

Monarch butterfly use of eucalyptus and native trees during winter months in central coastal California

Sarah L. Stock, Nelli Thorngate, and Jessica L. Griffiths
Big Sur Ornithology Lab of Ventana Wilderness Society, Big Sur, California

ABSTRACT

The Big Sur Ornithology Lab, a program of the Ventana Wilderness Society, has been conducting research on overwintering monarch butterflies (*Danaus plexippus*) and their winter habitats in central coastal California since 2001. Overwintering monarchs require specific microclimate features, such as appropriate roost trees that absorb heat from the surrounding landscape. To determine the relationship between tree characteristics and overwintering monarchs and seasonal weather patterns, we conducted weekly monarch surveys at six overwintering sites containing multiple tree species on the central California coast in Monterey County during the winter months. We observe a general shift in cluster formation away from blue gum eucalyptus (*Eucalyptus globulus*) to Monterey pine (*Pinus monophylla*). Monarchy cyprus (*Cupressus macrocarpa*), and coast redwood (*Sequoia sempervirens*) following winter storm events, and a dispersal to various tree species, including ornamental, towards the end of the overwintering season. These results suggest that native tree species are critical to the persistence of butterfly populations, even in the presence of eucalyptus trees. We recommend that biologists develop management plans for monarch habitat that are designed to phase out eucalyptus trees while installing native trees.

INTRODUCTION

Monarch butterflies in western North America migrate to specific overwintering habitats along the Pacific coast of California each fall, where they form tight aggregations during the winter months. A suitable overwintering habitat contains a relatively dense grove of trees with underlying localized near water and nuclear sources, and protected from wind by topographic landforms or trees (Sasal and Calvert 1981). An overwintering habitat acts as a protective "thermal sink" to ameliorate climatic extremes of temperature and moisture occurring outside the grove (Sasal and Calvert 1981).

Monarchs historically depended on native California trees such as Monterey pine, Monterey cypress, and coast redwood but in the last century have also been observed roosting in nonnative eucalyptus trees (Napano and Lane 1985; Hamilton et al. 2002; Frey et al. 2003). Extensive land development, logging, and forest management have reduced the number of native tree stands that support overwintering monarchs in California (Brooner et al. 2006), whereas groves of eucalyptus remain mostly intact. Potential negative impacts of eucalyptus trees on monarch populations are not well understood. In this study we examined patterns in tree species used by monarchs over the course of three winters, in relation to seasonal timing and winter storm events.

METHODS

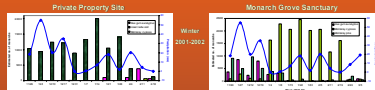
We conducted weekly surveys of six overwintering sites in Monterey County, Monterey Grove Sanctuary in Pacific Grove and a private property site in Big Sur. Monterey Grove Sanctuary is composed of Monterey pine, Monterey cypress, and blue gum eucalyptus, while private property site is composed of coast redwood, Monterey pine, Monterey cypress, and blue gum eucalyptus.

We conducted surveys from November to March each year from winter 2001 to winter 2004. Monarch butterfly estimates were conducted in the mornings while temperatures were low (usually below 17° C) and monarchs were still clustered. For every tree that contained clustered monarchs, we recorded the number of butterflies, tree species, identification number, and location, and the aspect and height of clusters. To estimate cluster size, we used the number of butterflies in a small area of a cluster and then extrapolated this count to arrive at a total estimate for the entire cluster. We held two observations per tree per site each survey. We documented storm events using precipitation data from the Monterey Airport (<http://www.weather.nbaa.gov/climate>).

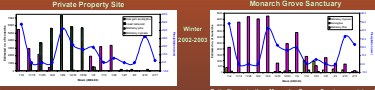
Two observers estimating a cluster of monarch butterflies

RESULTS

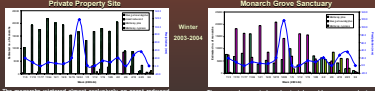
Timing, duration and density of storm events on the Monterey coast varied among winters 2001 to 2003. Winter 2001-02 was punctuated by major storm events characterized by heavy rain (January 19th), and above average precipitation in November (23 mm) and December (121 mm). Monarchs departed the Monterey coast in January 21st and February 24th, and in winter 2002-03 the winter storm event that peaked in late November and early February (2nd and 10th) had the heaviest rainfall (1.1 inches 2002-03 November 10th) and the most wind (100 mph gusts on February 2nd) of any winter storm event. In winter 2003-04, the winter storm event that peaked in late January (24th) was the most intense, with the heaviest rainfall (1.1 inches) and the most wind (100 mph gusts on January 24th) of any winter storm event. In contrast, February 18th-20th was stormy with 10 consecutive rain days.



