## Background:

Monarch butterflies have declined dramatically across North America and are under review for Endangered Species Act protection. Monarchs west of the Rockies occur broadly and are distinct from the larger eastern population. Monarchs in the west have declined 99.4 percent since the 1980s. They overwinter in California and Mexico, and breed and migrate across the west, including a considerable portion of Department of Defense (DoD) land. Breeding phenology differs between eastern and western populations. Eastern monarchs breed in successively northbound generations. Western monarchs do not follow this pattern, and basic information is lacking to construct management strategies that reduce conflict with active military training.



**Monarch butterfly on swamp milkweed near Mountain Home AFB, Idaho. Photo by Stephanie McKnight/Xerces Society**

## Objective:

The primary purpose is to determine seasonal timing of monarch butterflies in locations across the West, and to use this information to increase the efficiency and effectiveness of managing habitat for monarchs on DoD lands. This will help DoD land managers maximize the use of these lands for training while considering the needs of a widespread at-risk species.

## Summary of Approach:

The project involves systematic surveys and demographic models to determine seasonal timing of monarch breeding across the West. Monthly surveys were conducted throughout the expected breeding season at five installations in the West. Surveys documented abundance of monarch life stages (eggs, larvae, pupae and newly emerged adults) as evidence of site-based breeding phenology. The five installations were Vandenberg Air Force Base (AFB) in California, Naval Weapons Systems Training Facility in Boardman, Oregon, Joint Base Lewis-McChord Yakima Training Center in Washington, Naval Air

Station Fallon in Nevada, and Mountain Home Air Force Base in Idaho. In addition, we worked with US Army Corps of Engineers in northern California. Generalized Additive Models (GAMs) are being used to understand monarch breeding phenology and predict the number of monarch generations in each survey region. The broad geographic area surveyed in this project provides data to construct the western monarch population from relatively sparse data, which is a building block for constructing a full demographic model of western monarchs.

## Benefit:

By increasing knowledge of the timing, location, and habitat associations of monarch breeding in the West, data from this project will enhance military readiness by enabling DoD managers to balance habitat protection with training activities and other land uses. This work will contribute to key aspects of DoD land management plans, such as Integrated Natural Resources Management Plans (INRMPs) at each installation, by focusing efforts on the temporal windows with greatest importance to breeding monarchs throughout their range.

## Accomplishments:

Two years of surveys at DoD installations were completed successfully within each of the target regions. Preliminary data analyses suggest that breeding is mostly continuous in Southern and Northern California from early May to October and in Nevada from mid-May to September. Following a northward wave from overwintering sites, immature stages of monarchs are most abundant in August in Idaho, Oregon, and Washington. In 2018 surveys documented a decline in the range and density of monarch adults and immature stages at all study sites in the West, with very few monarchs reaching the northern breeding grounds in Oregon and Washington. A third year of surveys started in March 2019, and a new study site will be added at Beale Air Force Base in Northern California.

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