February 26, 2018

Saratoga Horticultural Research Endowment – Progress Report

1. **Project Title**: *Development of drought-tolerant California native plant materials for predators, parasitoids and pollinators*
2. **Investigators**
    a. Principal Investigator: Neal M. Williams, Professor, UCD Entomology
    b. Project Manager: Kimiora Ward, Staff Research Associate III, UCD Entomology
    c. Cooperating Entities: Ellen Zagory and UC Davis Arboretum, USDA NRCS, UC Davis Department of Entomology and Nematology, Eric Lonsdorf (Natural Capitals Project, University of Minnesota)

This project aims to expand the palette of native wildflowers used in California gardens, ornamental and other landscapes by identifying drought-tolerant species and by optimizing plant materials to benefit bees, predators and parasitoids while minimizing attractiveness to pests. We are comparing data on establishment from seed of 52 native wildflower species in irrigated and non-irrigated conditions and by assessing the potential of specific plant species to support key pests and natural enemies as well as bees. These data will parameterize an innovative decision tool allowing identification of the most cost-effective plant species for support of beneficial insects while minimizing pests. We will work with the UC Davis Arboretum to ensure the tool and our analysis incorporate horticulturally-relevant costs and benefits of each species, and will partner with them to integrate recommendations into the UC Davis Arboretum plant lists.

3. **Accomplishments to date**:
    - In November 2017 we completed our third and final year of weekly sampling of flowering resources and insect use of four replicates of 52 native California wildflower species planted in a randomized complete block design at the Harry Laidlaw Honey Bee Biology Facility at UC Davis (Figure 1). This data collection was funded elsewhere. Weekly samples consisted of flower counts and a timed one-minute sample of insect visitors to each 1 m^2 replicate planting. Wild bees, flies, wasps and moths/butterflies observed visiting flowers during timed visual observations were net-collected for identification to species, while honey bees were identified by eye and counted. During the three weeks of each species' peak flowering in 2015 and 2016, flower plots were vacuum sampled for pests and their natural enemies.
    - Data from 2015 and 2016 samples have been error-checked and run through a rigorous QA/QC protocol. Data QA/QC is ongoing for 2017. Bee, fly and butterfly specimens from 2015 and 2016 have been identified to species, and pests and natural enemies have been identified to broad taxonomic groups to classify each insect as a potential pest, predator, or parasitoid.
    - We conducted analyses to test if plant species differed in attractiveness for five broad functional insect groups: wild bees, honey bees, pests, predators and parasitoids, and submitted our results to the journal Functional Ecology (Lundin et al. in review).
    - Insect community data at the species level are ready for incorporation into the Lonsdorf and Williams seed mix optimization model (Williams and Lonsdorf 2018). We are currently coordinating with Lonsdorf to configure the bee data for running the model and strategizing for inclusion of pest/natural enemy data as well as establishment data under irrigated or drought conditions.

- We are currently coordinating with Ellen Zagory to solicit feedback on desired vs. undesirable characteristics of plants from a horticultural perspective, and discussing potential formats for presenting our results and integrating our recommendations into Arboretum plant lists. One preliminary shift from these discussions was the proposal that lists of quality plant species and their relative values for pollinators, beneficial insects and other characteristics may be equally important to Master Gardeners and others as a tool for selecting "best" mixes.

Figure 1. Replicated plantings of single species test plots at the Harry Laidlaw Honey Bee Biology Research Facility at UC Davis.

4. Obstacles and solutions:

- We have not encountered any obstacles and have made good progress following the timeline laid out in our project proposal.

Literature cited:

Lundin, O., K.L. Ward, N.M. Williams. (In review). Identifying native plants for coordinated habitat management of arthropod pollinators, herbivores and natural enemies. Functional Ecology.

Williams, N.M. and E. Lonsdorf. 2018. Selecting cost-effective plant mixes to support pollinators. Biological Conservation 217: 195-202