Monarchs at the private property site were highly exclusively clustered in eucalyptus trees at the beginning of the winter. Over time, however, they shifted away from eucalyptus to pine and redwood in mid-February when the Monterey cypress and coast redwood, but not eucalyptus, and Monterey cypress.



Following the early November storm, the monarchs began to shift from blue gum eucalyptus to other tree species in January. Monarchs were almost exclusively clustered in the winter. Concurrent with increasingly heavy rain and conditions in January, the monarchs switched to blue gum eucalyptus and a lesser extent Monterey cypress and Monterey pine, roosting on both.



The monarchs wintered almost exclusively on coast redwood throughout November and December until after the storm period shifted to the west coast. During the week of the storm, monarchs were clustered in eucalyptus trees at the Monterey cypress, in addition to coast redwood. Monarchs returned to eucalyptus in February.



Monterey pine

coast redwood

blue gum eucalyptus

DISCUSSION

Native tree species are a critical resource for overwintering monarchs in Monterey County. In response to winter storm events, monarch butterflies often switch from blue gum eucalyptus to available native tree species, including Monterey pine, Monterey cypress, and/or coast redwood. These native trees likely provide monarch butterflies greater protection from gusty winds and high tides, compared to non-native eucalyptus. Pine, cypress, and redwood trees may be more resilient to harsh coastal winter weather than eucalyptus, which tend to get blown violently with branches easily knocked to the ground. The needles of pine, cypress, and redwood may offer more protection from wind and precipitation, and may be easier for monarchs to cling to than the more slippery eucalyptus leaves. We observed that post-storm mortality was high in groves where monarchs were roosting primarily on blue gum eucalyptus. For example, the Pacific Grove site experienced an 80% population decline in 2002 after a large storm passed through the area.

A clearer understanding of the relationship between western monarchs and their overwintering habitats is needed to develop scientifically sound and successful management recommendations for native forests and non-native eucalyptus groves, as well as management plans for preserving the "treasured phenomenon" of monarch migration and overwintering (Wells et al. 1982). Future studies should examine the effects of wind speed and direction, sunlight intensity, and temperature on selection of roost trees relative to the entire grove.

Acknowledgments

Foremost, we are grateful to Helen Johnson for leading this project. We extend our appreciation to collaborators, Dr. Dennis Frey and Jason Scott, who were instrumental in laying the foundation for this work. We are also grateful to the many interns and volunteers who assisted in data collection and recording over the years.

LITERATURE CITED

Andrew, J. P., M. Moore, and K. Stone 2003. The Monarch Habitat Handbook: The Sierra Society Field Guide. S. L. Stock, S. Stevan, J. W. Scott, and J. L. Griffiths. 2003. Monarch butterfly population declines in California: a review of the literature. *Conservation Biology* 17: 100-109. <http://www.vventana.org>.
 Ventana Wilderness Society and California Pathfinders. 2004. *Monarch Butterfly Migration: A Field Guide*. Ventana Wilderness Society and California Pathfinders. Big Sur, California.
 Napano, C. J., P. Mariani, M. Waples, and J. Z. Miller. 1985. Overwintering monarchs in California. *Western Wildflowers* 10: 1-10.
 Brooner, C. and L. Lane. 1985. A survey of the distribution of overwintering monarchs in the state of California. *Wildlife Report* 10: 1-10.
 S. L. Stock, S. Stevan, J. W. Scott, and J. L. Griffiths. 2003. Monarch butterfly population declines in California: a review of the literature. *Conservation Biology* 17: 100-109. <http://www.vventana.org>.
 Wells, B. M., W. E. Pyke, and M. Collins. 1983. The OGD Monarch Butterfly Data Book. International Union for Conservation of Nature and Natural Resources, Grand, Switzerland.