seedlings were planted the following year (2015-2016), due to severe drought and cattle trampling at several reintroduction sites.
- A total of 1,000 seedlings, but no seeds, were planted at each of the four most promising reintroduction sites during the 2016-2017 growing season.

## PRELIMINARY RESULTS AND OBSERVATIONS

### Determination of Preferred Habitat (shade/moisture, rich soils, and low competition)

- The most successful reintroduction sites exhibit the following attributes:
  - No direct sunlight between November and March (as a result of steep, north-facing slopes and/or surrounding topography that casts shade)
  - Rich, moist, and essentially neutral pH clay loam soils, derived from sedimentary materials (primarily sandstone)
  - A relatively low cover of introduced annual grasses (i.e., low competition)
  - A relatively high cover of native grasses and forbs, such as *Poa secunda*, *Collinsia heterophylla*, *Sanicula bipinnata*, *Claytonia perfoliata*, and *Achillea millefolium*
  - Either low-to-moderate grazing levels (year-round), or intensive grazing outside the growing season of large-flowered fiddleneck (e.g., protected by fencing during during growing season)
- The least successful reintroduction sites exhibit the following attributes (including sites from previous reintroduction efforts):
  - Sunny and exposed sites, such as convex ridges and slopes other than north-facing
  - Soils that are excessively shallow, dry, sterile, stony, or of heavy clay (soils types that were worth reintroduction attempts due to low covers of annual grasses)
  - A relatively dense cover of introduced annual grasses, either naturally or from insufficient grazing
  - Intensive, year-round grazing--unfenced plots have been trampled by livestock (particularly cattle)

### Other Factors Influencing Success

- Individual plots planted with seedlings have fared better than those planted with seeds.
- Granivores, especially rodents, may significantly reduce populations.
- Based on limited data (8 years of monitoring) populations have fared best during years featuring periods of mid-winter drought, and worst during years of continuous wet-season rainfall.

### 2018 Reintroduction and Natural Site Populations (four promising sites out of ten)

- Populations of large-flowered fiddleneck within the ten reintroduction sites in 2018 ranged from 0 to 6,000 (one site each).
- In 2018, the four most successful sites had an average population of 3,375 plants, all in the vicinity of the lone natural site in Corral Hollow (southwestern San Joaquin County). These sites had last been planted in the winter of 2016-2017. The least successful sites averaged 12 plants.
- The 2018 population at the lone natural site was 1,500.

## CURRENT AND FUTURE TASKS (PLANTING, MANAGEMENT, AND MONITORING)

- 1,000 seedlings were planted at each of the four most successful reintroduction sites during winter of 2018-2019.
- An additional 4,000 seedlings will be propagated and planted at sites to be determined in 2019-2020.
- Management of reintroduced sites, including grazing/grass management and irrigation (as necessary).
- Monitoring of all reintroducted populations and the lone natural population until spring of 2021. Monitoring includes population census and distribution (GPS mapping), plant vigor (e.g., average plant height, number of flowering branches), and grass density and height (using Robel pole and golf balls).