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Preliminary Report

A preliminary study of *Ricinus communis* survivorship at Ballona Wetlands and Temescal Canyon, Los Angeles, California

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Abstract. Invasive plants such as Castor bean (*Ricinus communis*) are known to threaten ecosystems due to their competition for resources. The Ballona Wetlands and Temescal Canyon managers employ different techniques to manage the spread of *R. communis*, potentially resulting in differences in plant survivorship. To investigate this possibility, height of the stems of individual *R. communis* plants at each site were recorded in order to assign them to cohort groups. Based on the hypothesis predicted that *R. communis* would have a similar cohort structure at both sites but would exhibit higher survivorship at Temescal Canyon, where *R. communis* are removed less frequently than at the Ballona Wetlands. However, results indicate that management does not affect cohort structure or stability at either site, but rather, it may have contributed to the significantly higher overall survivorship of *R. communis* at Temescal Canyon.

Introduction

The Castor bean, *Ricinus communis*, is an exotic species that originated in East Africa and has progressively become established in areas throughout the world (Anosike, 1981). These invasive plants are known to threaten ecosystems where they are established by outcompeting native plants for resources (Vavra et al., 2007). In Los Angeles County, CA, Castor bean is common in both natural and disturbed habitats, including the Ballona Wetlands and Temescal Canyon. The Ballona Wetlands consist of a degraded salt marsh located on the western edge of the city of Los Angeles and is the last remaining major coastal wetland in Los Angeles County (West, 2001), while Temescal Canyon, Pacific Palisades, CA, is a riparian habitat located in the foothills of the Santa Monica Mountains approximately 16 km northeast of Ballona (Fig. 1). Management for the control of *R. communis* is carried out at both sites. However, at Temescal Canyon, these plants are only cut down whenever management personnel have the resources to do so (J. Whitehead, pers. comm.), whereas at the Ballona Wetlands, more frequent and intense efforts are used to remove Castor bean plants. This difference in management protocol would be expected to result in a difference in survivorship of *R. communis* at these sites.

In general, invasive plant performance influenced by management has usually been measured using population dynamics (Meekens and McCarthy, 2002). One way of quantifying population dynamics is by documenting pat-

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Figure 1. Map showing the locations of Temescal Canyon (A) and Ballona Wetlands (B).

terns of survival. Demographically, there are three types of survivorship curves: Type I, Type II, and Type III (Pinder et al., 1978): Type I individuals have high survivorship as juveniles and low survivorship as they age; Type II individuals die at equal rates regardless of age; and Type III individuals have low survivorship as juveniles and high survivorship when they are older. Plants generally fit the Type III survivorship curve (Miller, 1923). Thus, it was predicted that *R. communis* would exhibit a similar cohort structure at both Temescal Canyon and at the Ballona Wetlands, but would show a higher overall survivorship at Temescal Canyon, given their less intense removal protocol for *R. communis* as compared with the Ballona Wetlands. The present study was designed to investigate whether these predictions match actual patterns in the wild.

Materials and Methods

This study was completed at the Ballona Wetlands on November 18, 2009 and at Temescal Canyon on December 2, 2009. At each site, areas of Castor bean were located and then the stem diameter (mm) at the base of each plant was recorded using a dial caliper. Each plant was subsequently assigned to a cohort group for each site, which was categorized in increments of 1 0 mm. For each site sample, survivorship (l_x) was calculated using the formula:

$$l_x = \frac{n_x}{n_o} \quad (1)$$

Where n_0 is the number of individuals in the first cohort group and n_x is the number of individuals in each of the successive cohort groups. The fit of our cohort survivorship structure was compared against an exponential curve using a Kolmogorov-Smirnov one-sample. The survivorship curve of Ballona Wetlands was compared against the curve of Temescal Canyon using a Kolmogorov-Smirnov two-sample test.

Results

Stem diameters were recorded from 322 plants at Ballona Wetlands and 316 plants at

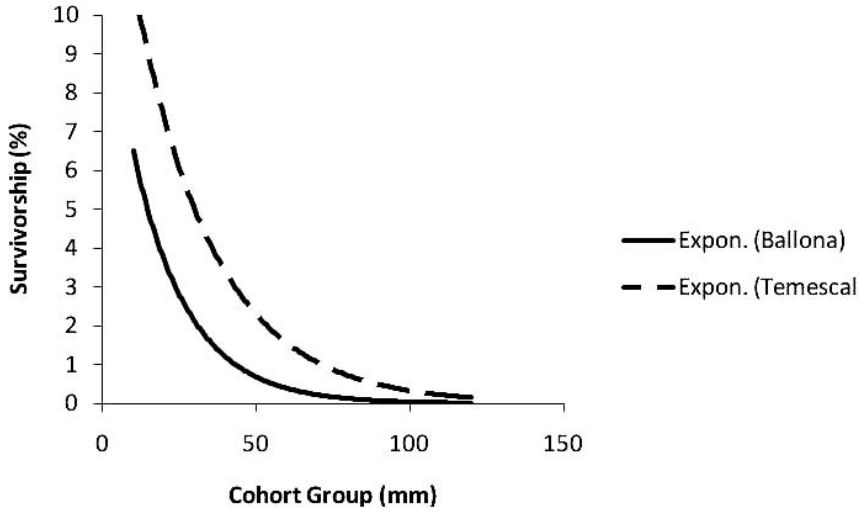

Figure 2. Graph of the exponential rate of decay in percent survivorship with cohort group based on size of *Ricinus communis* at Ballona Wetlands and Temescal Canyon.

Temescal Canyon. The survivorship curves for *R. communis* at the Ballona Wetlands ($P = 0.452$) and Temescal Canyon ($P = 0.179$) were not significantly different from an exponential curve (Kolmogorov-Smirnov one-sample test, $P > 0.05$). The rate of increase of the curve for Ballona was significantly different from the curve for Temescal Canyon (Fig. 2, Kolmogorov-Smirnov two-sample test, $P = 0.028$, $P < 0.05$). Plants at Temescal Canyon showed a higher overall

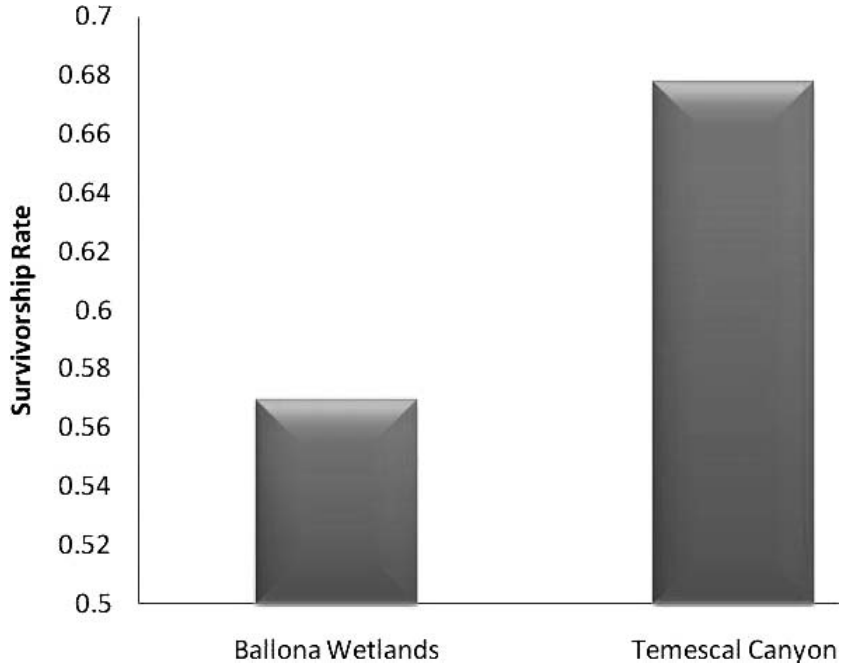

Figure 3. Survival rate of *Ricinus communis* at Temescal Canyon and Ballona Wetlands.

survivorship rate than at the Ballona Wetlands (Fig. 3).

Discussion

The results of this study support the prediction that *R. communis* would exhibit a similar cohort structure at both Temescal Canyon and at the Ballona Wetlands, but would have a higher overall survivorship at Temescal Canyon. While the goal of management at both sites is to control the extent of this invasive plant, the data indicates that while management efforts at both the Ballona Wetlands and Temescal Canyon do not affect cohort structure, the rate of survivorship is not negatively impacted by efforts at Temescal Canyon. While smaller Castor plants from younger cohorts are able to survive and become part of older cohorts at both sites, more deaths occur in each cohort at Ballona than at Temescal Canyon. This result suggests that more frequent removal efforts at Temescal Canyon, as is done at Ballona, would similarly result in a greater reduction in survival rate but would not have an impact on cohort structure. These results suggest that cohort structure can be negatively impacted by management personnel at both sites if they were cut down earlier in the flowering phase (Gao et al., 2009). Furthermore, this study suggests that evaluation of population dynamics can assess management of an exotic species in a non-native habitat. Future studies will include measuring the fecundity of *R. communis* at both sites to calculate the net reproductive rates and testing whether cutting down the plants at certain times makes a significant difference in their survival.

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